Organization of the Site-Wide Environmental Impact Statement

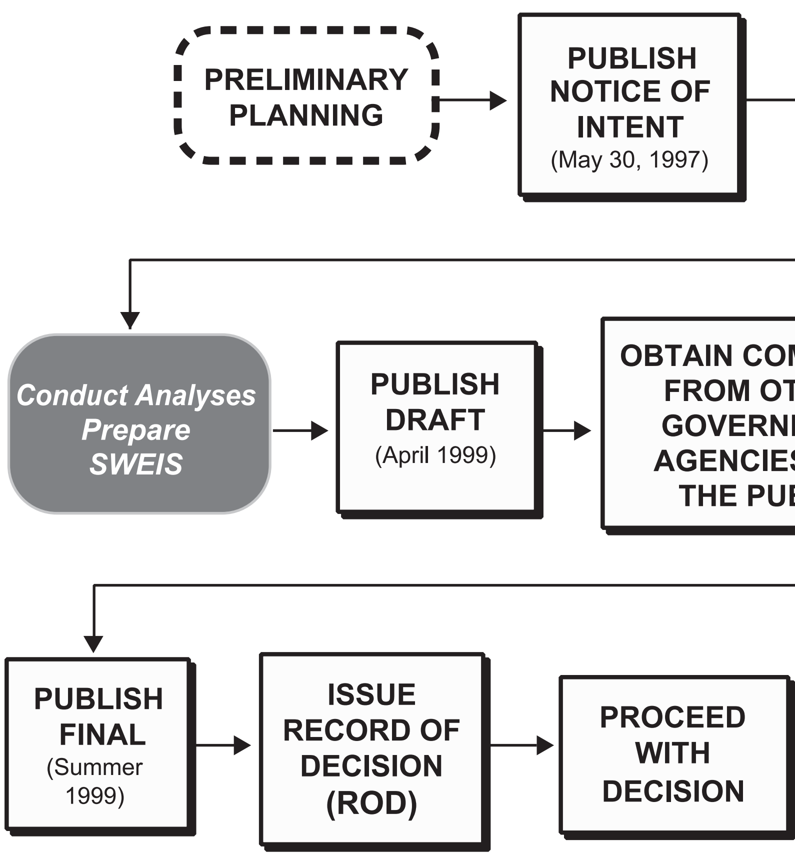
The Site-Wide Environmental Impact Statement (SWEIS) is divided into a Summary and two volumes.

The Summary provides an overview of material presented in the SWEIS, including background, purpose and need, alternatives, existing environment, and environmental impacts.

Volume I analyzes the three alternatives (including the No Action Alternative) as they relate to U.S. Department of Energy (DOE) missions assigned to Sandia National Laboratories/New Mexico (SNL/NM): national security, energy resources, environmental quality, science and technology. Volume I contains 15 chapters. Chapter 1 provides introductory information on background, site missions, purpose and need, decisions to be made, related *National Environmental Policy Act* analyses, and public participation. Chapter 2 describes programs and facility operations at SNL/NM (including selected facilities). Chapter 3 describes the alternatives. Chapter 4 provides a discussion of the affected environment, and Chapter 5 presents an analysis of environmental consequences of each of the proposed alternatives. Chapter 6 describes potential cumulative effects (including effects from other DOE-funded operations and other activities on Kirtland Air Force Base). Chapter 7 contains applicable laws, regulations, and other requirements. Chapters 8 through 15 include references; a list of preparers; conflict of interest statements; list of agencies, organizations, and individuals who received copies of the Draft SWEIS; list of agencies and people contacted; glossary; notice of intent; and index.

Volume II contains appendixes of technical details in support of the environmental analyses presented in Volume I. These appendixes contain information on the following issues: material inventory, water quality analysis, cultural resources, air quality analysis, human health analysis, accidents analysis, transportation analysis, and waste generation.

The SWEIS Process



COVER SHEET

RESPONSIBLE AGENCY: U.S. DEPARTMENT OF ENERGY (DOE)

COOPERATING AGENCY: U.S. AIR FORCE

TITLE: Draft Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281)

CONTACT: For further information or to submit comments concerning the Draft Site-Wide Environmental Impact Statement (SWEIS), contact

Julianne Levings, NEPA Document Manager
U.S. DOE, Albuquerque Operations Office
P.O. Box 5400, Albuquerque, NM 87185
Telephone: 1-888-635-7305, Fax: 505-845-6392

For further information or to submit comments by way of electronic mail, contact

www.nepanet.com

For general information on DOE's *National Environmental Policy Act* (NEPA) process, contact

Carol Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
U.S. DOE, 1000 Independence Avenue SW, Washington, DC 20585
Telephone: 202-586-4600 or leave a message at 1-800-472-2756

Abstract: The DOE proposes to continue operating the Sandia National Laboratories/New Mexico (SNL/NM) located in central New Mexico. The DOE has identified and assessed three alternatives for the operation of SNL/NM: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. In the No Action Alternative, the DOE would continue the historical mission support activities SNL/NM has conducted at planned operational levels. In the Expanded Operations Alternative, the DOE would operate SNL/NM at the highest reasonable levels of activity currently foreseeable. Under the Reduced Operations Alternative, the DOE would operate SNL/NM at the minimum levels of activity necessary to maintain the capabilities to support the DOE mission in the near term. Under all of the alternatives, the affected environment is primarily within 50 miles (80 kilometers) of SNL/NM. Analyses indicate little difference in the environmental impacts among alternatives.

Public Comments: Comments on the Draft SWEIS may be submitted through the end of the 60-day comment period (expected to be June 15, 1999), which will commence with the publication of the Environmental Protection Agency's *Federal Register* Notice of Availability for this document. Comments may be submitted in writing, orally, or by electronic mail to the DOE at the addresses and phone number indicated above. Oral or written comments may also be submitted at public meetings to be held during the comment period on dates and locations to be announced in the *Federal Register* and via other public media shortly after issuance of the Draft SWEIS. Comments submitted will be considered in preparation of the Final SWEIS.

This page was intentionally left blank.

SUMMARY

Table of Contents

List of Figures

List of Tables

Summary Acronyms, Abbreviations, and Units of Measure

ac	acre
BLM	Bureau of Land Management
CFR	*Code of Federal Regulations*
CWL	Chemical Waste Landfill
DOE	U.S. Department of Energy
DU	depleted uranium
ER	Environmental Restoration (Project)
FR	*Federal Register*
ft^3	cubic feet
FY	fiscal year
gal	gallon
IRP	Installation Restoration Program
KAFB	Kirtland Air Force Base
kg	kilogram
kw	kilowatt
M	million
MEI	maximally exposed individual
mi	mile
mrem	millirem
mrem/yr	millirems per year
MWh	megawatt hour
NEPA	*National Environmental Policy Act*
NESHAP	*National Emissions Standards for Hazardous Air Pollutants*
NOI	Notice of Intent
OEL	occupational exposure limits
PCB	polychlorinated biphenyl
R&D	research & development
rem	Roentgen equivalent, man
SNL/NM	Sandia National Laboratories/New Mexico
SWEIS	Site-Wide Environmental Impact Statement
TA	technical area
TCP	traditional cultural property
U.S.C.	*United States Code*
USAF	U.S. Air Force
USFS	U.S. Forest Service

Note: Italics are used to denote formal names or titles of acts, published documents, or computer models.

Metric Conversion Chart

TO CONVERT FROM U.S. CUSTOMARY INTO METRIC			TO CONVERT FROM METRIC INTO U.S. CUSTOMARY		
If you know	**Multiply by**	**To get**	**If you know**	**Multiply by**	**To get**
Length					
inches	2.540	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.03281	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.6214	miles
Area					
square inches	6.452	square centimeters	square centimeters	0.1550	square inches
square feet	0.09290	square meters	square meters	10.76	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.4047	hectares	hectares	2.471	acres
square miles	2.590	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.57	milliliters	milliliters	0.03381	fluid ounces
gallons	3.785	liters	liters	0.2642	gallons
cubic feet	0.02832	cubic meters	cubic meters	35.31	cubic feet
cubic yards	0.7646	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.35	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.205	pounds
short tons	0.9072	metric tons	metric tons	1.102	short tons
Temperature					
Fahrenheit (°F)	subtract 32, then multiply by 5/9	Celsius (°C)	Celsius (°C)	multiply by 9/5, then add 32	Fahrenheit (°F)
kelvin (°k)	subtract 273.15	Celsius (°C)	kelvin (°k)	Multiply by 9/5, then add 306.15	Fahrenheit (°F)

Metric Prefixes

PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS	PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS
atto-	10^{-18} = 0. 000,000,000,000,000,001	**dekta-**	10^{1} = 10
femto-	10^{-15} = 0. 000,000,000,000,001	**hecto-**	10^{2} = 100
pico	10^{-12} = 0. 000,000,000,001	**kilo-**	10^{3} = 1,000
nano-	10^{-9} = 0. 000,000,001	**mega-**	10^{6} = 1,000,000
micro-	10^{-6} = 0.000,001	**giga-**	10^{9} = 1,000,000,000
milli	10^{-3} = 0.001	**tetra-**	10^{12} = 1,000,000,000,000
centi	10^{-2} = 0.01	**peta-**	10^{15} = 1,000,000,000,000,000
deci-	10^{-1} = 0.1	**exa-**	10^{18} = 1,000,000,000,000,000,000

Note: 10^{0} = 1

This page was intentionally left blank.

SUMMARY

PURPOSE AND NEED

As directed by the President and Congress, the U.S. Department of Energy (DOE) provides stewardship and management of our country's nuclear weapons stockpile. In addition, the DOE has national security, energy resources, environmental quality, and science and technology mission lines, which it performs at a number of facilities across the United States (Table S–1). The DOE directs and funds Sandia National Laboratories/New Mexico (SNL/NM) activities in support of its programs and missions (Figure S–1). In turn, SNL/NM's facilities and operations are designed to meet the requirements of the programs, projects, and activities assigned to the laboratory.

The DOE will need to continue to meet its responsibilities for national security, energy resources, environmental quality, and science and technology. These needs are met, in part, by national laboratories. The primary purpose for SNL/NM is to serve as a national resource for scientific, technical, and engineering expertise, with a special focus on national security. The DOE needs to continue to fulfill its responsibilities as mandated by statute, Presidential Decision Directive, and congressional authorization and appropriation. The DOE goal in meeting this need is to do so in a manner that protects human health and the environment. This Site-Wide Environmental Impact Statement (SWEIS) evaluates the environmental impacts associated with alternative levels of operation at SNL/NM that will meet these responsibilities.

As part of the DOE's strategy for implementing the *National Environmental Policy Act* (NEPA) (42 United States Code [U.S.C.] §4321), the Department prepares a SWEIS to examine environmental impacts of operations at multi-program sites (10 Code of Federal Regulations [CFR] §1021.330). In May 1977, the DOE (formerly Energy Research & Development Administration) prepared the *Environmental Impact Assessment, Sandia Laborarories, Albuquerque, New Mexico* for the operation of SNL/NM. Since that time, site programs and activity levels have changed. Based on these changes and SNL/NM's status as a multi-program site, the DOE has performed a thorough environmental analysis of ongoing SNL/NM operations and proposed operations to 2008. This SWEIS is the result of that analysis.

SCOPING PROCESS

Figure S–2 shows a timeline for the preparation of the SNL/NM SWEIS. A public scoping period began after the publication of the Notice of Intent (NOI) on May 30, 1997 (62 Federal Register [FR] 29332), and continued until July 14, 1997. The NOI informed the public that the DOE intended to prepare a SWEIS on SNL/NM operations and invited other Federal agencies, Native American tribes, state and local governments, and the public to participate in the scoping process.

The DOE presented information on its SWEIS proposal at public scoping meetings on June 23, 1997, in Albuquerque, New Mexico. The public was invited to present oral and/or written comments at the meetings or by mail, facsimile, electronic mail, or telephone. Twenty-nine individuals and organizations submitted requests for information or presented oral or written comments. These comments covered a range of issues, including the following:

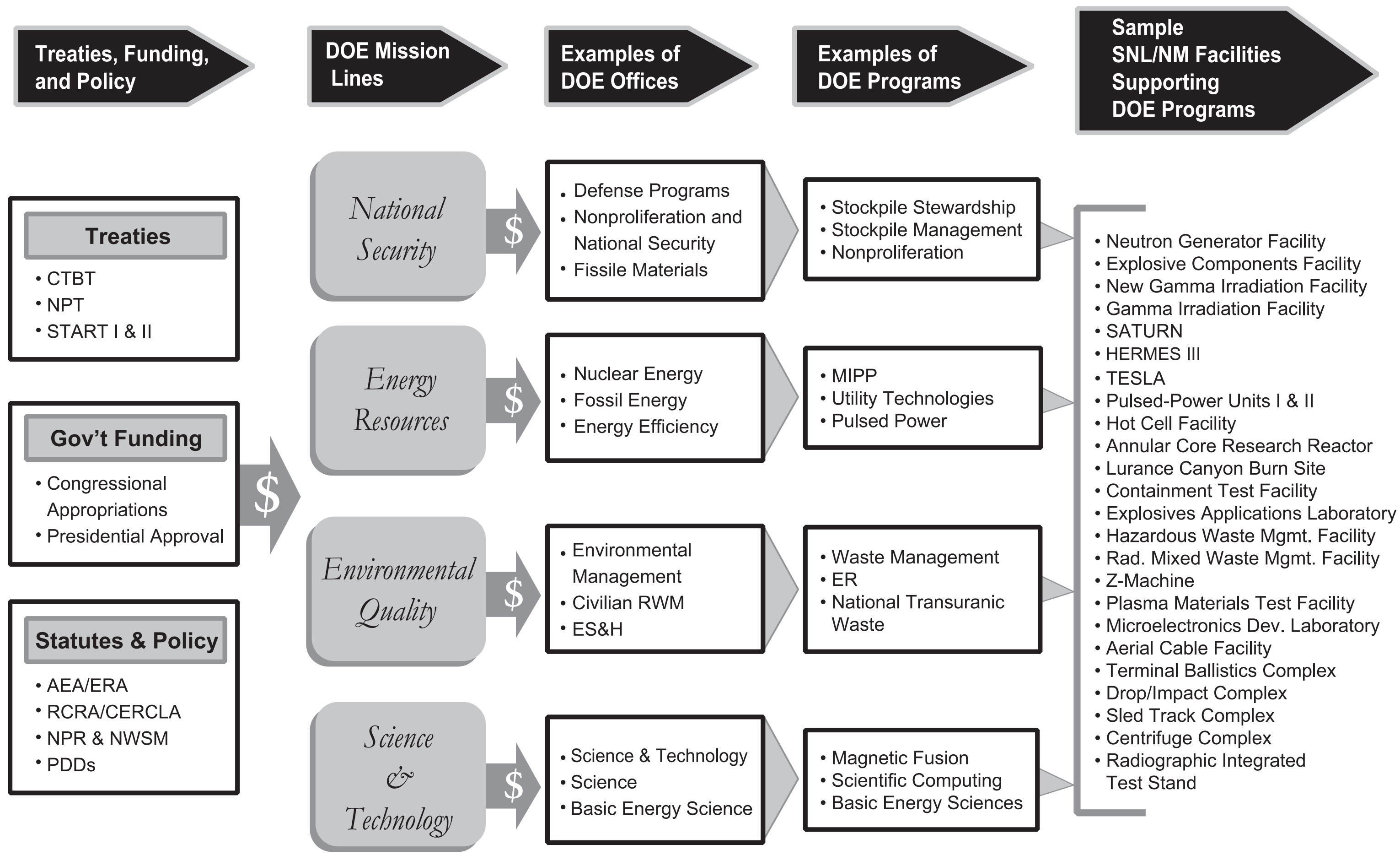
- impacts of SNL/NM operations on natural and cultural resources, including air, groundwater, surface water, biological and ecological resources, and Native American cultural and religious sites;
- SNL/NM mission, policy, management, and alternatives for future operations;
- methods to be used for analyzing impacts and impartiality of the SWEIS;
- socioeconomic impacts including those affecting minority, low-income, and Native American populations (environmental justice);
- cleanup of known contamination or waste discharge and compliance with environmental regulations;
- potential seismic effects;
- health and safety of onsite workers and the surrounding community;
- impacts from SNL/NM operations on land use;
- level of public involvement in SWEIS preparation; and
- relationship of SNL/NM operations to city and county transportation planning policies.

These comments were distributed to experts for each resource or issue area to ensure that they were considered during the preparation of the SWEIS.

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

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

Source: DOE 1997c



AEA - *Atomic Energy Act*
CTBT - Comprehensive Test Ban Treaty
CERCLA - *Comprehensive Environmental Response, Compensation & Liability Act*
ES&H - Environment, Safety, and Health
ERA - *Energy Reorganization Act*
ER - Environmental Restoration
HERMES - High Energy Radiation Megavolt Electron Source
MIPP - Medical Isotopes Production Project
NPR - Nuclear Posture Review
NPT - Nuclear Nonproliferation Treaty
NWSM - Nuclear Weapons Stockpile Memorandum
PDDs - Presidential Decision Directives
RCRA - *Resource Conservation and Recovery Act*
RWM - Radioactive Waste Management
START - Strategic Arms Reduction Treaty
TESLA - Tera-Electron Volt Energy Semiconducting Linear Accelerator

Figure S–1. DOE Funding of SNL/NM

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

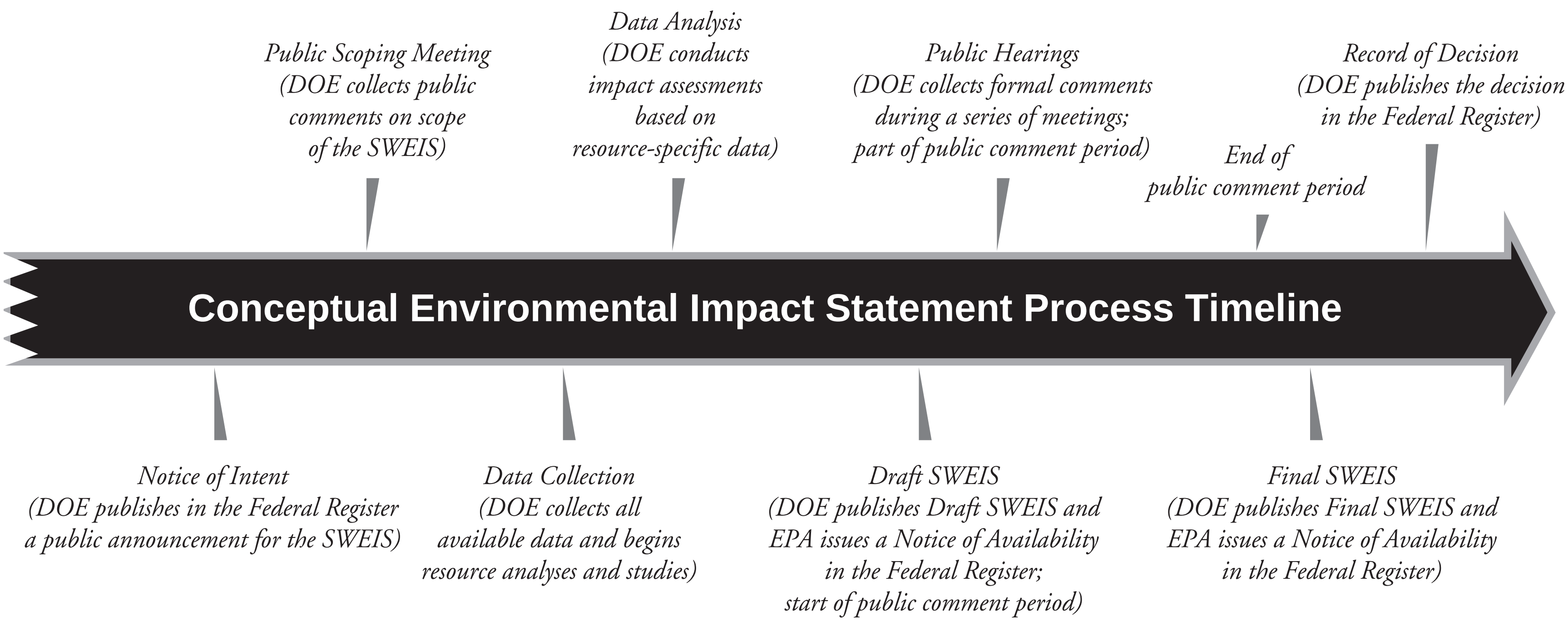


Figure S–2. Site-Wide Environmental Impact Statement Preparation Timeline

SWEIS preparation will follow the typical NEPA timeline.

ALTERNATIVES

The DOE identified the following three alternatives that would meet its purpose and need, as well as support existing and potential future programs at SNL/NM: No Action, Expanded Operations, and Reduced Operations.

The NOI proposed that the SWEIS consider the No Action and Expanded Operations Alternatives. However, the DOE added the Reduced Operations Alternative to show a broader range of alternatives and respond to comments received from the public during the scoping process. These alternatives were chosen for analysis because they cover the range of potential operations at SNL/NM. The SWEIS analyzes the environmental impacts of activities associated with these three alternatives at SNL/NM over a 10-year period of operations from 1998 to 2008. The DOE has not selected a preferred alternative.

Alternatives Evaluated in the SNL/NM SWEIS

No Action Ongoing DOE and interagency programs and activities at SNL/NM would continue the status quo, that is, operating at planned levels as reflected in current DOE management plans. In some cases, these planned levels include increases over today's operating levels. This would also include any recent activities that have already been approved by DOE and have existing NEPA documentation.

Expanded Operations DOE and interagency programs and activities at SNL/NM would increase to the highest reasonable activity levels that could be supported by current facilities and the potential expansion and construction of new facilities for future actions specifically identified in the SWEIS.

Reduced Operations DOE and interagency programs and activities at SNL/NM would be reduced to the minimum level of operations needed to maintain SNL/NM facilities and equipment in an operational readiness mode.

SNL/NM FACILITIES

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

To accomplish this objective, the DOE used the results of a detailed questionnaire distributed throughout SNL/NM to develop a database containing pertinent information about the approximately 670 buildings and outdoor test facilities where SNL/NM operations are conducted.

This database was then assessed and refined by qualitatively evaluating the types of operations performed, identifying those with the highest potential for environmental impacts or concerns, and then grouping them according to function and location.

Finally, a set of facilities was selected for detailed analysis. To be selected, a facility had to meet one or more of the following criteria:

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

Based on these criteria, the DOE selected 10 facilities or facility groups for in-depth analysis.

- *Neutron Generator Facility*—Manufactures neutron generators, which provide a controlled source of neutrons.

- *Microelectronics Development Laboratory*—Performs research and development (R&D) and fabricates custom and radiation-hardened microelectronics.
- *Advanced Manufacturing Processes Laboratory*—Performs R&D of technologies, practices, and unique equipment and fabricates prototype hardware for advanced manufacturing processes.
- *Integrated Materials Research Laboratory*—Performs R&D of semiconducting and other specialized materials, including silicon processing and equipment development and materials synthesis, growth, processing, and diagnostics.
- *Explosive Components Facility*—Performs R&D and testing of explosives components, neutron generators, batteries, and explosives.
- *Physical testing and simulation facilities group*—Performs physical testing and simulation of a variety of natural and induced environments at four facilities consisting of numerous principal buildings and structures. These facilities include extensive environmental test facilities, such as sled tracks, centrifuges, and a radiant heat facility.
- *Accelerator facilities group*—Performs inertial-confinement fusion research and pulsed-power research at 10 facilities. The accelerators are also used to conduct research on inertial-confinement fusion and particle-beam weapons.
- *Reactor facilities group*—Performs R&D and testing at five experimental and engineering nuclear reactors and electron-beam accelerators in a highly secure, remote research area. Some of these facilities are being converted to production facilities for medical radioactive isotopes.
- *Outdoor test facilities group*—Conducts physics, explosives, and burn testing at five facilities located in remote areas of Kirtland Air Force Base (KAFB).
- *Selected infrastructure facilities group*—Supports steam generation, waste management, and waste disposal activities at four facilities.

The operations within these facilities or facility groups are the basis for differentiating among the three alternatives analyzed in the SWEIS and for any associated environmental impacts between alternatives.

Taken together, these facilities and facility groups represent the majority of exposure risks associated with continuing operations at SNL/NM. They represent

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

Some activities at SNL/NM are not likely to change regardless of which alternative the DOE selects for continued operations. Although included within the analysis of all alternatives, these activities were projected to remain at currently planned levels over the 10-year period analyzed. Examples of these activities are maintenance support, material management and operations, waste management and operations, natural resource management, environmental restoration, and science and engineering work at nonselected (balance of operations) facilities.

AFFECTED ENVIRONMENT

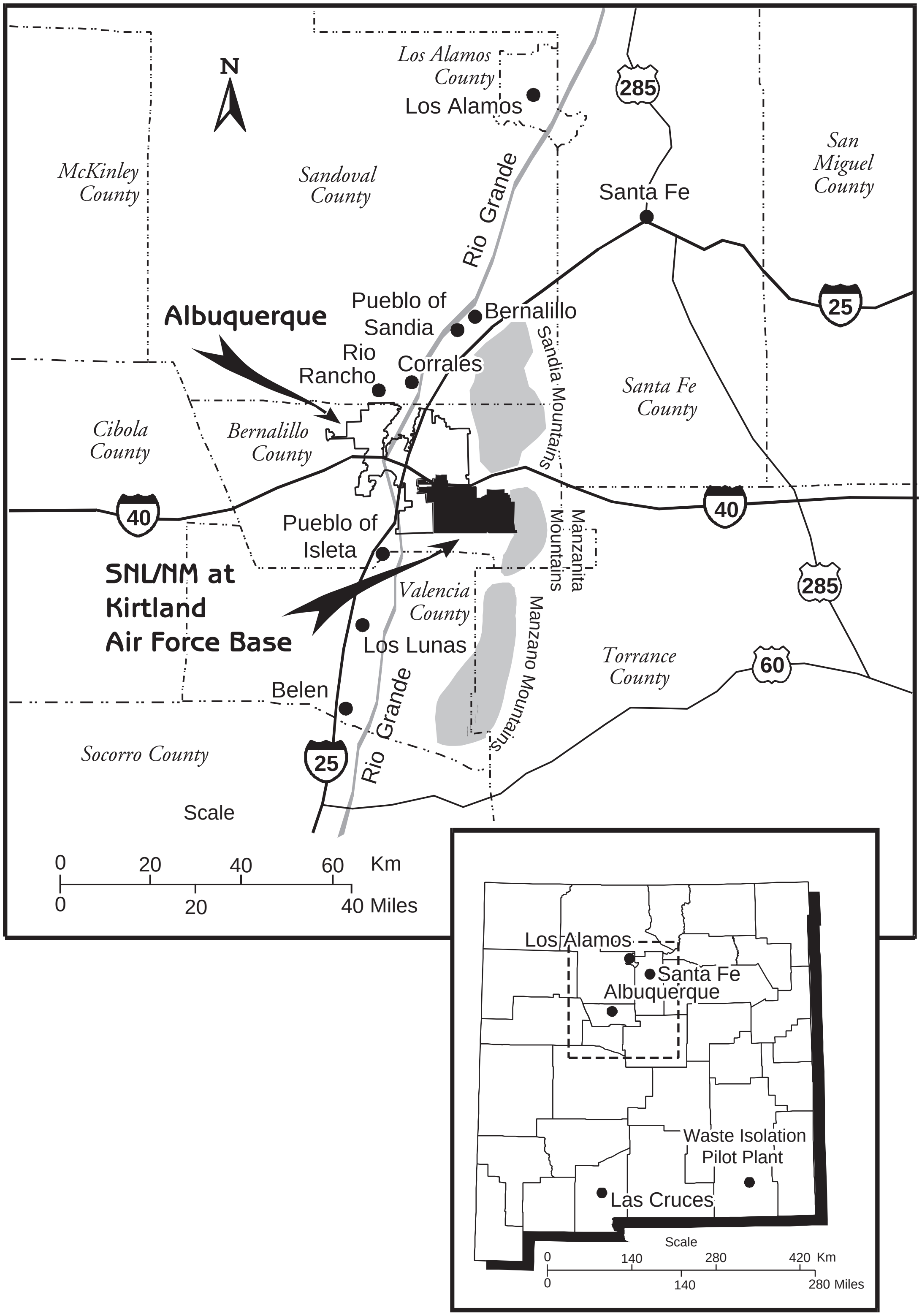
Location

SNL/NM is located on KAFB, approximately 7 mi southeast of downtown Albuquerque, New Mexico (Figure S–3). SNL/NM comprises approximately 8,800 ac of Federal land on KAFB. Albuquerque is in Bernalillo county, in north-central New Mexico, and is the state's largest city, with a population of approximately 420,000. The Sandia Mountains are immediately north and east of the city, with the Manzanita Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales to the northwest, the Pueblo of Sandia and town of Bernalillo to the north, and the Pueblo of Isleta and towns of Los Lunas and Belen to the south.

Land Use and Visual Resources

Areas Surrounding KAFB

Areas immediately surrounding KAFB on the north and northwest consist of single- and multi-family residential neighborhoods, mixed/minor commercial



Source: SNL/NM 1997j

Figure S–3. General Location of KAFB

KAFB is located southeast of the city of Albuquerque in Bernalillo county.

establishments, and light industrial/wholesale operations. The eastern boundary of KAFB almost entirely abuts Cibola National Forest. Some private land, scattered residential dwellings, and industrial operations are present northeast of KAFB. Single-family residences are present just beyond the national forest, approximately 1 mi east of the KAFB eastern boundary. The southern portion of KAFB borders a wide expanse of open rangeland owned by the Pueblo of Isleta. To the west, adjacent land consists of the Albuquerque International Sunport (the city's major airport), some city and county open space, and a large parcel of open space for an extensive future planned community known as Mesa del Sol. Under agreements with the Pueblo of Isleta and the state of New Mexico, two areas, encompassing over 9,000 ac adjacent to the southwestern boundary of KAFB, are designated as buffer zones for SNL/NM testing activities.

KAFB Land Ownership

KAFB land is owned primarily by the U.S. Air Force (USAF), DOE, Bureau of Land Management (BLM), and U.S. Forest Service (USFS). The USAF owns the majority of acreage comprising the western half of KAFB. The DOE also owns land in this area, which is occupied almost entirely by SNL/NM facilities. Some land owned by the BLM, also in the southwestern half, has been withdrawn from public access by the USAF. The eastern portion of KAFB, commonly referred to as the Withdrawn Area, consists of more than 20,480 ac of USFS land within the Cibola National Forest that has been withdrawn from public use by the USAF and the DOE in separate actions.

USAF Activities on KAFB

KAFB land occupied by the USAF is used for a wide variety of purposes, including equipment maintenance, research, munitions storage, residential housing, recreational facilities, medical activities, and administration. In addition, large areas of land on KAFB, particularly in the Withdrawn Area, do not support specific facilities or programs, but are used as safety zones for USAF training activities.

SNL/NM Activities on KAFB

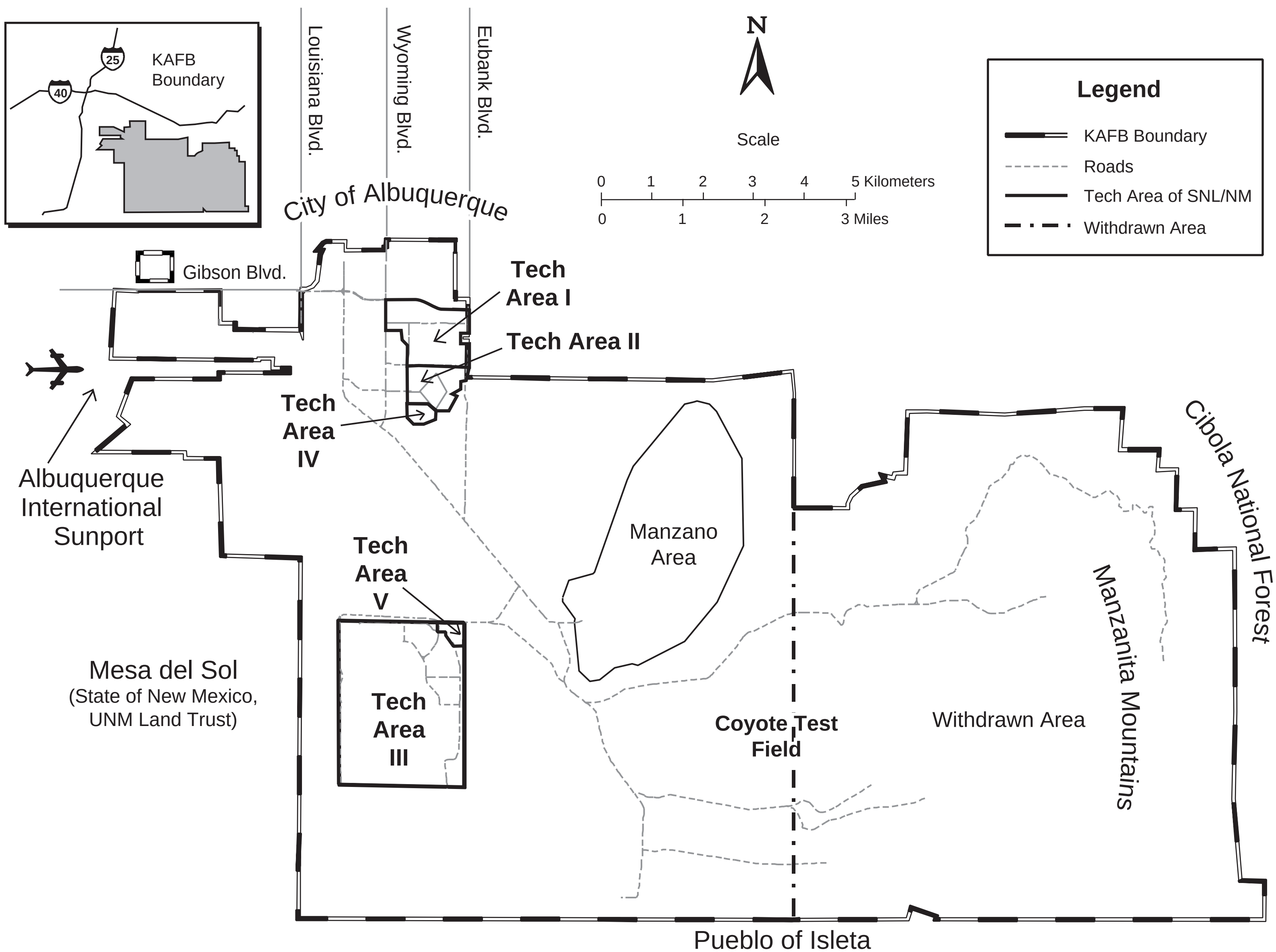
SNL/NM facilities and activities are located primarily in five technical areas (TAs) (Figure S–4). TAs-I, -II, and -IV encompass approximately 645 ac. TAs-III and -V encompass approximately 1,900 ac.

- TA-I is located in the northeast part of KAFB. It is the most densely developed and populated of the TAs, with over 6,600 employees and 370 structures. The structures within TA-I consist of laboratories, shops, offices, warehouses, and other storage buildings used for administration, site support, technical support, basic research, defense programs, component development, microelectronics, energy programs, exploratory systems, technology transfer, and business outreach.
- TA-II is immediately south of TA-I. Like TA-I, the area is urbanized but less densely developed, with approximately 440 employees in over 30 structures that consist of several laboratories, limited office space, and numerous storage buildings.
- TA-III is approximately 5 mi south of TA-I in the southwest portion of KAFB. Approximately 224 people work in the area, which is composed of 20 test facilities devoted to large-scale physical testing and simulating a variety of natural and induced environments. Over 150 structures are located within TA-III, most of which are grouped in small units separated by extensive open spaces.
- TA-IV is immediately south of TA-II. TA-IV is urbanized but less densely developed than TA-I with 546 employees occupying about 70 structures. The area is primarily an R&D site for pulsed-power sciences and particle-beam fusion accelerators.
- TA-V is adjacent to the northeast corner of TA-III. TA-V consists of about 35 closely grouped structures where experimental and engineering nuclear reactors are located. Approximately 160 personnel work in the area.

In addition to the TAs, SNL/NM conducts activities in the Coyote Test Field (Figure S–4), a large undeveloped area on KAFB that contains a variety of remote testing sites and facilities. Approximately 173 structures consisting of laboratories, mobile offices, and storage areas are widely dispersed throughout the area.

Infrastructure

Infrastructure consists of buildings, services, maintenance, utilities, material storage, and transportation systems and corridors that support the operations of a facility. Specifically, SNL/NM's infrastructure consists of water, sanitary sewer, storm drain, steam, fossil fuels, chilled water, electrical transmission, electrical distribution, communications, roads, and parking that support the TAs and other DOE facilities at KAFB. From 28 to 36 percent of system



Source: SNL/NM 1997j

Figure S–4. Locations of SNL/NM Technical Areas

SNL/NM conducts most operations in five technical areas and the Coyote Test Field.

capacity was used to supply water, wastewater, electricity, and natural gas in 1996.

Geology and Soils

Seismic activity, slope stability, and soil contamination were evaluated in the geology and soils resource area. Albuquerque is in a region expected to experience moderate earthquakes that could result in damage to buildings. The largest magnitude earthquake in Albuquerque this century measured 4.7 on the Richter scale.

Most SNL/NM facilities are constructed on level ground or gentle slopes. Slope stability has not been an issue at SNL/NM facilities.

SNL/NM identified 182 locations of potential soil contamination at KAFB resulting from past activities. Of these, 122 have been proposed to the New Mexico Environment Department as requiring no further action because no contamination was found, contaminants were below risk- or regulatory-based criteria, or cleanup has been completed. Investigation or cleanup continues at the other sites.

Water Resources

Groundwater beneath KAFB is in the Albuquerque-Belen Basin aquifer, the sole source of drinking water for Albuquerque and surrounding communities. At SNL/NM TAs, depth to groundwater is 400 to 500 ft. Basinwide groundwater levels have been decreasing for more than 30 years, the result of groundwater withdrawal by municipal and private wells exceeding the rate of groundwater recharge. In 1996, SNL/NM used 440 million gal of water. Concentrations of contaminants above Federal drinking water standards have been detected in groundwater near several SNL/NM facilities. Of these contaminants, concentrations of trichloroethene (TCE) at one site are attributed to past SNL/NM waste disposal practices. This site is 4 mi from the nearest water supply well.

Surface water at KAFB is almost exclusively ephemeral, that is, present in onsite drainages only during periods of heavy rainfall in the summer “monsoon” season (July through September). Surface water flowing through KAFB could discharge to the Rio Grande, 6 mi downstream from the KAFB boundary.

Biological and Ecological Resources

At least 267 plant species and 195 animal species occur on KAFB. This diversity is due in part to the variety of habitats, which include cliff faces, caves, abandoned mines, and drainages, as well as the four major vegetation associations (grassland, woodland, riparian, and altered habitat). Only one Federally listed threatened or endangered species has been observed on KAFB. This was a single sighting of a Peregrine Falcon (Federally endangered), probably a migrant. Sixteen other animal and two plant species present or observed on KAFB are listed by the Federal government as species of concern or sensitive species, or by the state of New Mexico as threatened or sensitive.

Cultural Resources

Cultural resources at KAFB include prehistoric archaeological sites, which in the Albuquerque area date to before A.D. 1540 (the initiation of Spanish exploration of the area), historic archaeological sites (sites, buildings, and structures from A.D. 1540 to 1948). Within the boundaries of KAFB and DOE buffer zones are 284 recorded prehistoric and historic archaeological sites. No traditional cultural properties (TCPs) have been identified at KAFB.

Air Quality

Major sources of air emissions in the Albuquerque area are motor vehicles, wood burning stoves and fireplaces, and open burning. The SNL/NM steam plant, which provides heat to a large number of SNL/NM facilities, accounts for more than 90 percent of the total SNL/NM emission of pollutants from fixed facilities regulated by the *Clean Air Act*. All emissions are within permitted levels and result in concentrations of these pollutants that are below standards set to protect health with an ample margin of safety. Actual emissions are only a fraction of permitted levels. Hazardous chemical air emissions are small and are not required to be individually monitored. Vehicle carbon monoxide emissions are the dominant source of this pollutant from SNL/NM and are of concern because the Albuquerque/Bernalillo county area is a U.S. Environmental Protection Agency (EPA)-designated “maintenance” area for carbon monoxide. All other sources of carbon monoxide at SNL/NM are small, and the total carbon monoxide emissions are about 3 percent of the total carbon monoxide emissions in the county.

Currently, 16 SNL/NM facilities emit radionuclides. The maximum calculated total dose of radiation from

> **Exposure to Radiation**
>
> All people are constantly exposed to some form of radiation. This radiation can be from different sources: cosmic from space, medical from X-rays, internal from food, and external from rocks and soil (such as radon in homes). The "Roentgen equivalent, man" (rem) unit is a measurement of the dose from radiation and its physical effects and is used to predict the biological effects of radiation on the human body. Therefore, one rem of one type of radiation is presumed to have the same biological effects as one rem of any other type of radiation. This allows comparison of the biological effects of radiological materials that emit different types of radiation. A commonly used dose unit of measure is millirem (mrem), which is equal to 0.001 rem.

atmospheric emissions at all SNL/NM facilities to an individual is 0.007 mrem/yr, which is much lower than the regulatory limit of 10 mrem/yr. This dose is also small compared to an individual background radiation dose from all sources of 360 mrem/yr received by residents of the Albuquerque area.

Human Health and Worker Safety

SNL/NM has the potential of affecting human health from radiological or hazardous materials that could reach either workers or the public. Of the average background radiation dose of 360 mrem/yr, more than 80 percent is from natural sources such as radon. The major nonnatural source of radiation is medical testing, which accounts for 15 percent of the total dose. The maximum 1996 dose estimate from air emissions at SNL/NM facilities for an individual in a publicly accessible area is 0.007 mrem/yr, which is 0.002 percent of the background radiation dose. This dose is associated with an increased lifetime cancer risk of 1 in 285 million. The 1996 collective dose to the population within 50 mi is 0.14 person-rem. Based on current environmental monitoring data, radiation exposures would not be expected through media such as surface water, soil, groundwater, and natural vegetation.

Nonradiological chemical air pollutants are released from SNL/NM facilities that house chemistry laboratories or chemical operations. Concentrations of these pollutants are below safety levels established for workers in industrial areas and are known to diminish with increasing distance from the sources. Environmental monitoring data indicate that the public is not in contact with chemical contamination through surface water, soil, or groundwater.

Workers in some SNL/NM facilities receive an additional dose of radiation, measured by personal radiation monitoring devices (dosimetry badges). The average annual collective radiation dose to the entire group of radiation workers is 12 person-rem per year, based on 1992 through 1996 data. This dose is associated with a latent cancer fatality risk to the radiation worker population of 1 in 200. At this risk level, no additional fatal cancers would be likely to occur within the radiation worker population.

SNL/NM's nonfatal injury/illness rate has ranged between 2.3 and 4.1 per 100 workers per year from 1992 through 1996. This is significantly less than national (7.4 to 8.9) or New Mexico (7.3 to 8.5) private industry rates. SNL/NM had no fatal occupational injuries from 1992 through 1996.

Transportation

Normal transportation activities can affect air quality and cause noise, vibration, and traffic congestion. Transportation activities at SNL/NM involve the receipt, shipment, and transfer of hazardous and nonhazardous materials and waste. The most frequently received hazardous materials are chemicals. In 1997, SNL/NM received more than 25,000 chemical containers in approximately 2,800 shipments.

From 1994 through 1997, SNL/NM had 10 transportation-related incidents involving onsite transfer or offsite shipment or receipt of hazardous material. None resulted in the release of a hazardous cargo to the environment or exposure of the workforce or the public to hazardous materials.

Waste Generation

Waste generation activities consist of managing, storing, and preparing waste for offsite disposal in accordance with applicable Federal and state regulations, permits, and DOE Orders. Waste generated onsite under current operations include radioactive waste, hazardous waste, biohazardous (medical) waste, asbestos, polychlorinated biphenyls (PCBs), nonhazardous solid waste, and process wastewater. Waste generated in 1996 included 25,600 ft^3 of radioactive waste, 48,000 kg of hazardous waste, 52,000 kg of PCBs, and 77,000 kg of asbestos. Additional waste will be generated by the ER Project. Several waste transfer and storage facilities exist at

SNL/NM to handle this waste for onsite or offsite disposal.

Noise and Vibration

SNL/NM produces sounds from the detonation of explosives or sonic booms from sled track activities. The distance at which these so-called "impulse" sounds can be heard varies depending on the intensity of the initial blast, meteorological conditions, terrain, and background noise levels. These sounds are sometimes heard beyond the KAFB boundary. In 1996, SNL/NM produced 1,059 impulse noise events, only a small fraction of which were of sufficient magnitude to be heard beyond the KAFB boundary. Offsite damage from vibrations associated with these noise events would be unlikely.

Socioeconomics

SNL/NM is the fifth-largest private employer in New Mexico. For Fiscal Year (FY) 1997, the SNL/NM payroll in the local four-county region was $417 million for 6,824 full-time personnel. During the same year, SNL/NM spent approximately $309 million in procurements in the region. The total operating and capital budget for SNL/NM for FY 1996 was approximately $1.4 billion, of which an estimated $877 million was spent in central New Mexico.

Environmental Justice

Presidential Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations. According to a 1990 report, *Poverty Thresholds*, from the U.S. Bureau of the Census, 49 percent of New Mexico's population was minority, and 21 percent was listed as in poverty or designated as having low income. Areas with greater than the state average of minority population border KAFB to the northeast, west, and south. Areas with greater than the state average of low-income populations border KAFB to the west and south.

ENVIRONMENTAL CONSEQUENCES

This section summarizes, by resource area, the environmental consequences of operating SNL/NM facilities according to the levels of activity specified in the three alternatives. Table S–2 also provides a comparison of impacts across alternatives for each resource area. Table S–3 provides this comparison for accidents.

Land Use and Visual Resources

No adverse impacts to land resources are expected as a result of the No Action, Expanded Operations, or Reduced Operations Alternatives. The extent of DOE land and USAF-permitted acreage currently available for use by SNL/NM facilities on KAFB would remain approximately the same. Operations would remain consistent with industrial and research park uses and would have no foreseeable effects on established land use patterns or requirements. Buffer zones would continue to remain at their current size and location. New SNL/NM facilities, expansions, and upgrades would be limited and would not require changes to current land ownership or classification status because these activities would be planned in or near existing facilities, within already disturbed or developed areas, or on land already under DOE control. There would be no adverse impacts to visual resources that change the overall appearance of the existing landscape, obscure views, or alter the visibility of SNL/NM structures. New facilities, expansions, and upgrades would be planned in or near existing facilities in areas with common scenic quality. Efforts initiated by SNL/NM to incorporate a campus-style design would continue.

Infrastructure

Annual projected utility demands for all alternatives would be well within system capacities. Electrical consumption would range from 185,000 MWh (Reduced Operations Alternative) to 198,000 MWh. Projected water usage would range from 416 million gal to 495 million gal per year. Actual water usage probably would be lower because SNL/NM has implemented a conservation program to reduce usage by 30 percent by 2004. For comparison purposes, a conservation scenario is provided under the No Action Alternative. Other infrastructure-related factors, including maintenance, roads, communications, steam, natural gas, and facility decommissioning, would be similar for each alternative and would not be adversely affected by the projected levels of SNL/NM operations. The Expanded Operations Alternative considered a 10-percent margin, which shows that utility systems supporting SNL/NM maintain adequate capacities.

Geology and Soils

No activities planned for any of the alternatives would present a potential for slope destabilization. Slope instability has not been an issue in past SNL/NM operations and would likely not be a concern in the future. Existing soil contamination is being cleaned up through SNL/NM's ER Project, which is scheduled for completion by 2004. Under the Expanded Operations Alternative, there would be the potential for increased deposition of soil contaminants in outdoor testing areas. Potential contaminants would include depleted uranium (DU) fragments, explosive residue, and metals contained in weapons that are used in the tests. SNL/NM performs periodic sampling and radiation surveys in these testing areas. DU fragments are collected after tests. Potential contaminants have not been detected at concentrations above background at current testing levels. These areas are not accessible to the general public.

Water Resources and Hydrology

Groundwater contamination attributable to known SNL/NM activities is present at one site, the Chemical Waste Landfill (CWL) in TA-III. Investigation and cleanup planning are ongoing at this site, and any final plans must be approved by the New Mexico Environment Department. Under a no-cleanup scenario, the only contaminant exceeding EPA concentration limits in groundwater would be TCE, which occurs in a plume extending 410 ft from the CWL. This would not impact drinking water supplies because the nearest water supply well is approximately 4 mi from the CWL. Although the resulting impact is due to past waste management practices rather than current operations, it is considered to be adverse. Groundwater investigation would continue at several additional locations where the source of potential contamination has not been identified. Investigation and cleanup at locations with groundwater contamination would continue at the same rate under any of the three alternatives.

The estimated SNL/NM portion of local (in the immediate vicinity of KAFB) aquifer drawdown from 1998 to 2008 would range from 11 to 12 percent for all alternatives. Local drawdown would range from less than 1 to 28 ft across KAFB during this period. The impact resulting from SNL/NM's contribution to drawdown in the aquifer derives from both past and present water usage and is considered to be adverse. This drawdown would not have an immediate effect on other water users, spring flow, or land subsidence. Long-term effects would be greatly mitigated by the city of Albuquerque's conversion to surface water use, scheduled to begin in 2004. Water demand under each alternative would be within existing KAFB water rights.

Potential sources of surface water contamination at SNL/NM would be storm water runoff from ER Project sites (including active testing areas) and runoff from developed areas. However, no contaminants attributable to SNL/NM activities have been detected in surface water samples collected onsite. The elevated levels of naturally occurring metals detected in the storm water samples have not been attributed to SNL/NM. No SNL/NM activities are projected under any of the alternatives that would contribute contaminants to surface water.

SNL/NM has little effect on the quantity of surface water in arroyos or the Rio Grande. The combined excess storm water runoff from SNL/NM facilities and discharge to Albuquerque's Southside Water Reclamation Plant would contribute from 0.06 to 0.07 percent to the annual Rio Grande flow under all alternatives, with no measurable impacts to the Rio Grande.

Biological and Ecological Resources

Beneficial impacts to biological and ecological resources would occur under all alternatives. Restricted access and limited development and use have benefited biological resources at KAFB. For example, the absence of livestock grazing has improved the quality of the grasslands in relation to the region.

SNL/NM operations in TAs-I, -II, and -V would continue to occur primarily inside buildings. Under all alternatives, small areas of vegetation would be removed (see Section 2.3.5), but this removal would not affect the viability of the plant communities. Proposed activities could result in the local displacement of wildlife. There would be slightly increased levels of noise and activity under the Expanded Operations Alternative. However, data from raptor surveys of KAFB indicate that they have become accustomed to the noise and activities that currently exist, as raptor species at KAFB return to the same nest sites each year. Outdoor activities at TA-III and the Coyote Test Field would continue to affect small localized areas.

Limited site access and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to benefit the animals and plants, including sensitive species on KAFB.

Cultural Resources

Restricted access in association with activities at certain facilities would continue to have a beneficial effect on prehistoric and historic archaeological resources because it would protect the resources from vandalism, theft, or unintentional damage. For all three SWEIS alternatives, there would continue to be a potential for impacts to prehistoric and historic archaeological resources. These impacts would derive from explosive testing debris and shrapnel produced as a result of outdoor explosions, off-road vehicle traffic, and unintended fires and fire suppression. However, the potential for impacts due to these factors would be minimal under all three alternatives.

As a result of the ongoing consultation with 15 Native American tribes; no TCPs have been identified at SNL/NM; however, several tribes have requested that they be consulted under the *Native American Graves Protection and Repatriation Act* (NAGPRA) if human remains are discovered within the region of influence. These consultations will continue. If specific TCPs are identified, any impacts of SNL/NM activities on the TCP and any impacts of restricting access to the TCP would be determined in consultation with Native American tribes, and further NEPA review would be conducted, if appropriate.

Air Quality

Concentrations of criteria and chemical pollutants in air would be below regulatory standards and human health guidelines. Maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b would represent a maximum of 96 percent of the allowable regulatory limits of several criteria pollutants (nitrogen dioxide, total suspended particulates, and particulate matter less than 10 microns in diameter) at a public access area.

These standards, in general, are set to provide an ample margin of safety below any pollutant concentration that might be of concern. The methodology used in the criteria pollutant analysis also produces projections that are conservative maximum concentrations.

Based on the analysis of stationary and mobile source emissions, carbon monoxide emissions from SNL/NM would be less than 1996 emissions under any alternative. Emissions would remain below the 10-percent threshold that denotes a regionally significant action in a nonattainment area. As a result, the DOE has determined that a conformity determination under 40 CFR Part 93 Subpart B is not required.

With the exception of one chemical (chromium trioxide), concentrations of noncarcinogenic chemicals emitted from 12 facilities on SNL/NM were projected to be below screening levels based on occupational exposure limit (OEL) guidelines generally referenced to determine human health impacts. Concentrations of carcinogenic chemical emissions would pose little cancer risk (less than 1 in 1 million) to onsite workers or the general public. Chemical emissions would be highest for the Expanded Operations Alternative, although they would still be below levels that would affect public health.

The impact from emissions of criteria pollutants for the No Action and Expanded Operations Alternatives would be essentially the same. The major source of criteria pollutants (other than mobile sources) would be the steam plant, which supplies steam to the facilities for heating. No increase in floor space is anticipated under the Expanded Operations Alternative; therefore, no increase in steam production would be required. The Reduced Operations Alternative would require less steam, resulting in lower emissions from the steam plant.

The radiological dose impacts due to the annual air emissions from SNL/NM facilities during normal operations under each of the alternatives would be much lower than the regulatory National Emissions Standards for Hazardous Air Pollutants (NESHAP) limit of 10 mrem/yr to a maximally exposed individual (MEI). The calculated radiological dose to an MEI would be 0.15 mrem/yr under the No Action Alternative; 0.51 mrem/yr under the Expanded Operations Alternative; and 0.02 mrem/yr under the Reduced Operations Alternative. The dose to an MEI under each alternative would be small in comparison to the average individual background radiation dose of 360 mrem/yr.

The calculated collective dose to the population within 50 mi of SNL/NM from the annual radiological air emissions due to the SNL/NM operations under each alternative would be 5.0 person-rem per year under the No Action Alternative; 15.8 person-rem per year under the Expanded Operations Alternative; and 0.80 person-rem per year under the Reduced Operations Alternative. The collective dose would be much lower than the collective dose of 263,700 person-rem to the same population from background radiation.

Human Health

Routine releases of hazardous radiological and chemical materials would occur during SNL/NM operations. These releases would have the potential to reach receptors (workers and members of the public) by way of different environmental pathways. The levels of exposure to chemicals and radionuclides were assessed for each environmental medium determined to be a pathway for these releases.

The SWEIS impact analyses identified air as the primary environmental pathway having the potential to transport hazardous material from SNL/NM facilities to receptors in the SNL/NM vicinity. In the assessment of human health risk from air emissions, a number of receptor locations and possible exposure scenarios were analyzed. The total composite cancer health risk is the sum of potential chemical and radiation exposures, calculated from the radiation cancer health risk to the MEI, plus the upper bound chemical cancer health risk from a hypothetical worst-case exposure scenario. This very conservative estimate of maximum health risk is greater than any of the individual health risks based on more likely exposure estimates at specific receptor locations.

Both the composite cancer health risk estimate of 1 in 385,000, and the cancer health risk estimates for specific receptor locations are below levels that regulators consider protective of public health. No adverse health effects would be expected from any of the three alternatives for SNL/NM. The small amounts of chemical carcinogens and radiation released from SNL/NM facilities would increase the MEI lifetime risk of cancer by less than 1 chance in 434,000 under the No Action Alternative and by less than a possible 1 chance in 126,000 under the Expanded Operations Alternative. Noncancer health effects would not be expected based on hazard index values of less than 1. No additional nonfatal cancers, genetic disorders, or latent cancer fatalities (LCFs) would be expected in the population living within a 50-mi radius.

Transportation

The SNL/NM material and waste truck traffic offsite would be projected to increase from 14.5 shipments per day (1996) to 34.4 shipments per day under the Expanded Operations Alternative. However, the SNL/NM truck traffic would comprise less than 0.03 percent of the total traffic, including all types of vehicles entering and leaving the Albuquerque area by way of interstate highways. Therefore, the impact under the Expanded Operations Alternative would be minimal. The total local traffic on roadways would be expected to increase by a maximum of 3.6 percent overall under the Expanded Operations Alternative.

The overall maximum lifetime fatalities from SNL/NM annual shipments of all types of materials and wastes due to SNL/NM operations were estimated to be 1.7 fatalities under the Expanded Operations Alternative. Of these estimates, 1.3 fatalities would be due to traffic accidents; 0.33 fatalities would be due to incident-free transport of radiological materials and wastes; and 0.06 fatalities would be due to air pollution from truck emissions.

The maximum lifetime LCFs in the population within a 50-mi radius were estimated, based on a population dose of 4.93 person-rem, to be 0.0025 from the annual transport of radiological materials and wastes.

Waste Generation

Generation of radioactive waste, hazardous waste, process wastewater, and nonhazardous solid waste was reviewed. The goal of the review was to determine the adequacy of existing onsite and offsite storage and treatment and disposal capabilities. Storage capacity for all anticipated waste types would be adequate. Limited onsite hazardous and mixed waste treatment capacity would be within current permit limits. Most hazardous waste would be treated and disposed of offsite within the commercial sector. Commercial offsite capacity is currently adequate and would exceed anticipated future demand.

Recycling of wastes was not included in the modeling to bound actual projected waste quantities. Radioactive

Radioactive Waste Categories

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

Low-Level Mixed Waste—Waste that contains both hazardous waste regulated under the *Resource Conservation and Recovery Act* (42 U.S.C. §6901) and low-level waste.

material management practices would be required to reduce quantities of material that could inadvertently become contaminated. Low-level waste (LLW) and low-level mixed waste (LLMW) (see text box) would increase by a maximum of 198 and 69 percent, respectively, under the Expanded Operations Alternative. One new operation, the Medical Isotopes Production Project, would be the major contributor to this increase. Capacity currently exists to manage the waste generated from all operations at the Expanded Operations Alternative level.

Trends for all hazardous waste clearly show a significant reduction due to the implementation of pollution prevention protocols at SNL/NM. New procedures and recycling for the solid waste and process wastewater would have similar impacts on the nonhazardous waste volumes being generated.

Noise and Vibration

The No Action Alternative would enable SNL/NM to operate at current planned levels, which include baseline background noise levels and short-term noise impacts from SNL/NM test activities. Impulse noise-producing test activities would increase an estimated 35 percent over the 1996 number of test activities by 2008.

Projections under the Expanded Operations Alternative indicate a 250 percent increase in the number of impulse noise tests over 1996 levels. This would result in an average of approximately 1 impulse noise event per hour for an 8-hour work day, based on a 261-day work year.

The projected frequency of impulse noise events for the Reduced Operations Alternative would be 65 percent less than the 1996 levels, resulting in an average of 1.5 impulse noise tests per day.

Only a small fraction of these tests would be loud enough to be heard or felt beyond the site boundary. The vast majority of tests would be below background noise levels for locations beyond the KAFB boundary and would be unnoticed in neighborhoods bounding the site. Ground vibrations would remain confined to the immediate test area.

Socioeconomics

Direct SNL/NM employment projections range from 7,422 (Reduced Operations Alternative) to 8,417 (Expanded Operations Alternative), in comparison to 7,652 full-time SNL/NM employees in the base year. These employment changes would change regional population, employment, personal income, and other socioeconomic measures in the region by less than 1 percent.

Environmental Justice

Based on the analyses of other impact areas, the DOE would not expect any environmental justice-related impacts from the continued operation of SNL/NM under any of the alternatives. Resource areas of potential concern were evaluated on an individual basis with respect to minority populations and low-income populations, as appropriate.

No TCPs have been identified at SNL/NM. If specific TCPs are identified, Native American tribes will be consulted.

Accidents

At SNL/NM, accidents could occur that would affect workers and the public. Potential accidents with the largest impacts would involve radioactive materials in TA-V facilities and hazardous chemicals in TA-I facilities. In most instances, involved workers (those individuals located in the immediate vicinity of an accident) would incur the largest risk of serious injury or fatality. This is because, for most accidents, the magnitude of the damaging effects are highest at the point of the accident and diminish with increasing distance. This would apply, for example, to releases of radioactive and chemical materials, explosions, fires, airplane crashes, earthquakes, and similar events. In some situations, however, the mitigating effects of structural barriers, personal protection equipment, and engineered safety features may offer greater protection for close-in workers than others in the general vicinity of the accident.

In TA-I, under all three alternatives, there could be numerous situations in laboratory rooms where workers could be accidentally exposed to small amounts of dangerous chemicals. The potential also exists in TA-I for a catastrophic accident, such as an airplane crash into a facility or an earthquake, in which multiple dangerous chemicals could be released and expose onsite individuals to harmful or fatal chemical concentrations. Large quantities of hydrogen stored in outside areas of TA-I could also explode as a result of a catastrophic event and cause serious injury or fatality to involved workers and other nearby onsite individuals. The probability of a catastrophic chemical or explosive accident with serious consequences is low (less than once in a thousand years). Should such an accident occur, emergency procedures, mitigating features, and administrative controls would minimize its adverse impacts.

The potential for accidents would exist in TA-V that would cause the release of radioactive materials, causing injury to workers, onsite individuals, and the public. The magnitudes of impacts for the worst-case accident, an earthquake, would be minimal for all alternatives. If an earthquake occurred, the impacts would range from a 1 in 33 increase in probability of an LCF for a noninvolved worker on the site to 1 in 120,000 for a maximally exposed member of the public. For the entire population residing within 50 mi of SNL/NM, one or two additional LCFs would be expected. Involved workers, as in the case of chemical accidents, would incur the largest risk of injury or fatality in the event of almost any accident because of their close proximity to the hazardous conditions.

Cumulative Effects

Cumulative effects result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions. To conduct this analysis, the DOE examined the effects associated with the continued and expanded operation of SNL/NM, and then added the effects of other past, present, and reasonably foreseeable future actions to assess the cumulative effects to various resource areas. These additional effects are primarily because of the presence of USAF and other DOE facilities at KAFB and the environmental effects caused by residents and businesses in the city of Albuquerque.

Other DOE Facilities

There are seven other DOE facilities at KAFB: the DOE Albuquerque Operations Office, Energy Training Complex, Transportation Safeguards Division, Nonproliferation and National Security Institute (formerly the Central Training Academy), Lovelace Respiratory Research Institute (formerly the Inhalation Toxicology Research Institute), Federal Manufacturing & Technology/New Mexico (also known as AlliedSignal), and Ross Aviation, Inc. The potential for environmental impacts from these facilities would be low. These facilities do not have stationary sources of air pollutants designated as “major” by Federal or local air quality regulations. Criteria pollutant air emissions from these facilities were modeled in combination with those for SNL/NM in the 1996 operating permit application required by 20 NMAC 11.42, and potential concentrations of pollutants from these emissions were found to be below levels designed to protect human health with an ample margin of safety. Emissions from these facilities are expected to be below these maximum potential levels. Hazardous air pollutant emissions are minimal, and only small quantities of chemicals are purchased. Emissions of carbon monoxide from vehicles were included with the analysis for vehicles associated with SNL/NM.

None of the activities at these facilities would pose any significant adverse threat to the environment.

USAF Operations

USAF installations typically generate waste solvents, oils, paints, paint sludges, and some R&D chemical wastes that are regulated as hazardous waste. The KAFB Hazardous Waste Management Plan sets local management procedures for managing hazardous waste and preventing pollution. The plan incorporates Federal, state, and local requirements regarding hazardous waste, and applies to all host and associate organizations that generate hazardous waste on KAFB.

USAF installations typically have numerous sources of air pollutant emissions that are regulated and might require permits for construction and operation. Primary emission sources are steam plants, paint shops, aircraft and ground vehicles, and processes and test activities. KAFB currently has two air permits in effect. The Title V permit application was submitted in December 1995. KAFB also conducts environmental restoration under the USAF’s Installation Restoration Program (IRP). There are currently 70 IRP sites and 12 areas of concern.

NonDOE or USAF Operations

A number of other activities in the area surrounding KAFB are not DOE- or USAF-related. The city of Albuquerque and its suburbs form the state’s largest metropolitan area with a population over 500,000. Over 400 local manufacturers produce a wide range of products including electronic components, baked goods, computers, construction materials, and heavy trailers. The counties surrounding SNL/NM have numerous existing and planned industrial facilities and residences with permitted air emissions and discharges to surface waters. These facilities comprise electric generating stations (including Cobisa Power Station), computer chip manufacturers, construction materials industries, and other manufacturing facilities. KAFB has residential and commercial centers onsite, as well as to the north, south, west, and northeast. There are many local and regional influences as well as private and public activities.

Analysis Results

The analysis found that cumulative effects to the environment resulting from SNL/NM activities would be small.

No adverse cumulative impacts to land use would occur. Land in the area surrounding KAFB would continue to be developed at its present rate of growth regardless of the presence of the DOE and SNL/NM. In addition, no adverse impacts to infrastructure would occur. Consumption of natural gas, fuel oil, and electricity at KAFB would decline slightly or remain at recent historic levels. Adequate capacities exist for all utilities.

No adverse cumulative effects to transportation routes would be expected. However, traffic congestion and transportation construction projects would continue to affect local transportation.

Cumulative effects to water resources would be small. Total SNL/NM withdrawal of groundwater would be approximately 1 percent of basin-wide withdrawal and 12 percent of local withdrawal.

Cultural resources would not be adversely affected by SNL/NM or DOE activities. The restricted public access at KAFB would result in the protection of cultural resources.

Cumulative effects to air quality would be small. A comprehensive analysis of air emissions from SNL/NM show no individual or aggregate emissions of concern to human health. Emissions from KAFB are also unlikely to be of concern to human health because, like SNL/NM, hazardous chemical air emissions are below levels requiring monitoring by the *Clean Air Act* or local air quality regulations. Carbon monoxide emissions from vehicles are the primary air pollutant of concern. Carbon monoxide emissions from SNL/NM and KAFB show decreasing trends and, combined, are less than 10 percent of the total carbon monoxide emissions in the county. There would be no adverse cumulative impacts due to radiological air emissions. In addition, there would be no adverse impacts to human health or safety.

Slight increases in ambient noise levels would occur due to intermittent testing at KAFB; however, no long-term increases in noise or vibration levels would occur.

Beneficial cumulative impacts would result from direct and indirect socioeconomic effects. The DOE expects that overall expenditures and employment at SNL/NM would expand gradually at a steady rate over the next 10 years, which would tend to maintain demographic patterns in the region.

MITIGATION MEASURES

The regulations promulgated by the Council on Environmental Quality to implement the procedural provisions of NEPA require that an environmental impact statement include a discussion of appropriate mitigation measures. Mitigation includes the following (40 CFR Part 1508.20):

- avoiding an impact by not taking an action or parts of an action;
- minimizing impacts by limiting the degree of magnitude of an action and its implementation;
- rectifying an impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact by preservation and maintenance operations during the life of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

The mitigation measures in this SWEIS are built into the alternatives. These measures address the range of potential impacts of continuing to operate SNL/NM. Based on the results of the analyses, the DOE does not anticipate implementing additional mitigation measures. The following list contains examples of SNL/NM programs, plans, and projects that are integral to the SWEIS alternatives:

- Environmental Surveillance and Compliance Program (monitors SNL/NM for permit and environmental management requirements)
- Threatened and Endangered Species Habitat Management Plan
- Natural Resource Management Plan (in development)
- Public and worker health studies in and around SNL/NM
- Groundwater Protection Management Program Plan
- Safeguards and Security Program
- Emergency management and response capability enhancement
- Fire Protection Program
- Pollution Prevention and Waste Minimization Programs
- Water and Energy Conservation Programs
- ER Project plans

Table S–2. Comparison of Potential Consequences of Continued Operations at SNL/NM

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Land Use		No changes projected in classification or ownership	Same as No Action Alternative	Same as No Action Alternative
Visual Resources		Changes would be minor and transitory. Projected new construction in already developed areas	Same as No Action Alternative	Same as No Action Alternative
Infrastructure		All projected activities within capacities of existing road, waste management, and utility systems	Same as No Action Alternative	Same as No Action Alternative
Water Use		440-463 M gal/yr	495 M gal/yr	416 M gal/yr
Geology and Soils	Slope Stability	SNL/NM activities are not anticipated to destabilize slopes.	Same as No Action Alternative	Same as No Action Alternative
	Soil Contamination	Minimal deposition of contaminants to soils and continued removal of existing contaminants under the ER Project	Same as No Action Alternative	Same as No Action Alternative
Water Resources and Hydrology	Groundwater Quality	TCE above MCL from SNL/NM disposal activities is present in groundwater near the Chemical Waste Landfill (TA-III). No future activities are anticipated to cause further groundwater contamination.	Same as No Action Alternative	Same as No Action Alternative
	Groundwater Quantity	SNL/NM groundwater use is projected to account for 11% of local aquifer drawdown and 1% of basin-wide use. The potential consequence is considered adverse.	SNL/NM groundwater use is projected to account for 12% of local aquifer drawdown and 1% of basin-wide use.	Same as No Action Alternative
	Surface Water Quality	No contaminants attributable to SNL/NM activities have been detected in water samples collected onsite. No future activities are anticipated to cause surface water contamination.	Same as No Action Alternative	Same as No Action Alternative
	Surface Water Quantity	SNL/NM s projected portion of Rio Grande flow is 0.07%.	Same as No Action Alternative	Projected portion of Rio Grande flow is 0.06%

Table S–2. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Biological and Ecological Resources		Impacts projected for biological or ecological resources are low to negligible.	Same as No Action Alternative	Same as No Action Alternative
Cultural Resources[a]		Potential for impacts to cultural resources is low to negligible. Explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires present a low to negligible potential for impacts. SNL/NM security would likely result in continued protection of archaeological sites.	Same as No Action Alternative	Same as No Action Alternative
Air Quality				
Nonradiological Air Quality	Stationary Source Criteria Pollutants	Concentrations would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Modeling results (summary) Carbon Monoxide (8 hours): 57% of standard Lead (quarterly): 0.07% of standard Nitrogen dioxide (annually): 30% of standard Total suspended particulates (annually): 69% of standard Sulfer dioxide (annually): 4% of standard	Same as No Action Alternative	Same as No Action Alternative
	Chemical Pollutants	Concentrations are below regulatory standards and human health guidelines.	Same as No Action Alternative	Same as No Action Alternative
	Mobile sources (percent of Bernalillo county mobile-source carbon monoxide emissions)	4.6	5.1	4.5
	Fire testing facilities	Chemical concentrations are below OEL/100 guideline.	Same as No Action Alternative	Same as No Action Alternative

Table S–2. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Air Quality (continued)				
Radiological Air Quality	MEI dose	0.15 mrem/yr	0.51 mrem/yr	0.02 mrem/yr
	Collective ROI dose	5.0 person-rem/yr	15.8 person-rem/yr	0.80 person-rem/yr
	Average individual dose within ROI	6.8×10^{-3} mrem/yr	2.16×10^{-2} mrem/yr	1.1×10^{-3} mrem/yr
Human Health and Worker Safety	MEI public risk (from radiation)	7.5×10^{-8} LCF/yr	2.6×10^{-7} LCF/yr	8.0×10^{-9} LCF/yr
	ROI population risk to public (from radiation)	2.5×10^{-3} LCF/yr	7.9×10^{-3} LCF/yr	4.0×10^{-4} LCF/yr
	Fatal SNL/NM worker occupational injuries	none	Same as No Action Alternative	Same as No Action Alternative
	Average radiation-badged SNL/NM worker dose (risk)	47 mrem/yr (1.9×10^{-5} LCF/yr)	Same as No Action Alternative	Same as No Action Alternative
	Nonfatal SNL/NM worker occupational injuries/illnesses	311/yr	326/yr	287/yr
	Occupational SNL/NM worker chemical exposures	1-2/yr	Same as No Action Alternative	Same as No Action Alternative
	Environmental risk to public (from chemical exposures)	$<1 \times 10^{-6}$ ELCR	Same as No Action Alternative	Same as No Action Alternative

Table S–2. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Transportation	Transportation population risk within ROI (from radiation)	8.3×10^{-4} LCF/yr (1.7 person-rem)	2.5×10^{-3} LCF/yr (4.9 person-rem)	2.0×10^{-4} LCF/yr (0.4 person-rem)
	Total transportation population risk (from radiation)	0.1 LCF/yr	0.33 LCF/yr	4.5×10^{-2} LCF/yr
	Traffic accident fatalities	0.49/yr	1.3/yr	0.18/yr
	Total transportation population risk (from truck emissions)	0.03 LCF/yr	0.06 LCF/yr	0.01 LCF/yr
Waste Generation (Annual)	Management capability (infrastructure)	All projected activities are within capacities of existing facilities and systems.	Same as No Action Alternative	Same as No Action Alternative
	Total radioactive waste	Up to 176 m^3	Up to 289 m^3	Up to 106 m^3
	Total chemical waste	Up to approximately 379,000 kg	Up to approximately 441,000 kg	Up to approximately 306,000 kg

Table S–2. Comparison of Potential Consequences of Continued Operations at SNL/NM (concluded)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Noise and Vibration		Impulse noise-producing test activities projected to increase 35% over 1996 level to 1,435 tests by 2008. Effects would be limited to windows rattling or startle reaction. Background noise levels would continue at current levels from generators, air conditioners, and ventilation systems, but increase due to additional vehicular traffic, aircraft noise, and temporary construction projects (range from 50 to 70 dB).	There would be a 250% increase in test activities over 1996 levels, to 2,638 per year, approximately one impulse noise event per hr for an 8-hr work day and a 261-day work year. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed in neighborhoods bounding the site.	Test activities would be 65% less than the 1996 level, 371 tests per year, an average of approximately 1.5 impulse noise tests per day. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore be unnoticed in neighborhoods bounding the site.
Socioeconomics[b]	SNL/NM employment[c]	8,035	8,417	7,422
	SNL/NM total economic activity within the ROI	$4.13 B/yr	$4.33 B/yr	$3.81 B/yr
	Percent of ROI total economic activity	9.7	10.1	9.0
Environmental Justice[a]		No disproportionately high and adverse impacts to minority or low-income communities are anticipated.	Same as No Action Alternative	Same as No Action Alternative

Source: TtNUS 1998l
B: billion
dB: decibel
ELCR: excess lifetime cancer risk
gal: gallon
hr: hour
kg: kilogram
LCF: latent cancer fatality
M: million
m^3: cubic meter
MCL: maximum contaminant level
MEI: maximally exposed individual
mrem: millirem
ROI: region of influence
TA: technical area
TCE: trichloroethene
TCP: traditional cultural property
yr: year

[a] No TCPs have been identified at SNL/NM. If specific TCPs are identified, Native American tribes will be consulted.
[b] Bounding analysis is based on parameters presented in DOE 1997j.
[c] Section 4.12, Affected Environment, differs slightly, using 6,824 full-time employees. Base year in Section 5.3.12, Environmental Consequences (also see Table 3.6–2), used 7,652 full-time employees.

Table S–3. Comparison of Potential Consequences for Accident Scenarios at SNL/NM

RESOURCE AREA	NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
SITE-WIDE EARTHQUAKE			
RADIOLOGICAL IMPACTS			
50-Mile Population (Additional Latent Cancer Fatalities)	$8.1x10^{-2}$	$7.5x10^{-2}$	$7.5x10^{-2}$
Maximally Exposed Individual (Increased Probability of Latent Cancer Fatality)	$8.6x10^{-6}$	$7.7x10^{-6}$	$7.7x10^{-6}$
Noninvolved Worker (Increased Probability of Latent Cancer Fatality)	$3.1x10^{-2}$	$3.0 x10^{-2}$	$3.0x10^{-2}$
CHEMICAL IMPACTS			
Distance (feet) to reach ERPG-2 Levels	3,800	3,800	3,800
CATASTROPHIC ACCIDENT SINGLE FACILITY			
RADIOLOGICAL IMPACTS			
ACRR Medical Isotopes Production			
50-mile population (additional latent cancer fatalities)	$1.6x10^{-6}$ to $4.9x10^{-3}$	$1.6x10^{-6}$ to $4.9x10^{-3}$	$1.6x10^{-6}$ to $4.9x10^{-3}$
Maximally Exposed Individual (increased probability of latent cancer fatality)	$1.0x10^{-10}$ to $6.1x10^{-7}$	$1.0x10^{-10}$ to $6.1x10^{-7}$	$1.0x10^{-10}$ to $6.1x10^{-7}$
Noninvolved Worker (increased probability of latent cancer fatality)	$4.9x10^{-8}$ to $7.6x10^{-5}$	$4.9x10^{-8}$ to $7.6x10^{-5}$	$4.9x10^{-8}$ to $7.6x10^{-5}$
Hot Cell Facility			
50-mile population (additional latent cancer fatalities)	$1.6x10^{-6}$ to $7.9x10^{-2}$	$1.6x10^{-6}$ to $7.9x10^{-2}$	$1.6x10^{-6}$ to $7.9x10^{-2}$
Maximally Exposed Individual (increased probability of latent cancer fatality)	$1.0x10^{-10}$ to $6.6x10^{-6}$	$1.0x10^{-10}$ to $6.6x10^{-6}$	$1.0x10^{-10}$ to $6.6x10^{-6}$
Noninvolved Worker (increased probability of latent cancer fatality)	$4.2x10^{-9}$ to $7.4x10^{-6}$	$4.2x10^{-9}$ to $7.4x10^{-6}$	$4.2x10^{-9}$ to $7.4x10^{-6}$
Sandia Pulsed Reactor			
50-mile population (additional latent cancer fatalities)	$1.2x10^{-3}$ to $9.2x10^{-3}$	$1.2x10^{-3}$ to $9.2x10^{-3}$	$1.2x10^{-3}$ to $9.2x10^{-3}$
Maximally Exposed Individual (increased probability of latent cancer fatality)	$1.5x10^{-7}$ to $8.4x10^{-7}$	$1.5x10^{-7}$ to $8.4x10^{-7}$	$1.5x10^{-7}$ to $8.4x10^{-7}$
Noninvolved Worker (increased probability of latent cancer fatality)	$2.5x10^{-4}$ to $3.8x10^{-3}$	$2.5x10^{-4}$ to $3.8x10^{-3}$	$2.5x10^{-4}$ to $3.8x10^{-3}$

Table S–3. Comparison of Potential Consequences for Accident Scenarios at SNL/NM (concluded)

RESOURCE AREA	NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
ACRR-Defense Programs Configuration			
50-mile population (additional latent cancer fatalities)	$1.3x10^{-3}$ to $9.0x10^{-3}$	$1.3\ x10^{-3}$ to $9.0x10^{-3}$	Not operational
Maximally Exposed Individual (increased probability of latent cancer fatality)	$1.7x10^{-7}$ to $1.0x10^{-6}$	$1.7x10^{-7}$ to $1.0x10^{-6}$	Not operational
Noninvolved Worker (increased probability of latent cancer fatality)	$1.2x10^{-5}$ to $2.2x10^{-4}$	$1.2x10^{-5}$ to $2.2x10^{-4}$	Not operational
CHEMICAL IMPACTS			
Technical Area-I			
Distance (feet) to reach ERPG-2 Levels[a]	1,440 - 4,884	1,440 - 4,884	1,440 - 4,884
EXPLOSIVE IMPACTS			
Technical Area-I			
Distance (feet) to reach 2 psi (Damage to cinder block walls)	370	370	370
Distance (feet) to reach 10 psi (rupture of 50% of eardrums)	126	126	126
Distance (feet) to reach 50 psi (50% fatalities)	61	61	61

Source: Original
ERPG: emergency response planning guideline
ACRR: Annular Core Research Reactor
psi: pounds per square inch
[a] For the three largest worker (people) densities within ERPG-2 levels related to Buildings 858, 883, and 893

This page was intentionally left blank.

This page was intentionally left blank.

This page was intentionally left blank.

COVER SHEET

RESPONSIBLE AGENCY: U.S. DEPARTMENT OF ENERGY (DOE)

COOPERATING AGENCY: U.S. AIR FORCE

TITLE: Draft Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281)

CONTACT: For further information or to submit comments concerning the Draft Site-Wide Environmental Impact Statement (SWEIS), contact

Julianne Levings, NEPA Document Manager
U.S. DOE, Albuquerque Operations Office
P.O. Box 5400, Albuquerque, NM 87185
Telephone: 1-888-635-7305, Fax: 505-845-6392

For further information or to submit comments by way of electronic mail, contact

www.nepanet.com

For general information on DOE's *National Environmental Policy Act* (NEPA) process, contact

Carol Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
U.S. DOE, 1000 Independence Avenue SW, Washington, DC 20585
Telephone: 202-586-4600 or leave a message at 1-800-472-2756

Abstract: The DOE proposes to continue operating the Sandia National Laboratories/New Mexico (SNL/NM) located in central New Mexico. The DOE has identified and assessed three alternatives for the operation of SNL/NM: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. In the No Action Alternative, the DOE would continue the historical mission support activities SNL/NM has conducted at planned operational levels. In the Expanded Operations Alternative, the DOE would operate SNL/NM at the highest reasonable levels of activity currently foreseeable. Under the Reduced Operations Alternative, the DOE would operate SNL/NM at the minimum levels of activity necessary to maintain the capabilities to support the DOE mission in the near term. Under all of the alternatives, the affected environment is primarily within 50 miles (80 kilometers) of SNL/NM. Analyses indicate little difference in the environmental impacts among alternatives.

Public Comments: Comments on the Draft SWEIS may be submitted through the end of the 60-day comment period (expected to be June 15, 1999), which will commence with the publication of the Environmental Protection Agency's *Federal Register* Notice of Availability for this document. Comments may be submitted in writing, orally, or by electronic mail to the DOE at the addresses and phone number indicated above. Oral or written comments may also be submitted at public meetings to be held during the comment period on dates and locations to be announced in the *Federal Register* and via other public media shortly after issuance of the Draft SWEIS. Comments submitted will be considered in preparation of the Final SWEIS.

This page was intentionally left blank.

Table of Contents

Chapter 4 Affected Environment

Chapter 5 Environmental Consequences

Chapter 6 Cumulative Effects Analysis

Appendixes

List of Figures

List of Tables

Acronyms

58th SOW	58th Special Operations Wing
A/BC AQCB	Albuquerque/Bernalillo County Air Quality Control Board
ACGIH	American Conference of Governmental Industrial Hygienists
ACPR II	Annular Core Pulsed Reactor II
ACRR	Annular Core Research Reactor
ACS	American Cancer Society
AEA	*Atomic Energy Act*
AEHD	Albuquerque Environmental Health Department
AEI	average exposed individual
AFRL	Air Force Research Laboratory
AFSC	Air Force Safety Center
AL	Albuquerque Operations Office
ALARA	as low as reasonably achievable
ALOHA	*Areal Locations of Hazardous Atmospheres*
AMPL	Advanced Manufacturing Processes Laboratory
ANSI	American National Standards Institute
APCD	Air Pollution Control Division
APPRM	Advanced Pulsed Power Research Module
AQCR	Air Quality Control Region
ARF	airborne release fraction
AT&T	American Telephone and Telegraph
BEA	Bureau of Economic Analysis
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CAA	*Clean Air Act*
CAB	Citizens Advisory Board
CAMP	Capital Assets Management Process
CAMU	Corrective Action Management Unit
CAP88-PC	*Clean Air Assessment Package*
CAS	Chemical Abstract Service
CDG	Campus Design Guideline

Note: Italics are used to denote formal names or titles of acts, published documents, or computer models.

CDI	chronic daily intake
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CHEST	Conventional High Explosives and Simulation Test
CIS	Chemical Information System
CPMS	Criteria Pollutant Monitoring Station
CRMP	Cultural Resource Management Plan
CSRL	Compound Semiconductor Research Laboratory
CTA	Central Training Academy
CTTF	Containment Technology Test Facility
CWA	*Clean Water Act*
CWL	Chemical Waste Landfil
CY	calendar year
D&D	decontamination and decommissioning
DARHT	dual-axis radiographic hydrotest
DEAR	Department of Energy Acquisitions Regulations
DF	decontamination factor, dispersion factor
DFG	Deutsche Forschungemeinschaft
DNL	day-night average noise level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DP	Defense Programs
DR	damage ratio
DU	depleted uranium
EA	environmental assessment
EAL	Explosives Applications Laboratory
ECF	Explosive Components Facility
EDE	effective dose equivalent
EF	emission factor
EID	environmental information document

EIS	environmental impact statement
ELCR	excess lifetime cancer risk
EM	Office of Environmental Management
EMP	electromagnetic pulse
EO	*Executive Order*
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
EPCRA	*Emergency Planning and Community Right-to-Know Act*
ER	Environmental Restoration (Project)
ERPG	emergency response planning guideline
ES&H	Environment, Safety, and Health
ETC	Energy Training Center
FAA	Federal Aviation Administration
FCDSWA	Field Command, Defense Special Weapons Agency
FFCA	*Federal Facilities Compliance Act*
FM&T/NM	Federal Manufacturing & Technology/New Mexico
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FSID	*Facilities and Safety Information Document*
FY	fiscal year
GHA	ground hazard area
GIF	Gamma Irradiation Facility
GIS	geographic information system
GRABS	Giant Reusable Air Blast Simulator
GWPMPP	*Groundwater Protection Management Program Plan*
HA	hazards assessment
HAP	hazardous air pollutants
HBWSF	High Bay Waste Storage Facility
HCF	Hot Cell Facility
HEAST	Health Effects Assessment Summary Tables
HEPA	high efficiency particulate arrestance
HERMES	High-Energy Radiation Megavolt Electron Source
HERTF	High-Energy Research Test Facility
HI	hazard index

HLW	high-level radioactive waste
HPML	High Power Microwave Laboratory
HQ	headquarters
HR	hydrogeologic region
HSWA	*Hazardous and Solid Waste Amendments*
HVAR	high velocity aircraft rocket
HWMF	Hazardous Waste Management Facility
IBMRL	Ion Beam Materials Research Laboratories
ICF	inertial confinement fusion
ICRP	International Commission on Radiological Protection
IDLH	immediately dangerous to life and health
IH	industrial hygiene
IHE	insensitive high explosives
IHIL	Industrial Hygiene Instrumentation Laboratory
IHIR	Industrial Hygiene Investigation Report
IMRL	Integrated Materials Research Laboratory
IPS	Integrated Procurement System
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
ISC	industrial source complex
ISCST3	*Industrial Source Complex Short-Term Model, Version 3*
ISS	interim storage site
JIT	just-in-time
JP	jet propulsion
KAFB	Kirtland Air Force Base
KAO	Kirtland Area Office
KUMMSC	Kirtland Underground Munitions and Maintenance Storage Complex
L90	the A-weighted background sound pressure level that is exceeded 90 percent of the time, based on a maximum of a 1-hour period
LADD	lifetime average daily dose
LANL	Los Alamos National Laboratory
LANMAS	Local Area Network Nuclear Material Accountability System
LBERI	Lovelace Biomedical and Environmental Research Institute, Inc.
LCF	latent cancer fatality

LLMW	low-level mixed waste
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LPF	leak path factor
LSA	low specific activity
LSF	Lightning Simulation Facility
LWDS	Liquid Waste Disposal System
M&O	management and operations
M.W.	molecular weight (in grams)
MAC	maximum allowable concentration
MACCS2	*MELCOR Accident Consequence Code System, Version 2*
MAR	material-at-risk
MBTA	*Migratory Bird Treaty Act*
MCL	maximum contaminant level
MDL	Microelectronics Development Laboratory
MEI	maximally exposed individual
MEMF	Mobile Electronic Maintenance Facility
MEPAS	Multimedia Environmental Pollutant Assessment System
MIPP	Medical Isotopes Production Project
MOBILE 5a	*Mobile Source Emission Factor (model)*
MOU	Memorandum of Understanding
MSDS	material safety data sheet
MTRU	mixed transuranic waste
MWL	Mixed Waste Landfill
NAAQS	*National Ambient Air Quality Standards*
NAGPRA	*Native American Graves Protection and Repatriation Act*
NASA	National Aeronautics and Space Administration
NCA	*Noise Control Act*
NCEA	National Center for Environment Assessment
NCRP	National Council on Radiation Protection and Measurements
ND	not detected
NEPA	*National Environmental Policy Act*
NESHAP	*National Emissions Standards for Hazardous Air Pollutants*
NEW	net explosive weight

NF not found

NGF Neutron Generator Facility

NGIF New Gamma Irradiation Facility

NHPA *National Historic Preservation Act*

NRHP National Register of Historic Places

NIOSH National Institute of Occupational Safety and Health

NMAAQS *New Mexico Ambient Air Quality Standards*

NMAC *New Mexico Administrative Code*

NMED New Mexico Environment Department

NMEIB New Mexico Environmental Improvement Board

NMFRCD New Mexico Forestry and Resource Conservation Division

NMDGF New Mexico Department of Game and Fish

NMSA *New Mexico Statutes Annotated*

NMSU New Mexico State University

NMWQCC New Mexico Water Quality Control Commission

NNSI Nonproliferation and National Security Institute

NOI Notice of Intent

NOVA North Vault

NPDES National Pollutant Discharge Elimination System

NPS National Park Service

NRC U.S. Nuclear Regulatory Commission

NRHP National Register of Historic Places

NTS Nevada Test Site

OBODM *Open Burn/Open Detonation Model*

OEL occupational exposure limits

OLM ozone limiting method

ORPD Occupational Radiation Protection Division

ORPS Occurrence Reporting and Processing System

OSHA Occupational Safety and Health Administration

PBCA Particle Bed Critical Assembly

PBFA Particle Beam Fusion Accelerator

PCB polychlorinated biphenyl

PDFL Photovoltiac Device Fabrication Laboratory

PDL Power Development Laboratory

PEIS	Programmatic Environmental Impact Statement
PEL	permissible exposure limit
PL	*Public Law*
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
PM_{10}	particulate matter smaller than 10 microns in diameter
PNM	Public Service Company of New Mexico
PPE	personal protective equipment
PSD	prevention of significant deterioration
PSL	Production Primary Standards Laboratory
PT	product tester
R&D	research & development
RCRA	*Resource Conservation and Recovery Act*
REL	recommended exposure limit
REMS	Radiation Exposure Monitoring System
RF	respirable fraction
RHEPP	Repetitive High Energy Pulsed Power
RHI	risk hazard index
RITS	Radiographic Integrated Test Stand
RME	reasonable maximum exposure
RMMA	Radioactive Materials Management Area
RMP	Risk Management Plan
RMSEL	Robotic Manufacturing Science Engineering Laboratory
RMWMF	Radioactive and Mixed Waste Management Facility
ROD	Record of Decision
ROI	region of influence
RV	reentry vehicle
SA	safety assessment
SABRE	Sandia Accelerator & Beam Research Experiment
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
SDWA	*Safe Drinking Water Act*
SECOM	Secure Communication Center
SHPO	State Historic Preservation Officer (NM)
SIP	State Implementation Plan

SMERF	Smoke Emission Reduction Facility
SMS	Scenery Management System
SNAP	Systems for Nuclear Auxiliary Power
SNL/CA	Sandia National Laboratories/California
SNL/HI	Sandia National Laboratories/Hawaii
SNL/NM	Sandia National Laboratories/New Mexico
SNL/NV	Sandia National Laboratories/Nevada
SNM	special nuclear material
SPA	sawdust-propellant-acetone
SPHINX	Short-Pulse High Intensity Nanosecond X-Radiator
SPR	Sandia Pulsed Reactor
SSM	stockpile stewardship and management
SST	safe, secure transport
START	Strategic Arms Reduction Treaty
STEL	short-term exposure limit
STL	Simulation Technology Laboratory
STP	standard temperature and pressure
SVOC	semivolatile organic compound
SWEIS	Site-Wide Environmental Impact Statement
SWISH	Small Wind Shielded Facility
SWMU	solid waste management unit
SWTF	Solid Waste Transfer Facility
TA	technical area
TAP	toxic air pollutants
TBF	Terminal Ballistics Facility
TCP	traditional cultural property
TEDE	total effective dose equivalent
TESLA	Tera-Electron Volt Semiconducting Linear Accelerator
TEV	threshold emission value
TLV	threshold limit value
TRU	transuranic
TSCA	*Toxic Substances Control Act*
TSD	Transportation Safety Division
TSP	total suspended particulates

TTF	Thermal Treatment Facility
TWA	time weighted average
U.S.	United States
U.S.C.	*United States Code*
UBC	Uniform Building Code
UNM	University of New Mexico
UPS	United Parcel Service
USAF	U.S. Air Force
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tan
VDL	vacuum diode load
VHI	vapor hazard index
VHR	vapor hazard ratio
VMF	vehicle maintenance facility
VOC	volatile organic compound
WARE	Worksite Accident Reduction Expert
WFO	work for others
WIPP	Waste Isolation Pilot Plant
WM	Waste Management

UNIT OF MEASURE	ABBREVIATION
acre	ac
billion gallons per year	BGY
centimeters	cm
cubic feet	ft^3
cubic feet per second	ft^3/s
cubic meters	m^3
cubic yards	yd^3
Curie	Ci
decibel	dB
degrees Celsius	°C
degrees Fahrenheit	°F
feet	ft
gallon	gal
gallons per day	gpd
gram	g
grams per second	g/sec
gravity	*g*
hectare	ha
Hertz	Hz
hour	hr
kelvin	K
kilogram	kg
kilojoule	kJ
kilometer	km
kilometer per hour	km/hr
kilovolt	kV
kilovoltampere	kVA
kilowatt	kW
kilowatt hour	kWh
liter	L
megajoule	MJ
megavolt-ampere	MVA

UNIT OF MEASURE	ABBREVIATION
megawatt	MW
megawatt hour	MWh
megawatt-electric	MWe
megawatt-thermal	MWt
meter	m
meters per second	m/sec
microcurie	µCi
microcuries per gram	µCi/g
microgram	µg
micrograms per cubic meter	µg/m^3
micrograms per kilogram	µg/kg
micrograms per liter	µg/L
micron or micrometer	µm
microohms per centimeter	µohms/cm
micropascal	mPa
mile	mi
miles per hour	mph
millicurie	mCi
millicurie per gram	mCi/g
millicurie per millimeter	mCi/ml
milligram	mg
milligram per liter	mg/L
milliliter	ml
millimeters of mercury	mmHg
million	M
million electron volts	MeV
million gallons per day	MGD
million gallons per year	MGY
millirem	mrem
millirem per year	mrem/yr
nanocurie	nCi
nanocuries per gram	nCi/g

UNIT OF MEASURE	ABBREVIATION
part per billion	ppb
part per billion by volume	ppbv
part per million	ppm
particulate matter of aerodynamic diameter less than 10 micrometers	PM_{10}
particulate matter of aerodynamic diameter less than 25 micrometers	PM_{25}
pascal	Pa
picocurie	pCi
picocuries per gram	pCi/g
picocuries per liter	pCi/L
pound	lb
pounds mass	lbm
pounds per square inch	psi
pounds per year	lb/yr
quart	qt
Roentgen equivalent, man	rem
second	sec
square feet	ft^2
square kilometers	km^2
square meters	m^2

Metric Conversion Chart

TO CONVERT FROM U.S. CUSTOMARY INTO METRIC			TO CONVERT FROM METRIC INTO U.S. CUSTOMARY		
If you know	**Multiply by**	**To get**	**If you know**	**Multiply by**	**To get**
Length					
inches	2.540	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.03281	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.6214	miles
Area					
square inches	6.452	square centimeters	square centimeters	0.1550	square inches
square feet	0.09290	square meters	square meters	10.76	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.4047	hectares	hectares	2.471	acres
square miles	2.590	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.57	milliliters	milliliters	0.03381	fluid ounces
gallons	3.785	liters	liters	0.2642	gallons
cubic feet	0.02832	cubic meters	cubic meters	35.31	cubic feet
cubic yards	0.7646	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.35	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.205	pounds
short tons	0.9072	metric tons	metric tons	1.102	short tons
Temperature					
Fahrenheit (°F)	subtract 32, then multiply by 5/9	Celsius (°C)	Celsius (°C)	multiply by 9/5, then add 32	Fahrenheit (°F)
kelvin (°k)	subtract 273.15	Celsius (°C)	kelvin (°k)	Multiply by 9/5, then add 306.15	Fahrenheit (°F)

Metric Prefixes

PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS	PREFIX	EXPONENT CONVERTED TO WHOLE NUMBERS
atto-	10^{-18} = 0. 000,000,000,000,000,001	**dekta-**	10^{1} = 10
femto-	10^{-15} = 0. 000,000,000,000,001	**hecto-**	10^{2} = 100
pico	10^{-12} = 0. 000,000,000,001	**kilo-**	10^{3} = 1,000
nano-	10^{-9} = 0. 000,000,001	**mega-**	10^{6} = 1,000,000
micro-	10^{-6} = 0.000,001	**giga-**	10^{9} = 1,000,000,000
milli	10^{-3} = 0.001	**tetra-**	10^{12} = 1,000,000,000,000
centi	10^{-2} = 0.01	**peta-**	10^{15} = 1,000,000,000,000,000
deci-	10^{-1} = 0.1	**exa-**	10^{18} = 1,000,000,000,000,000,000

Note: 10^{0} = 1

CHAPTER 1

Introduction and Purpose and Need for Agency Action

This chapter introduces Sandia National Laboratories' (SNL's) role in supporting the U.S. Department of Energy's (DOE's) statutory missions and operations, a statement of the purpose and need for the Department's action, a description of DOE missions for SNL, an overview of the alternatives to be considered, and a review of the decisions that the DOE will make based in part on the findings in this Site-Wide Environmental Impact Statement (SWEIS) in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] Section 4321). In addition, it discusses the public participation process, related NEPA documents, and the organization and contents of the remaining chapters in the SWEIS.

1.1 INTRODUCTION

SNL is one of several national laboratories that support the DOE's statutory responsibilities for nuclear weapons research and design, development of other energy technologies, and basic scientific research. SNL is one of the largest laboratories in the world, with an annual budget of approximately $1.4 billion and a workforce of approximately 7,500 (DOE 1998j). SNL is composed of four geographically separated facilities: Albuquerque, New Mexico (SNL/NM); Tonopah, Nevada; Kauai, Hawaii; and Livermore, California (SNL/CA). This SWEIS focuses on SNL/NM. (A SWEIS was completed in 1992 for SNL/CA and Lawrence Livermore National Laboratory (DOE/EIS-0157) (DOE 1992f).) SNL/NM comprises approximately 8,800 ac of Federal land (owned by the DOE, U.S. Department of Defense [DoD], and U.S. Forest Service [USFS]) on Kirtland Air Force Base (KAFB) southeast of the city of Albuquerque (Figure 1.1–1) (SNL/NM 1997a). SNL/NM shares KAFB with other Federal agencies, primarily the U.S. Air Force (USAF) and the USFS. The USAF is a cooperating agency in the preparation of the SWEIS.

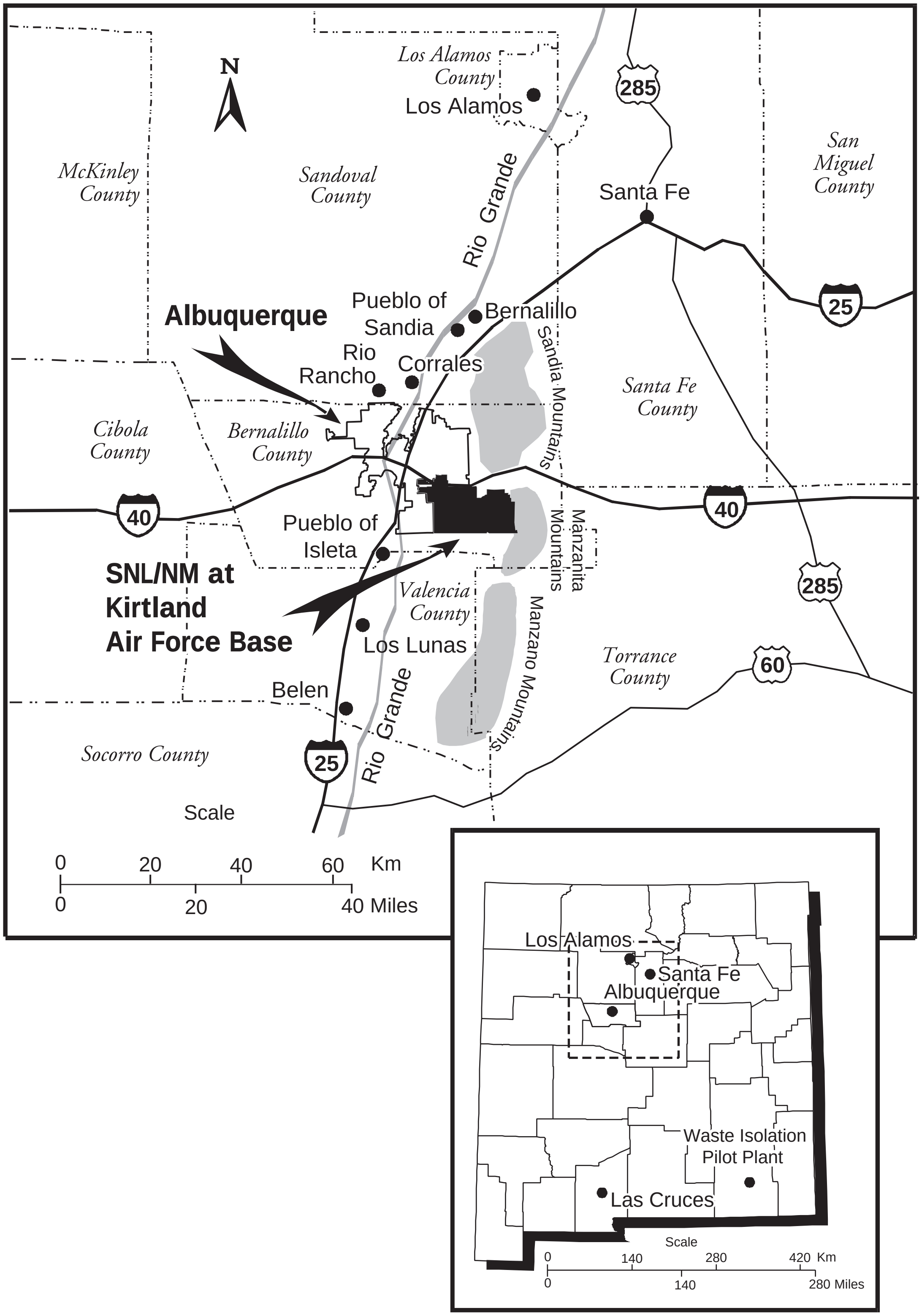
The DOE has prepared the SWEIS to examine the environmental impacts associated with three alternatives for SNL/NM's continued operation (see Section 1.2 and Chapter 3 for additional information regarding the alternatives). In the SWEIS, the DOE describes the consequences, both onsite and offsite, of ongoing and proposed SNL/NM operations and compares the potential consequences to three alternative levels of future operations.

DOE activities at the national laboratories and production facilities are known as mission lines. In the DOE *Strategic Plan*, mission lines are also known as business lines. Descriptions of DOE mission/business lines follow (DOE 1997c):

> **The Importance of SNL's National Security Role**
>
> The continuing need for SNL to support the DOE's national security mission line was confirmed by President Clinton, who stated, ***"...to meet the challenge of ensuring confidence in the safety and reliability of our stockpile, I have concluded that the continued vitality of all three DOE nuclear weapons laboratories will be essential."*** Statement by the President: Future of Major Federal Laboratories (The White House 1995).

- *National Security*—effectively support and maintain a safe, secure, and reliable enduring stockpile of nuclear weapons without nuclear testing; safely dismantle and dispose of excess nuclear weapons; and provide technical leadership for national and global nonproliferation and nuclear safety activities.
- *Energy Resources*—ensure adequate supplies of clean energy; reduce U.S. vulnerability to supply disruptions; encourage efficiency and advance alternative and renewable energy technologies; and increase energy choices for all consumers.

> **The DOE Mission Statement**
>
> To foster a secure and reliable energy system that is environmentally and economically sustainable, to be a responsible steward of the nation's nuclear weapons, to clean up our own facilities, and to support continued United States leadership in science and technology.
> (DOE 1996e)



Source: SNL/NM 1997j

Figure 1.1–1. SNL/NM, KAFB, and Surrounding Region

SNL/NM is located within the boundaries of KAFB, southeast of Albuquerque in Bernalillo county.

- *Environmental Quality*—reduce the environment, safety, and health risks and threats from DOE facilities and materials; safely and permanently dispose of civilian spent nuclear fuel and defense-related radioactive waste; and develop the technologies and institutions required for solving domestic and international environmental problems.
- *Science and Technology*—combine the unique resources of the Department's laboratories and the nation's universities to maintain leadership in basic research and to advance scientific knowledge; focus applied research and technology development in support of the Department's mission lines; contribute to the nation's science and mathematics education; and deliver relevant scientific and technical information.

1.2 PURPOSE AND NEED FOR AGENCY ACTION

The DOE needs to continue to meet its responsibilities for national security, energy resources, environmental quality, and science and technology. These responsibilities are met, in part, by national laboratories, of which SNL is one. The primary purpose for SNL is to serve as a national resource for scientific, technical, and engineering expertise, with a special focus on national security. The DOE needs to continue to fulfill its responsibilities as mandated by statute, Presidential Decision Directive (PDD), and congressional authorization and appropriation. The DOE goal in meeting these responsibilities is to do so in a manner that protects human health and the environment.

DOE missions for SNL have evolved over time in response to national needs. When assigning missions to SNL, the DOE considers many factors, including PDDs; the *National Defense Authorization Act of 1994* (Public Law 103-160); the DoD Nuclear Posture Review; and treaties, both implemented and proposed, including the Nuclear Nonproliferation Treaty, Strategic Arms Reduction Treaty (START) I, proposed START II, and the proposed Comprehensive Test Ban Treaty. Following are specialized capabilities SNL/NM provides in support of the Department's mission lines:

- science-based performance and reliability testing and computer-based modeling of nuclear components;
- production of nonnuclear components;
- production of neutron generators;
- materials science, including studying behavior of materials under high temperature and pressure;
- engineering and high-energy physics;
- high explosives research and development (R&D) and testing;
- microelectronics and photonics research;
- medical isotopes production; and
- radiation effects experimentation and accelerator operations.

For additional discussion of SNL/NM's support of DOE mission lines, see Section 2.1.

SWEIS Terminology

Mission	DOE's mission is to foster a secure and reliable energy system that is environmentally and economically sustainable, to be a responsible steward of the nation's nuclear weapons, to clean up its facilities, and to support continued United States leadership in science and technology.
Mission Lines	The DOE accomplishes its major responsibilities by assigning groups or types of activities (National Security, Energy Resources, Environmental Quality, Science and Technology) to its system of national laboratories and production facilities.
Programs	The DOE is organized into Program Offices. Each has a primary responsibility within one of the four DOE mission lines. The Program Offices provide funding and direction for activities at DOE facilities. Similar, coordinated sets of activities that meet Program Office responsibilities are referred to as programs. Programs are usually long-term efforts with broad goals or requirements.
Capabilities	The combination of equipment, facilities, infrastructure, and expertise required to implement mission assignments.

Description of Alternatives

No Action Ongoing DOE and interagency programs and activities at SNL/NM would continue the status quo, that is, operating at planned levels as reflected in current DOE management plans. In some cases, these planned levels include increases over today's operating levels. This would also include any recent activities that have already been approved by DOE and have existing NEPA documentation.

Expanded Operations DOE and interagency programs and activities at SNL/NM would increase to the highest reasonable activity levels that could be supported by current facilities and the potential expansion and construction of new facilities for specifically identified future actions.

Reduced Operations DOE and interagency programs and activities at SNL/NM would be reduced to the minimum level of operations needed to maintain SNL/NM facilities and equipment in an operational readiness mode.

1.3 PROPOSED ACTION AND ALTERNATIVES

The DOE proposes to continue operating SNL and managing its resources in a manner that meets evolving DOE mission lines and that responds to the concerns of affected and interested individuals and agencies.

The DOE identified three alternatives—No Action, Expanded Operations, and Reduced Operations—that would meet its purpose and need for agency action and support existing and potential future program-related activities at SNL/NM. The Notice of Intent (NOI) (62 Federal Register [FR] 29332) proposed that the first two alternatives be considered in the SWEIS (see Chapter 14); however, a third alternative, the Reduced Operations Alternative, was added to show a broader range of alternatives and respond to comments received from the public during the scoping process (Section 1.7). The SWEIS analyzes the environmental impacts of activities at SNL/NM associated with these three alternatives, as well as activities common to all alternatives including maintenance support and material management. The alternatives are more fully described in Chapter 3.

1.4 OBJECTIVE OF THE SWEIS

In the SWEIS, the DOE is examining the environmental impacts of the three alternatives for the continued operation of the laboratory. The objective of the SWEIS is to provide the DOE, other agencies, and the public with the following:

- descriptions of the affected environment, current operation, and potential impacts associated with the continued operation of SNL/NM;
- sufficient information to facilitate routine decisions by DOE regarding verification of operational status;
- a document that can be used for tiering (linking) NEPA analyses for future proposed actions, to eliminate repetitive discussions of similar issues and focus on the actual issues ready for decisions at each level of environmental review; and
- an understanding of SNL/NM's contribution to cumulative environmental impacts in the context of KAFB, other DOE activities at the site, and other activities in the Albuquerque area.

The last site-wide NEPA document for SNL/NM was prepared in 1977 (ERDA 1977). Since that time, site programs and activity levels have changed. Recently, the DOE has made programmatic decisions on the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996a), the Final Waste Management Programmatic Environmental Impact Statement (DOE 1997i), the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), and the *Nonnuclear Consolidation Environmental Assessment* (DOE/EA-0792) (DOE 1993c). Based on these changes and programmatic decisions, the DOE decided that a thorough environmental analysis was needed to describe impacts of ongoing SNL/NM operations.

1.5 DECISIONS TO BE SUPPORTED BY THE SWEIS

The SWEIS will be used to support DOE decisions on the levels of operations at SNL/NM, as well as serving as a basis for tiering future NEPA analyses and decisions regarding specific activities, as needed.

No sooner than 30 days after the final SWEIS is issued, the DOE will consider preparing a Record of Decision

(ROD). The ROD will contain the DOE's decisions on future operating levels for SNL/NM. In the ROD, the DOE will explain all factors, including environmental impacts, that the Department considered in reaching its decision and identify the environmentally preferable alternative or alternatives. The DOE may select one of the three alternatives or a combination of the alternatives analyzed in the SWEIS. If mitigation measures, monitoring, or other conditions are adopted as part of the DOE decision, these, too, will be summarized in the ROD.

1.6 PROJECTS UNDER CONSIDERATION

The following five projects are under consideration, but have not been included in this NEPA process because they are not ripe for decision-making. Separate NEPA review of each would be conducted before implementation of these projects.

- *X-1 Advanced Radiation Source*—an accelerator envisioned to generate X-ray outputs far greater than those that can be generated on the SNL/NM Z-machine or the ZX machine. The X-1 would enable a comprehensive range of weapon research activities, made possible by achievement of high fusion yield. Four potential alternate locations for this facility, including SNL/NM, were outlined in the Final PEIS for Stockpile Stewardship and Management. However, pre-conceptual design on this project is stopped at this time, and the DOE does not know whether it will propose to pursue the project.
- *ZX*—a concept for a ZX experimental facility is under discussion that would provide a new X-ray source for high-energy density R&D and weapon effects testing. This facility would entail modifications to facilities in Technical Area (TA)-IV. The ZX would provide an increase in SNL/NM capabilities for stockpile stewardship studies. In concept, this facility would use existing facilities and infrastructure in TA-IV, but would require an additional building to house the pulsed-power accelerator and experimental area. The ZX would produce a significant increase in soft X-ray energy output (up to 7 MJ) per shot. Target materials would be similar to those used or planned for the Z facility.
- *Annular Core Pulse Reactor-II*—a proposed reactor that would use the same fundamental design as the existing Annular Core Research Reactor (ACRR) facility. This reactor could be used for defense program-related testing using the uranium oxide-beryllium oxide fuel from the existing ACRR. This facility could be constructed in TA-V. A potential scenario for operation of such a reactor is analyzed under the Expanded Operations Alternative, but would require separate NEPA review if the DOE proposes pursuing the project.
- *ACRR-medical isotopes production privatization*—The DOE could decide to privatize its medical isotopes production in the future.
- *DOE-owned portion of a local research park*—86 ac of undeveloped DOE land adjacent to the Sandia Science and Technology Park may be developed in the future. The entire research park comprises approximately 200 ac, and various public and private entities are involved in the development activities. This project has not been analyzed in this SWEIS, but is described in Section 6.4.1.

1.7 PUBLIC PARTICIPATION

Public participation is integral to the preparation of the SWEIS. This section summarizes the issues and concerns that were identified during the public scoping process.

1.7.1 Scoping Process

Scoping is a process for determining the range of issues to be addressed in an environmental impact statement (EIS) and for identifying significant issues associated with the alternatives (40 Code of Federal Regulations §1501.7). The objectives of the scoping process are to notify interested persons, agencies, and other groups about the proposed action and the alternatives being considered; solicit comments about environmental issues, alternatives for the proposed action, and other items of interest; and consider those comments in the preparation of the SWEIS.

Scoping for the SWEIS consisted of both internal DOE scoping and external public scoping processes. The internal DOE scoping process began with working groups comprised of DOE managers and SNL/NM laboratory managers. The external scoping process period began after the publication of the NOI (62 FR 29332) on May 30, 1997, and continued until July 14, 1997. The purpose of the NOI was to notify the public that the DOE was intending to prepare a SWEIS on SNL/NM operations and invite other Federal agencies, Native American tribes, state and local governments, and the general public to participate in the scoping process. The NOI also presented background information on

SNL/NM and preliminary alternatives and issues identified through the internal scoping process.

Two scoping meetings for the SWEIS were held for the general public on June 23, 1997, at the University of New Mexico Continuing Education Center in Albuquerque, New Mexico. At these meetings, the DOE presented information on its proposal to prepare the SWEIS and the alternatives that were to be analyzed. The public was invited to present oral and/or written comments at the scoping meetings or by telephone by way of a toll-free number. Written comments could also be submitted by mail, facsimile, or electronic mail.

1.7.2 Summary of Scoping Issues and Concerns

During the public scoping process, 29 individuals and organizations either submitted requests for information or made oral or written comments. These comments, summarized in Table 1.7–1, were sorted based on the organization of the SWEIS. All of these comments have been reviewed and considered at various stages during the preparation of the SWEIS. Many are explicitly addressed in the pertinent sections of the first seven chapters of the SWEIS.

1.8 RELATED NEPA DOCUMENTS

The following NEPA documents analyzed ongoing programs and activities at SNL/NM:

- Final *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS 0236-F) (DOE 1996a).
- Final *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE/EIS-0200-F) (DOE 1997i).
- *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE/EIS-0249-F) (DOE 1996b).
- *Nonnuclear Consolidation Environmental Assessment* (DOE/EA-0792) (DOE 1993c).
- *Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* (DOE/EA-1140) (DOE 1996c).
- Final *Rapid Reactivation Project Environmental Assessment* (DOE/EA-1264) (DOE 1999a).
- *Environmental Assessment of the Radioactive and Mixed Waste Management Facility* (DOE/EA-0466) (DOE 1993a).
- *Environmental Assessment for Operations, Upgrades, and Modifications in SNL/NM Technical Area-IV* (DOE/EA-1153) (DOE 1996g).
- *Environmental Assessment for the Processing and Environmental Technology Laboratory (PETL)* (DOE/EA-0945) (DOE 1995d).
- *Neutron Generator/Switch Tube Prototyping Relocation Environmental Assessment* (DOE/EA-0879) (DOE 1994a).

1.8.1 *Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (DOE/EIS-0236-F)

The DOE prepared the Stockpile Stewardship and Management (SSM) Programmatic Environmental Impact Statement (PEIS) and evaluated stockpile stewardship activities required to maintain a high level of confidence in the safety, reliability, and performance of nuclear weapons in the absence of underground testing and to be prepared to test weapons if directed by the President (DOE 1996a). Stockpile management activities include maintenance, evaluation, repair, or replacement of weapons in existing stockpiles.

The SSM PEIS examined the existing basic capabilities of the DOE laboratory and industrial complex, including SNL. The ROD for the PEIS determined SNL would continue as one of three weapons laboratories possessing most of the core intellectual and technical competencies of the U.S. in nuclear weapons.

1.8.2 Final *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE/EIS-0200-F)

In the Waste Management Programmatic Environmental Impact Statement (WM PEIS), the DOE evaluated the environmental impacts of alternatives for managing five types of radioactive and/or hazardous waste generated by defense and research activities at a variety of DOE sites around the U.S. SNL/NM manages four of the five waste types: low-level waste (LLW), low-level mixed waste (LLMW), transuranic (TRU) waste, and hazardous waste. The DOE decided on January 23, 1998, that

Table 1.7–1. Summary Public Scoping Comments

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
General	Discuss the effects of Sandia National Laboratories/New Mexico (SNL/NM) on the environment.
	Examine current and future energy requirements and conservation potential.
	What are your proposed activities now and 10 years from now?
Alternatives	Return all or part of the withdrawn U.S. Forest Service lands to public use.
	Consider zero production.
	Evaluate neutron generator production if manufactured at a higher level than indicated in the Nonnuclear Consolidation Environmental Assessment (EA).
	Consider reduced operations.
	Consider relocating and/or outsourcing of some current activities.
	Consider closure of SNL/NM.
	Continue some operations and increase/decrease others.
	Concern was expressed about the DOE s objectivity in defining minimum operations.
	Expand renewable energy, energy efficiency, and waste management research facilities.
	Dedicate vast unused lands owned by SNL as an Environmental Research Park.
	Expand some activities by making them available to other Federal agencies and move other activities that are underutilized to some other location.
	Broaden scope to anticipate research and development of new technologies to ensure leading-edge competency at SNL.
Land Use	Give full consideration of the use and impacts to U.S. Forest Service land.
	Consider impacts from testing/operations on land use, including tribal lands.
Geology	The potential for seismic activity along earthquake faults in the Manzanos makes the Manzano facility unsuited for nuclear storage.
Water Resources	Discuss water use, conservation, and cleanup.
	Consider the effects of testing on water in the East Mountain area.
	SNL should expand its research on wastewater treatment and water reuse technologies.
	Studies must include effects of an accident on groundwater quality.
	What impact will waste discharges to groundwater have on Isleta, and what impact will current and future surface water discharge have on the Rio Grande?
	Determine the extent of groundwater contamination.
	Is there a groundwater monitoring program in place?

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Water Resources (continued)	What is the current and future water use, and what is its impact on the Albuquerque Basin?
	How many acre feet of water rights do you currently have? Do you anticipate purchasing more in the future?
	Provide data on the present number of wells, including depth, water quantity, and water quality. Will more wells be needed?
	Is surface water currently used, including from the Rio Grande? Will it be used in the future?
	Is there any surface water contamination?
	Is there a surface water monitoring program in place?
	Consider implication of traffic associated with Sandia and Kirtland Air Force Base (KAFB) on water resources.
Biological Resources	Consider impacts on migratory birds such as the burrowing owl and gray vireo.
	Evaluate any research involving the capture and rendering of animals on KAFB for chemical or other analysis.
	What are the types of wildlife on your lands and how will they be impacted by future activities? If they migrate, where would they go?
	Have there been any tissue studies performed on any of the wildlife to determine if they have chemical concentrations that might be harmful to humans?
Cultural and Religious	Consider impacts to Native American archaeological sites and artifacts.
	Evaluate how impacts to cultural resources and properties, which may be historically significant, will be minimized.
	Full consideration must be given to Native American cultural and religious sites.
	Address cumulative impacts to traditional cultural properties.
	Consideration should be given to loss of access for Pueblo of Isleta to traditional cultural properties.
	A full ethnographic survey of impacted lands should be conducted.
Air Quality	Air quality must be addressed openly, otherwise public suspicion is fostered.
	Impacts of the open burn facility on the adjacent public use areas and the East Mountain area, including black smoke and forest fires, must be considered.
	Air conformity issues related to onsite transportation must be considered.
	Air conformity issues related to offsite transportation must be considered.
	Consider the cumulative impacts to Pueblo of Isleta due to discharges of hazardous air pollutants, including radionuclides.

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Air Quality (continued)	How many air pollutants are currently emitted and how will they be increased if activities are expanded?
Health and Safety	Could there be an increased incidence of thyroid cancer in the nearby community due to operation on KAFB?
	Have SNL/NM operations increased the incidence of child deformities?
	What is the current physical condition of the laboratories?
	How does the current condition of these laboratories compare with industry standards?
	What kind of environmental risk is posed by operating laboratories in their current physical condition?
	Are there criteria to ensure that a lab operation is appropriate to the condition of the lab?
	Is there a real option for a researcher or lab manager to stop work in a lab because it is unsafe?
	How has the maintenance or replacement budget for the individual labs fared and what is its future?
	The integrity of radioactive waste storage areas has to be examined to prevent environmental health hazards.
	Risks to surrounding neighborhoods in the case of an accident need to be studied.
	Cleanup standards for U.S. Forest Service land must consider ecological risks, not just the industrial human health cleanup standard.
	What types and quantities of nuclear materials and chemicals are used at SNL/NM?
	Does SNL/NM have an emergency response plan in place in the event of an emergency, and is the lab prepared for an evacuation if necessary?
	Are employees trained to handle a nuclear and/or chemical emergency?
	What are the potential public and worker exposures to radiological and/or hazardous materials?
Transportation	How can SNL/NM assist in developing more efficient, less intrusive transportation corridors?
	In what ways can SNL/NM assist in implementing a Southeast Corridor bypass?
	Discuss the effects of onsite transportation of radioactive and hazardous materials and wastes on the site workforce and the general public.
	Discuss impacts related to offsite transportation of radioactive and hazardous materials and wastes.
	Address the impact of SNL operations in relation to city and county policies regarding transportation planning.
	Is it in the best interest of the community to transport mixed waste to SNL/NM for treatment?

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Transportation (continued)	Will nuclear materials and chemicals be transported via Interstate 25 and the railroad?
Noise	Concerns were expressed about noise from explosions that can be felt and cause structural damage.
Socioeconomics	How can SNL/NM assist local communities in improving housing and services in the neighboring areas?
	Consider more employment opportunities for people whose lives and legacies are invested in New Mexico.
	Recognize the East Mountain area as an impacted community from SNL/NM activities.
	SNL/NM has had beneficial socioeconomic impacts on the Albuquerque area including contributions to the economy, establishment of businesses, as well as research, development, and technical support.
	Consider the economic effects of SNL/NM on the surrounding community and Isleta Pueblo.
	Address the impact of SNL operations in relation to city and county policies regarding growth management.
	How many Native Americans are employed at the laboratories?
Environmental Justice	Consider offsite transportation impacts to any disadvantaged groups.
	Consider impacts to disadvantaged populations or Native American interests.
Analysis of Impacts	Analyze direct impacts, as well as cumulative impacts.
	Consider impacts to U.S. Department of Energy (DOE) facilities not located in Technical Areas-I, -II, -III, -IV, and -V and Coyote Canyon.
	Consider the contribution of the Corrective Action Management Unit (CAMU) when evaluating cumulative impacts.
	To properly evaluate cumulative impacts, analyze remaining activities (other than CAMU) of the Environmental Restoration Project.
	Document all environmental impacts, as well as cumulative impacts, of SNL, KAFB, and associated facilities using Federal government lands, including U.S. Forest Service lands.
	The Site-Wide Environmental Impact Statement (SWEIS) cannot depend on the analyses in the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (PEIS) and the Waste Management PEIS.
	Consider cumulative impacts to Pueblo of Isleta lands.
Environmental Restoration/Waste and Waste Management	Confirm the existence of unexploded ordinance previously reported by the U.S. Department of Defense (DoD).
	How has waste handling been improved?
	What is being done to detect hazardous plastic hardeners that have been buried near the Manzano facility?

Table 1.7–1. Summary Public Scoping Comments (continued)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Environmental Restoration/Waste and Waste Management (continued)	The DOE needs to include thorough studies of potential cleanup sites and develop implementation strategies for cleanup of waste storage facilities.
	Studies must include effects of contamination on soils.
	If Mesa del Sol is contaminated from any SNL/NM sources, SNL/NM has a duty to clean it up.
	When considering returning U.S. Forest Service land to public access, the necessary decontamination and decommissioning must be carried out.
	Concerns relating to the Medical Isotope Production project need to be addressed including the life of the project, where and how spent fuel rods will be stored, how many spent fuel rods will be generated, has the disposal cost been considered, and which DOE program would pay for it.
	Consider impacts to Isleta property from soil contamination due to waste discharges.
	Consider heavy metal and depleted uranium contamination from overshot and explosives debris.
	What are current waste management practices, and are hazardous materials currently stored or disposed of onsite?
Regulatory Compliance	Consider SNL/NM s and KAFB s compliance with environmental laws, including the *Clean Air Act* and *Clean Water Act*.
	A study of Native American traditional cultural properties on KAFB and the U.S. Forest Service withdrawn land must consider not only the *National Historic Preservation Act*, but also the relevant aspects of the *American Indian Religious Freedoms Act*.
Public Involvement	Make technical data more available, including by computer access.
	Public involvement and input must be considered.
	There should be total public disclosure of activities.
	Information should be disseminated to the local Hispanic community and be available in Spanish.
	Copies of *National Environmental Policy Act* (NEPA) documents and supporting analyses should be available to the public for independent review.
	All comments, DOE responses, and other documents should be available on the Internet.
	Will there be public participation meetings?
	A work plan or some other similar document should be made available for public comment by the Fall of 1997 that would identify schedules, alternatives, facilities to be analyzed, contractors preparing the SWEIS, roles of other Federal agencies, and other NEPA documents the DOE intends to prepare during preparation of the SWEIS.
	The DOE should actively cooperate with and involve the Pueblo of Isleta in the preparation of the draft SWEIS.

Table 1.7–1. Summary Public Scoping Comments (concluded)

COMMENT CATEGORY/ RESOURCE AREA	COMMENT
Public Involvement (continued)	The DOE should provide for ongoing public input during the SWEIS process and keep the public informed on SWEIS progress.
	The Open House format of the June 23, 1997, public meeting permitted good communication and should be continued.
	The DOE should demonstrate during the NEPA process a respectful, continuing government-to-government relationship with the Pueblo of Isleta.
Mission, Policy and Management	Technology transfer between SNL/NM and Bernalillo county and local governments should continue to be encouraged.
	SNL/NM should stop open burn tests and any and all reclamation of plutonium pits from warheads.
	The DOE should set time limits for each constituent part of the SWEIS with the total time not to exceed 15 months.
	SNL/NM is a good place to work.
	Concern was expressed over ethics of experiments such as human radiation experiments on people living around SNL/NM.
	The DOE should reassign SNL/NM s mission statement and make it concentrate on energy and material efficiency, renewable resource research, waste management and recycling, and development of biodegradable and reusable materials.
	SNL/NM should make a commitment to engage in an arms control program, work on weapons disarmament, and seek improvements to the recent test-ban agreement.
	The SWEIS should be extended to cover business incubator activities.
	In the event of a war, would SNL/NM be a target?
Document Preparation	It should be explained in the SWEIS how the DOE will ensure that all proposed actions will receive the appropriate level of NEPA review after the document is completed.
	A description of how the DOE intends to condition funding for mitigation, if proposed, and a progress report on mitigation should be included in the SWEIS or a mitigation action plan.
	The many other project-specific NEPA documents that SNL/NM has prepared, other than the two called out in the Notice of Intent, should be considered.
	Any relationship between SNL/NM and contractors selected to prepare the SWEIS should be described in the disclosure statement.
	A classified appendix is not warranted.

Source: HNUS 1997

SNL/NM TRU waste would be sent to Los Alamos National Laboratory for storage pending disposal (63 FR 3629), and on August 5, 1998, that SNL/NM would continue to ship its hazardous waste offsite for treatment (DOE 1998m). The DOE has not yet decided on a national strategy for treatment and disposal of LLW and LLMW; but under the preferred alternatives for both waste types, SNL/NM would treat its own waste onsite, then ship it offsite for disposal.

1.8.3 *Medical Isotopes Production Project Environmental Impact Statement* (DOE/EIS-0249-F)

The DOE prepared the Medical Isotopes Production Project (MIPP) Environmental Impact Statement (EIS) and evaluated the domestic production of molybdenum-99 and related medical isotopes (DOE 1996b). The MIPP EIS's five alternatives regarding the production of a reliable domestic supply of molybdenum-99 included a baseline production level of 10 to 30 percent of the current U.S. demand and the capability to increase production to supply 100 percent of the U.S. demand.

The MIPP EIS evaluated the ACRR capabilities, target fabrication, target processing at the Hot Cell Facility, and waste management capabilities at SNL/NM. The ROD for the MIPP EIS determined SNL/NM would become a domestic producer and supplier of molybdenum-99 (61 FR 48921).

1.8.4 *Nonnuclear Consolidation Environmental Assessment* (DOE/EA-0792)

The DOE prepared the *Nonnuclear Consolidation Environmental Assessment* (EA) and evaluated the consolidation of nonnuclear component manufacturing, storage, and surveillance functions (DOE 1993c). The EA discussed six categories of capabilities: electrical/mechanical; tritium handling; detonation; beryllium technology and pit support; neutron generators, cap assemblies, and batteries; and special products.

The Finding of No Significant Impact for the EA determined the significance of impacts for the continuation of SNL/NM's existing research, development, testing, and prototyping capability, which would be augmented to provide the necessary fabrication capability for future neutron generators, cap assemblies, and other nonnuclear components (DOE 1993c).

1.8.5 *Environmental Assessment of the Environmental Restoration Project at SNL/NM* (DOE/EA-1140)

The DOE prepared the Environmental Restoration (ER) Project EA and Finding of No Significant Impact (FONSI). The EA evaluated the environmental impacts of site restoration characterization and waste cleanup activities (corrective actions) at SNL/NM (DOE 1996c). The corrective actions included a range of waste treatment options at a currently estimated 182 ER Project sites. The corrective measures implement treatment technologies that are reasonable, feasible, and capable of being implemented to achieve regulatory compliance.

1.8.6 *Rapid Reactivation Project Environmental Assessment* (DOE/EA-1264)

The Rapid Reactivation Project EA analyzed alternatives for continued neutron generator production. The DOE's FONSI covers the proposed alternative that increases the annual neutron generator production capacity from its current level of 600 to 2,000. Existing buildings and infrastructure would be used to the maximum extent possible to meet the additional production needs. The addition of approximately 26,290 gross square feet of facility space and other facility modifications would be necessary to achieve the proposed production capacity.

1.8.7 *Environmental Assessment of the Radioactive and Mixed Waste Management Facility* (DOE/EA-0466)

The DOE prepared the Radioactive and Mixed Waste Management Facility EA and FONSI for the proposed completion of construction and subsequent operation of the RMWMF in TA-III. The RMWMF was designed to receive, store, characterize, conduct limited bench-scale treatment of, repackage, and certify LLW and LLMW for shipment to an offsite disposal or treatment facility.

1.8.8 *Environmental Assessment for Operations, Upgrades, and Modifications in SNL/NM Technical Area-IV* (DOE/EA-1153)

The EA for Operations, Upgrades, and Modifications in SNL/NM Technical Area-IV and FONSI were prepared by the DOE for continuing existing operations, modifying an existing accelerator (Particle Beam Fusion Accelerator II) to support defense-related Z-pinch experiments, and constructing two transformer oil storage tanks to support the expansion of the Advanced Pulsed Power Research Module.

1.8.9 *Environmental Assessment for the Processing and Environmental Technology Laboratory (PETL)* (DOE/EA-0945)

In the EA for the PETL at SNL/NM, the DOE analyzed alternatives for the building and operation of the PETL. The DOE proposed constructing the PETL on KAFB and relocating operations from existing facilities to the new building in TA-I. The DOE issued a FONSI associated with the proposed alternative.

1.8.10 *Neutron Generator/Switch Tube Prototyping Relocation Environmental Assessment* (DOE/EA-0879)

The Neutron Generator/Switch Tube Prototyping Relocation EA analyzed two alternatives for expanded prototyping of neutron tubes, neutron generators, and switch tubes. The DOE's proposed action would relocate neutron tube, neutron generator, and switch tube prototyping operations from Buildings 891 and 878 to a Building 870 annex. A prototyping capability for electronic neutron generators would be established in Building 878. The DOE prepared a FONSI for this action.

1.9 COOPERATING AGENCIES

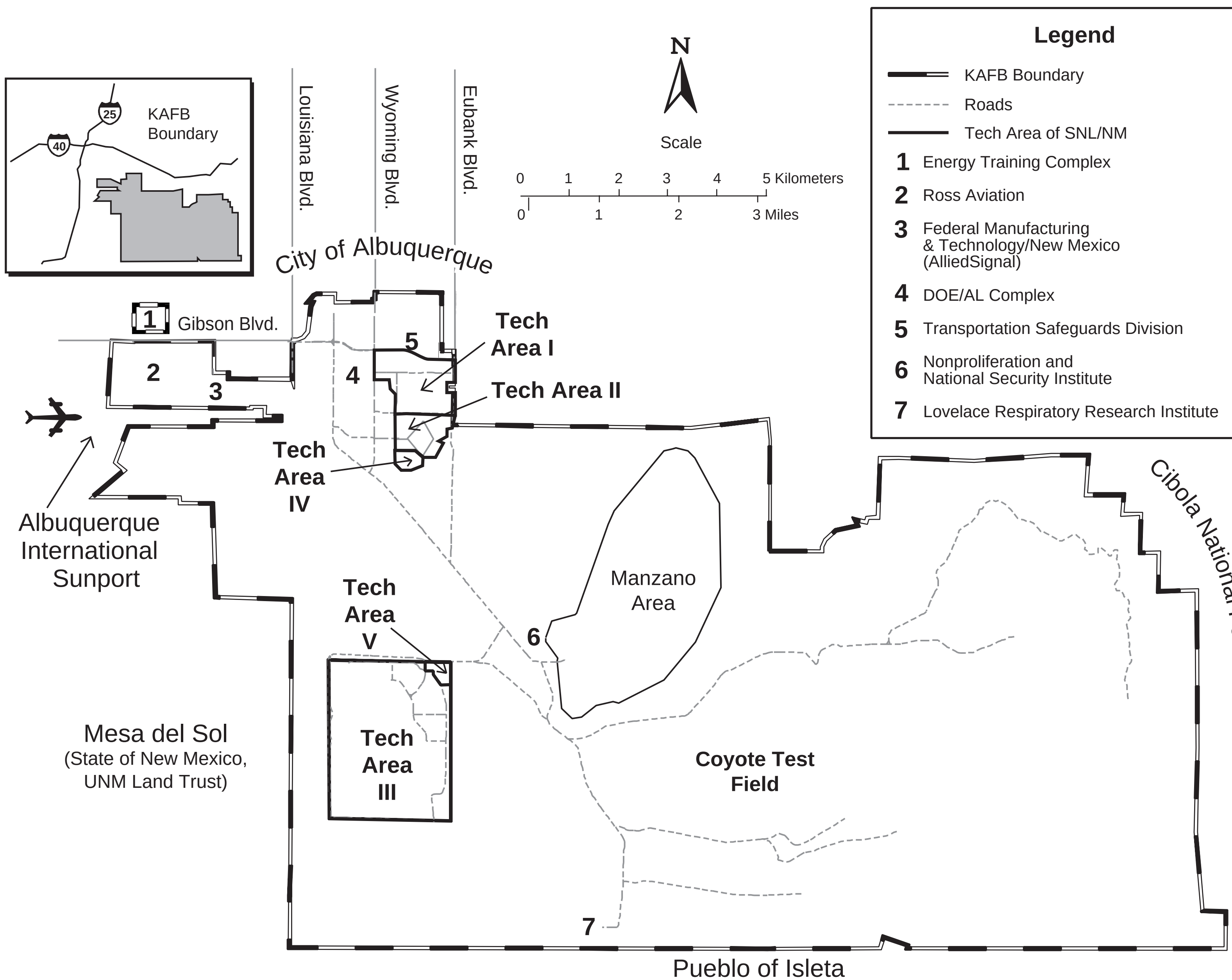
On May 30, 1997, the NOI announced the USAF as a cooperating agency because of the interdependence of KAFB and the DOE planning for SNL/NM. The USAF has participated in planning meetings, developing analytical methodologies and data projections, and reviewing analyses for and predecisional drafts of the SWEIS.

1.10 OTHER DOE OPERATIONS AT KAFB

In addition to SNL/NM, the following DOE-funded facilities are located on KAFB. The impacts from these facilities are not analyzed in Chapter 5 because they are not under the management of SNL. They are analyzed as part of cumulative effects in Chapter 6.

- The Lovelace Respiratory Research Institute, formerly the Inhalation Toxicology Research Institute, is a private business that leases space from the DOE. The Institute began operations in the 1960s as a research team for determining the long-term health impacts of inhaling radioactive particles. It has since become a recognized center for inhalation toxicology and related fields.
- The Nonproliferation and National Security Institute ensures the efficient and effective training of Safeguards and Security Division personnel from throughout the DOE who are, or might become, involved in the protection of materials and facilities vital to the nation's defense.
- The Transportation Safeguards Division (TSD) coordinates, implements, and operates the DOE Safeguards Program that transports special nuclear materials (SNM). The TSD coordinates and plans weapons distribution with the DoD and coordinates SNM shipments for all DOE field offices.
- Federal Manufacturing & Technology/ New Mexico, a division of AlliedSignal, is an applied science and engineering organization engaged in research, analysis, testing, and field operations. A major portion of this work is in the design, fabrication, and testing of electro-optic and recording systems for capturing fast transient signals.
- Ross Aviation is the DOE's support contractor providing air cargo and passenger service. Ross transports cargo between production plants, national laboratories, test sites, and military facilities and provides special passenger and cargo flights on request.
- The DOE's Albuquerque Operations Office complex houses DOE and contractor staff.
- The Energy Training Complex consists of classrooms for DOE training.

Figure 1.10–1 shows the approximate locations of these facilities. The above operations, along with KAFB activities, are discussed in more detail in Chapter 6.



Source: SNL/NM 1997j

Figure 1.10–1. Seven Additional DOE Facilities at KAFB

Other DOE-funded operations not related to SNL/NM are located within the boundaries of KAFB.

This page was intentionally left blank.

CHAPTER 2

Sandia National Laboratories/New Mexico Operations

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

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

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

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

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

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

2.1 SNL/NM SUPPORT FOR DOE MISSION LINES

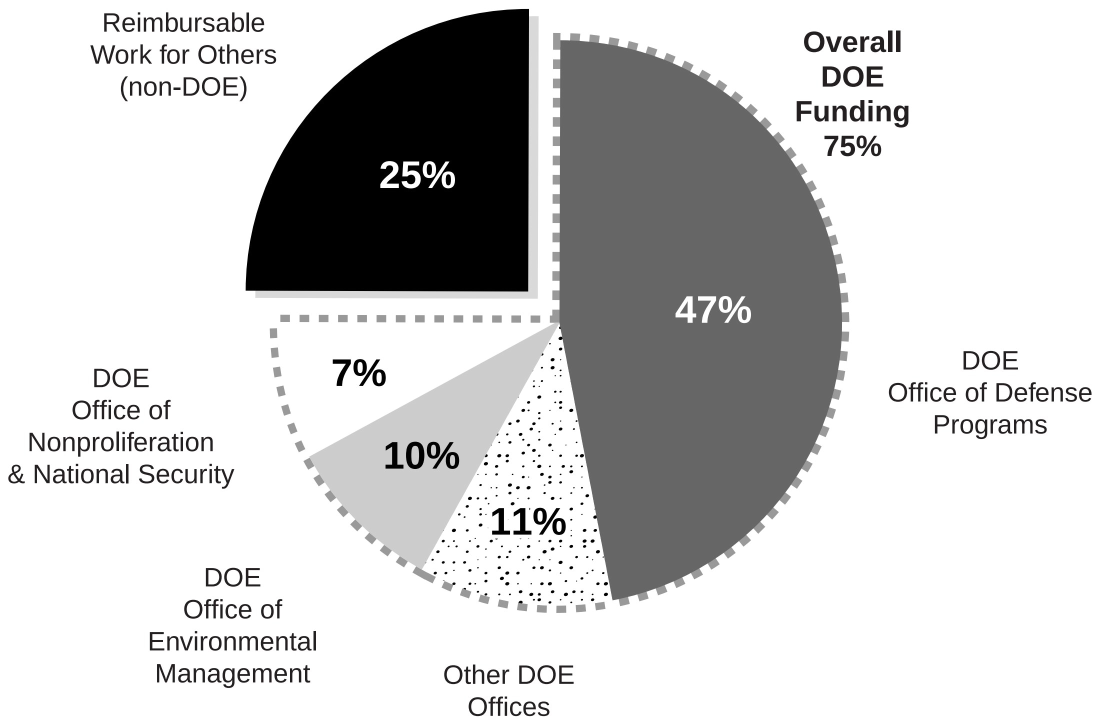
As discussed in Chapter 1, the DOE is responsible for ensuring the safety, reliability, and effectiveness of the nation's nuclear deterrent; fostering a secure and reliable energy system that is environmentally and economically sustainable; reducing the environment, safety, and health risks and impacts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

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

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

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

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



Source: SNL/NM 1997i

Figure 2.1–1. SNL Funding Sources by Major Program

SNL funding is provided by a variety of major programs.

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

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

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

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

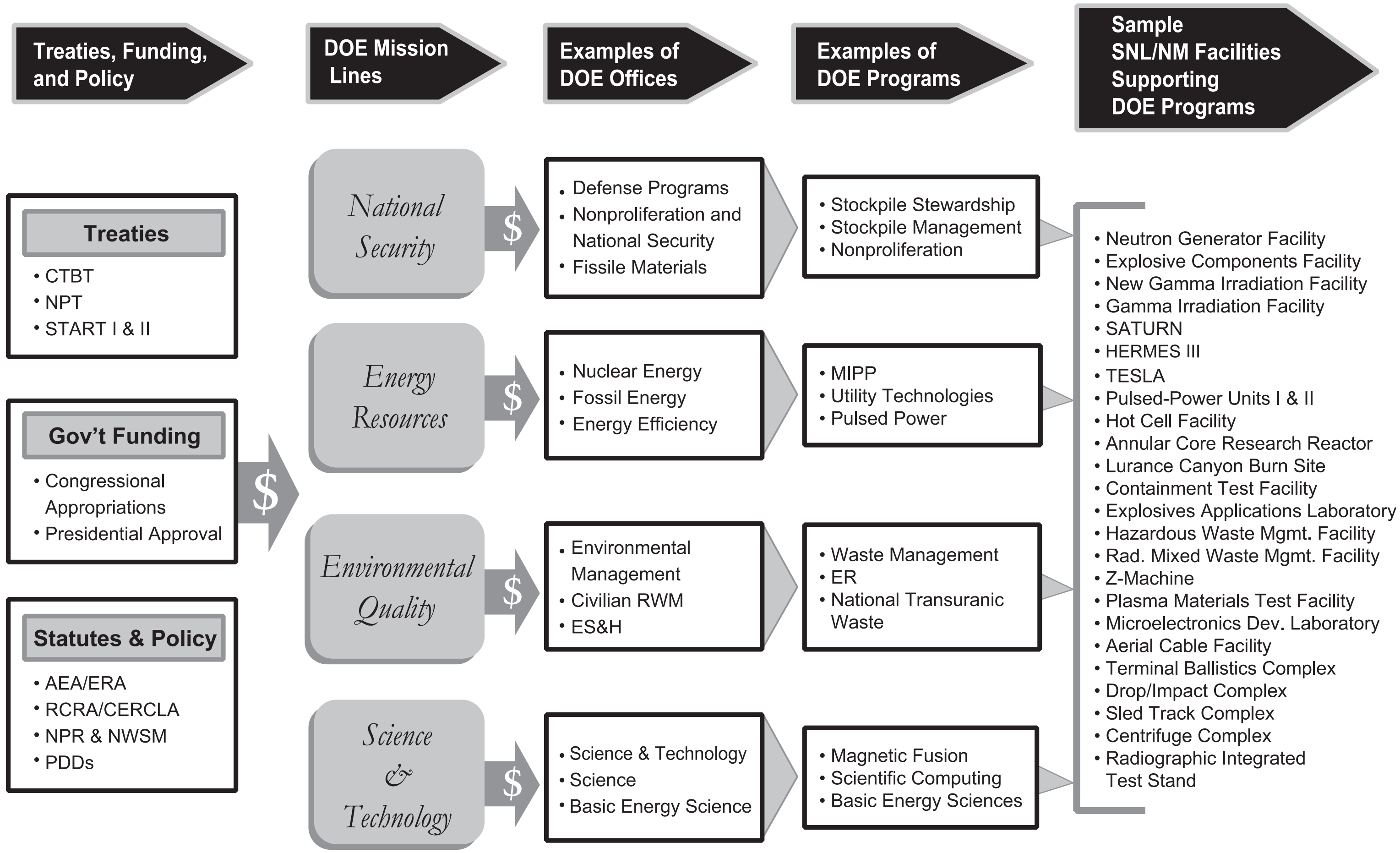
SNL/NM's principal DOE assignments under this mission line focus on the nuclear stockpile and reducing the vulnerability of a reduced stockpile; managing nonnuclear components of every weapon in the U.S. nuclear weapons stockpile; and reducing the vulnerability of the U.S. to threats of proliferation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

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

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

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

SNL/NM supports DOE assignments under this mission line to enhance the safety, security, and reliability of energy, focusing on implications for our nation's security related to the increasing interdependencies among domestic elements and global resources. SNL/NM helps develop strategies to protect the supply of the nation's energy resources. SNL/NM applies science and technology capabilities to develop various technologies. Following are the major DOE programs under this mission line:



AEA - *Atomic Energy Act*
CTBT - Comprehensive Test Ban Treaty
CERCLA - *Comprehensive Environmental Response, Compensation & Liability Act*
ES&H - Environment, Safety, and Health
ERA - *Energy Reorganization Act*
ER - Environmental Restoration
HERMES - High Energy Radiation Megavolt Electron Source
MIPP - Medical Isotopes Production Project
NPR - Nuclear Posture Review
NPT - Nuclear Nonproliferation Treaty
NWSM - Nuclear Weapons Stockpile Memorandum
PDDs - Presidential Decision Directives
RCRA - *Resource Conservation and Recovery Act*
RWM - Radioactive Waste Management
START - Strategic Arms Reduction Treaty
TESLA - Tera-Electron Volt Energy Semiconducting Linear Accelerator

Source: Original

Figure 2.1–2. Flow of DOE Funding by Mission Line to SNL/NM
The DOE's funding flows through various DOE offices to SNL/NM.

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

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

Source: DOE 1997c

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

Of the previously mentioned R&D projects in 1997, about 16 percent had applications that were energy resource-related.

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

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

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

Of the previously mentioned R&D projects in 1997, about 24 percent had applications that were environmental quality-related.

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

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

- *Magnetic Fusion*—R&D activities involving studying materials, components, and development processes.
- *Scientific Computing*—Advanced mathematical modeling, computational R&D, communication sciences, and information technologies.
- *Basic Energy Sciences*—R&D in material sciences, chemical sciences, energy biosciences, and engineering.

Of the previously mentioned R&D projects in 1997, about 15 percent had applications that were science and technology-related.

2.2 REIMBURSABLE WORK FOR OTHERS

SNL/NM performs reimbursable work for other Federal agencies and sponsors, including the private sector. This work, also known as work for others (WFO), must be compatible with the DOE mission work conducted at SNL/NM and must be work that cannot reasonably be performed by the public sector. Approximately 25 percent of SNL's funding is reimbursable work for agencies and organizations other than the DOE (Figure 2.1–1). SNL/NM activities support other Federal departments and agencies. The major agencies include the U.S. Department of Defense, U.S. Nuclear Regulatory Commission, U.S. Department of Transportation (DOT), National Aeronautics and Space Administration, Department of State, and U.S. Environmental Protection Agency (EPA). Details regarding WFO support activities and projects are provided in SNL/NM's *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b), and the *SNL Institutional Plan FY 1998-2003* (SNL 1997b).

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

2.3 SNL/NM FACILITIES: A FRAMEWORK FOR IMPACTS ANALYSIS

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

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

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

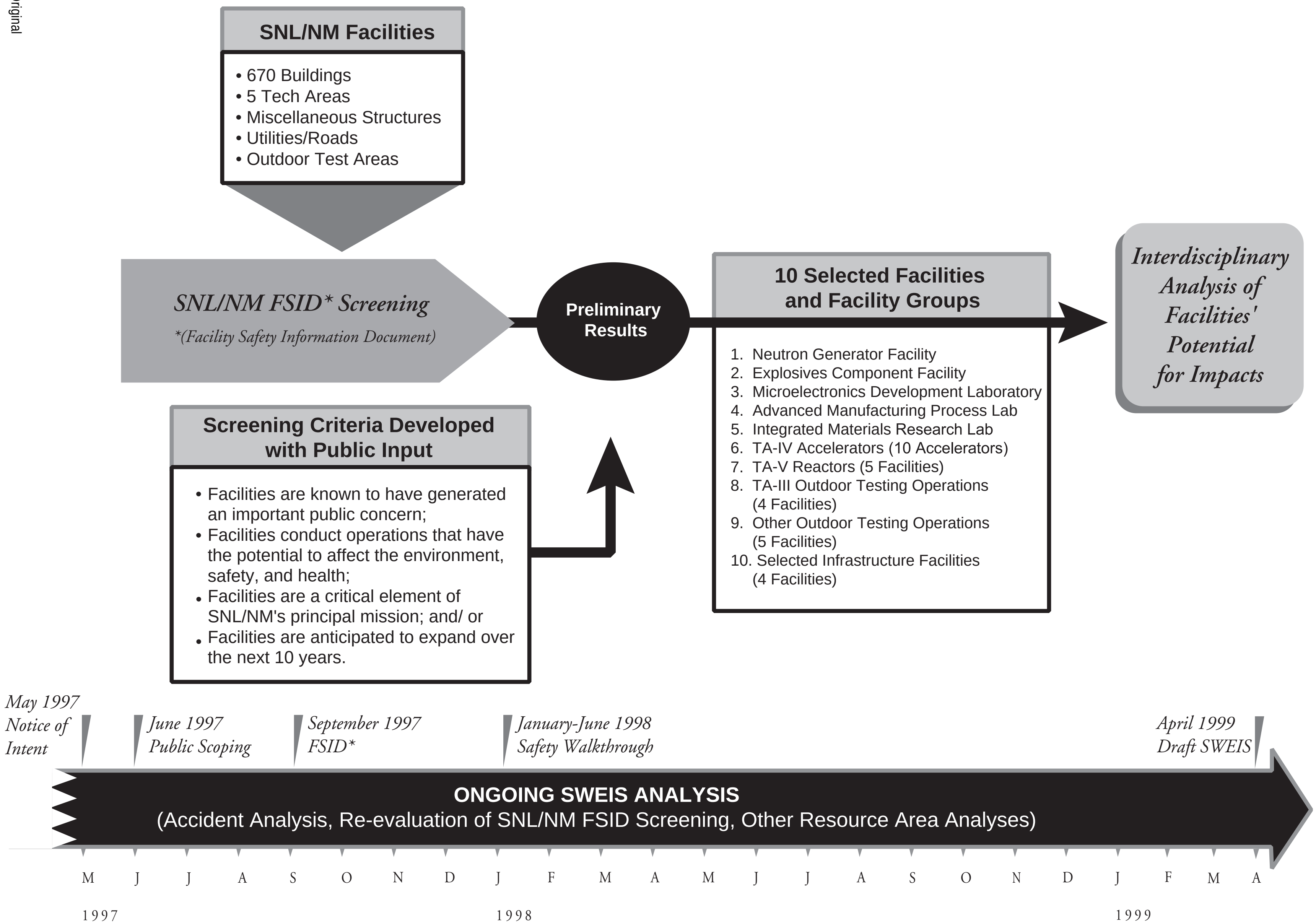
The operations within these facilities or facility groups are the basis for differentiating between the three alternatives analyzed in the SWEIS and any associated environmental impacts. Taken together, these facilities and facility groups represent the majority of exposure risks associated with continuing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

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

2.3.1 Facility Screening Process

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

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



Source: Original

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

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

2.3.2 Framework for Analysis

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

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

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

2.3.3 Technical Areas

DOE mission lines are executed at SNL/NM through program funding at multiple facilities. Facility operations are conducted within five TAs and many additional outdoor test areas, including an area of test facilities known as the Coyote Test Field. These TAs comprise the basic geographic configuration of SNL/NM. Figure 2.3–2 illustrates the five TAs. TA-I is the main administration and site support area and also contains several laboratories. TA-II consists primarily of support service facilities along with the new Explosive Components Facility (ECF), several active and inactive waste management facilities, and vacated facilities replaced by the ECF. TA-III is devoted primarily to physical testing, TA-IV is primarily accelerator operations, and TA-V is primarily reactor facilities. The Coyote Test Field and the Withdrawn Area are used primarily for outdoor testing. A complete listing of all the facilities in each TA is presented in the FSID (SNL/NM 1997b).

2.3.4 Selected SWEIS Facilities

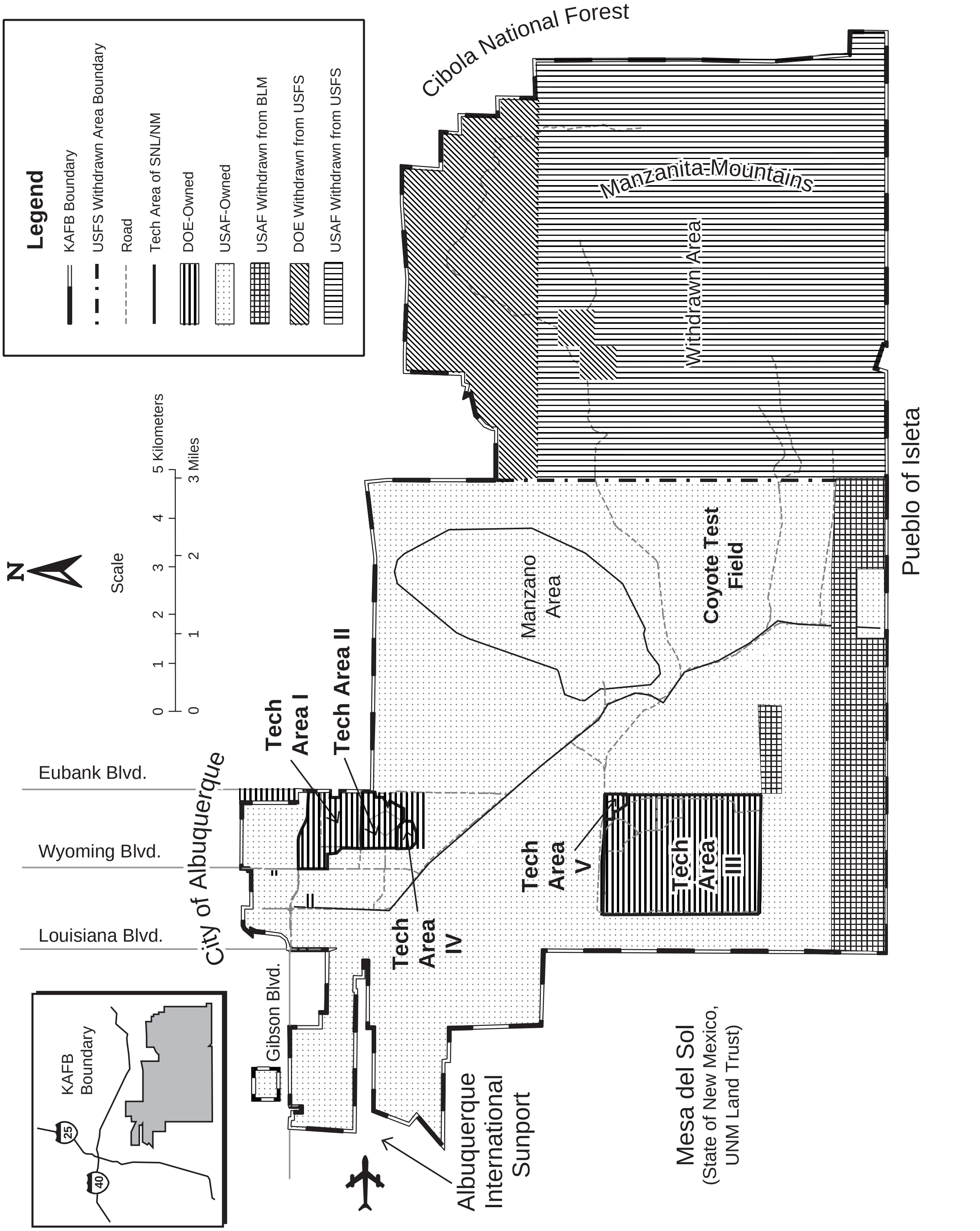
Table 2.3–1 identifies the 10 facilities or facility groups selected for in-depth analysis. Taken together, these facilities represent the main activities at SNL/NM that have the potential to affect the environment, have generated public concern, are critical to SNL/NM's missions, or are anticipated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

- physical testing and simulation facilities (TA-III) (Section 2.3.4.2),
- accelerator facilities (TA-IV) (Section 2.3.4.3),
- reactor facilities (TA-V) (Section 2.3.4.4),

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

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

Source: SNL/NM 1997b
TA: technical area



Source: SNL/NM 1997j

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

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

- outdoor test facilities (including Coyote Test Field and the Withdrawn Area) (Section 2.3.4.5), and
- selected infrastructure facilities (Section 2.3.4.6).

2.3.4.1 Manufacturing, R&D Laboratories, and Testing Facilities

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

- *Neutron Generator Facility (NGF)*—Manufactures neutron generators, which provide a controlled source of neutrons.
- *Microelectronics Development Laboratory (MDL)*—Performs R&D and fabricates custom and radiation-hardened microelectronics.
- *Advanced Manufacturing Processes Laboratory (AMPL)*—Performs R&D of technologies, practices, and unique equipment and fabricates prototype hardware for advanced manufacturing processes.
- *Integrated Materials Research Laboratory (IMRL)*—Performs R&D of semiconducting and other specialized materials, including silicon processing and equipment development and materials synthesis, growth, processing, and diagnostics.
- *Explosive Components Facility (ECF)*—Performs R&D and testing of explosives components, neutron generators, batteries, and explosives.

2.3.4.2 Physical Testing and Simulation Facilities

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

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

2.3.4.3 Accelerator Facilities

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

- *SATURN Accelerator*—Simulates the radiation effects of nuclear countermeasures on electronic and material components.
- *High-Energy Radiation Megavolt Electron Source III (HERMES III) Accelerator*—Provides gamma-ray effects testing for component and weapon systems development, which helps ensure operational reliability of weapon systems in radiation environments caused by nuclear explosions.
- *Sandia Accelerator & Beam Research Experiment (SABRE)*—Supports the inertial confinement fusion program for advanced extraction ion diode research and for target and focusing studies.
- *Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) Accelerator*—Measures X-ray-induced photocurrents from short pulses in integrated circuits and thermostructural response in materials.
- *Repetitive High Energy Pulsed-Power Unit I (RHEPP I) Accelerator*—Supports the development of technology for continuous operation of pulsed-power systems.
- *Repetitive High Energy Pulsed-Power Unit II (RHEPP II) Accelerator*—Supports the development of technology for continuous operation of pulsed-power systems for very high power outputs.
- *Z-Machine Accelerator (formerly the Particle Beam Fusion Accelerator)*—Generates high intensity light-ion beams for the inertial confinement fusion program and the high energy/density weapons physics program for stockpile stewardship.

Accelerators

Accelerators are devices that accelerate (speed up) the movement of atomic-sized particles such as electrons, protons, and ions. Examples of these devices range from huge cyclotrons to television sets. The accelerators in TA-IV use pulsed-power technology and are called pulsed-power accelerators. Accelerators can produce radiation by accelerating protons that strike target atoms, thereby producing radioisotopes.

Pulsed-power accelerators are single-shot devices that accelerate large numbers of particles (energy) in a very short period. These accelerators are considered high power. The HERMES III accelerator, for example, can generate a 350-kJ pulse of electrons in 20 nsec, or 17 TW ($17x10^{12}$ W) of power. However, because of the low shot rate of these machines (sometimes only one per day), the average power generated is typically very low. One of the areas of research being conducted in TA-IV is to increase the shot rate, or repetition rate, of these accelerators for applications that require high average power.

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

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

- *Tera-Electron Volt Energy Superconductior Linear Accelerator (TESLA)*—Tests plasma opening switches for pulsed-power drivers.
- *Advanced Pulsed-Power Research Module Accelerator (APPRM)*—Tests the performance and reliability of components for use in a much larger accelerator still in the conceptual stage.
- *Radiographic Integrated Test Stand (RITS) Accelerator*—Simulates nuclear weapons effects on nonnuclear components and subsystems.

2.3.4.4 Reactor Facilities

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

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

2.3.4.5 Outdoor Test Facilities

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

- *Containment Technology Test Facility - West*—Provides nuclear power reactor containment model testing.
- *Explosives Applications Laboratory (EAL)*—Supports the design, assembly, and testing of explosive experiments in support of site-wide programs.

Reactors

Typically, reactors are devices that provide neutron and sustained gamma-pulsed environments. The reactors in TA-V conduct a variety of experiments, including those for DP system component electronics testing and reactor safety research. The primary purpose for the ACRR is the production of medical isotopes.

Normally, the SNL/NM reactors operate at steady-state power. These reactors are considered low power. The SPR III reactor, for example, is limited to 10 kW.

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

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

- *Aerial Cable Facility*—Provides a controlled environment for high velocity impact testing on hard surfaces and precision testing of full-scale, ground-to-air missile operations; air-to-ground ordnance testing; and nuclear material shipping container testing for certification.
- *Lurance Canyon Burn Site*—Provides safety testing of various hazardous material shipping containers, weapons components, and weapons mockups in aviation fuel fires, propellant fires, and wood fires.
- *Thunder Range Complex*—Provides inspection facility capabilities and assembly and disassembly of special explosive-containing items. In the past, the facility was used for environmental, safety, and survivability testing for nuclear weapons applications.

2.3.4.6 Selected Infrastructure Facilities

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

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

2.3.5 Activities Common to All Alternatives

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

2.3.5.1 Research & Development Activities

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

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

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

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

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

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

2.3.5.2 Maintenance Support Activities

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

2.3.5.3 Material Management and Operations

Routine operations at SNL/NM require the management of hazardous, industrial, commercial, and recyclable materials. Appendix A contains information regarding the responsible organizations, regulatory requirements, and types and quantities of material at SNL/NM. SNL/NM standards, which were developed in accordance with DOE, DOT, and U.S. Air Force policies, determine if a material constitutes an onsite hazard.

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

2.3.5.4 Chemical Materials Management and Control

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

Chemical Materials

SNL/NM handles more than 25,000 chemical containers annually. Chemicals are designated as hazardous if they present either a physical or a health hazard as defined by the DOT and listed in 49 Code of Federal Regulations (CFR) §172.101. Chemicals are managed using

Hazardous Material

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

administrative and physical controls that are designed to minimize exposure to an identified hazard. Facilities that use and store chemicals are evaluated using SNL/NM's Integrated Safety, Environmental, and Emergency Management System for determining appropriate approaches to managing and controlling hazards.

Historic Chemical Materials Use

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

Baseline Hazardous Chemical Materials Use

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

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

2.3.5.5 Explosive Material Management and Control

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

2.3.5.6 Radioactive Material Management and Control

SNL/NM uses a two-fold approach to radioactive material management: reduce surplus legacy radioactive material inventories and manage current nuclear material inventories at mission-essential levels. Nuclear material is a subclass of radioactive material as defined by the *Atomic Energy Act of 1954* (AEA) (42 U.S.C. §2011). SNL/NM manages the three types of accountable nuclear material—special nuclear material, source material, and other nuclear material—through an inventory database known as the *Local Area Network Nuclear Material Accountability System (LANMAS)*. Other radioactive material (less than 1 percent by mass) located at SNL/NM is not tracked through this tracking system.

2.3.5.7 Waste Management and Operations

Waste Operations

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

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

Hazardous Waste

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

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

Radioactive Waste

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

Radioactive Waste Categories

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

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

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

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

2.3.5.8 Environmental Restoration

The ER Project is a phased project designed to identify, assess, and remediate contaminated DOE-owned or -operated facilities that have contamination from disposal sites, releases, or spills. The initial remedial assessment of SNL/NM sites was conducted under the Comprehensive Environmental Assessment and Response Program beginning in 1984 and ending in 1987. The assessment identified 117 potential release sites. By 1993, the number had increased to 219 potential release sites (including offsite locations). A Hazardous and Solid Waste Amendments (HSWA) module of the RCRA permit was issued in August 1993. As co-permittees, both SNL/NM and the DOE are responsible for compliance under the terms of the HSWA permit. The EPA Region 6 (Dallas, Texas) was the authorized permitting agency at the time of issuance, but beginning in January 1996, authority was transferred to the NMED. The terms, conditions, and schedule contained

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

in the original HSWA Part B permit are, and continue to be, the primary legal drivers for the ER Project. The remediation field activities under the ER Project are scheduled for completion in fiscal year (FY) 2002, with permit modification by FY 2004 to remove remediated sites from further action. Subsequent monitoring activities are scheduled for an additional 30 years. As of 1996, 153 sites remained for restoration or additional assessment. SNL/NM has proposed no further action for 100 of the 153 sites to the appropriate regulatory authority. The ER Project is currently the largest generator of regulated waste at SNL/NM. The project can potentially generate wastes of varying types due to the many kinds of material that have historically been handled at SNL/NM. For example, these wastes may consist of contaminated soils, debris, wastewater, and used personal protective equipment. The waste categories include LLW, LLMW, RCRA hazardous waste, TSCA waste, biohazardous waste (such as septic tank sludge), and nonhazardous waste. ER Project generated waste is processed through the HWMF, the RMWMF, or the SWTF. Once accumulated, sampled, and fully characterized, environmental restoration-generated waste is transferred to the appropriate SNL/NM waste management department for treatment, storage, and offsite disposal. The time frame for disposal of waste, once removed from a release site, can be months or years, depending on the time required for characterization and scheduling for shipment to disposal facilities.

In June 1996, SNL/NM submitted a request for a permit modification for a Corrective Action Management Unit (CAMU) designed to be a storage, treatment, and containment unit dedicated to ER Project-generated hazardous waste (SNL/NM 1997a). This unit will be located near the former Chemical Waste Landfill (a site scheduled for remediation and closure under a RCRA Closure Plan). SNL/NM security personnel will provide controlled access. The SNL/NM waste management departments will continue to manage waste generated by the ER Project, excluding hazardous waste designated for containment in the CAMU. The CAMU was approved in September 1997 by EPA Region 6. An environmental assessment was prepared for the ER Project at SNL/NM. It analyzes potential environmental effects of the characterization and waste cleanup or corrective action of environmental restoration sites (DOE 1996c). The impacts of the ER Project are incorporated into the analysis of the SWEIS.

2.3.5.9 Pollution Prevention and Waste Minimization

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

2.3.5.10 Recycling

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

2.3.6 Selected Facilities

Following Chapter 2 are a series of facility descriptions that provide additional detail for all of the facilities that are named in Sections 2.3.4.1 through 2.3.4.6. They consist of a brief description of the location, hazard class (low-hazard nonnuclear), primary purpose, and the major types of activities performed at the facility. Also

Low-Hazard Nonnuclear

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

identified are the basic processes performed at the facility, the programs and activities currently being supported, the major categories of radioactive and hazardous materials used by the processes, and the types or radioactive and hazardous emissions or wastes generated by activities at the facility. For all of the facilities described here and for each of the three alternatives described in Chapter 3, the FSID (SNL/NM 1997b) contains more detail including the estimated quantities for the specific radioactive and hazardous chemicals used and emissions or waste generated by a facility's operations. All of these details were considered in completing the consequence analysis in Chapter 5.

FACILITY DESCRIPTIONS
TABLE OF CONTENTS – BY FACILITY TYPE

MANUFACTURING, R&D LABORATORIES, AND TESTING FACILITIES

PHYSICAL TESTING AND SIMULATION FACILITIES

ACCELERATOR FACILITIES

REACTOR FACILITIES

OUTDOOR TEST FACILITIES

SELECTED INFRASTRUCTURE FACILITIES

FACILITY DESCRIPTIONS
TABLE OF CONTENTS – ALPHABETICAL ORDER

NEUTRON GENERATOR FACILITY (NGF)

Function and Description:

The mission of the NGF, located in Technical Area-I, is to support the U.S. nuclear weapons program by fabricating neutron generators (external initiators for nuclear weapons), neutron tubes, and prototype switch tubes. This is a low-hazard, nonnuclear facility located in Building 870, a two-story structure with a basement, where most processing and assembly operations take place. The facility includes a special air handling system that captures tritium from operations that have the potential to release this material. The NGF is primarily an assembly facility that receives components, including the tritium-loaded target materials, from various sources. Final neutron generator assembly is conducted and devices are tested.

Specific Processes, Activities, and Capabilities:

A variety of techniques are used and highly specialized metal work is done to accomplish the following categories of processes:

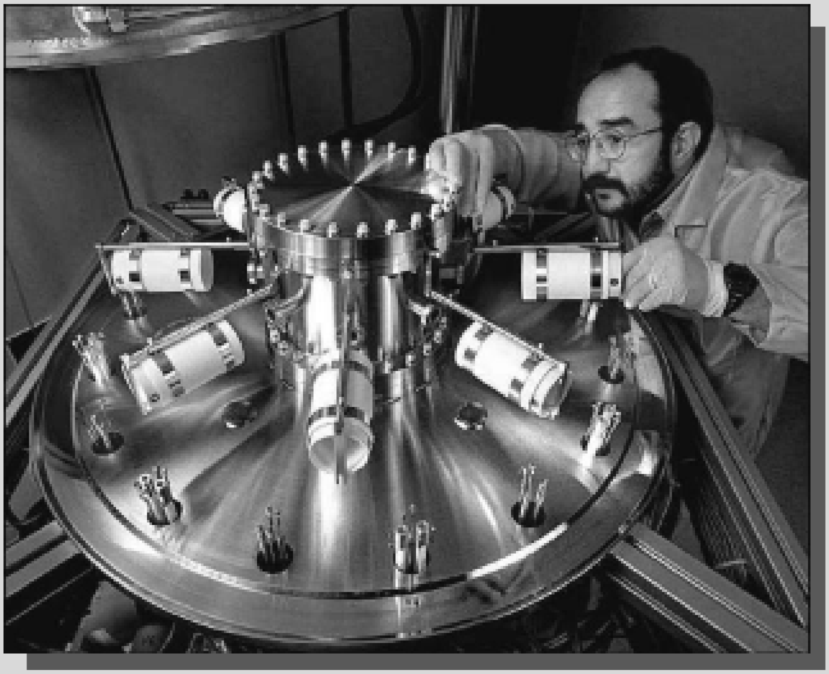
- preparing and coating the surfaces of components,
- joining and welding,
- encapsulating,
- fabricating and assembling, and
- inspecting and testing.

The NGF operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities and Weapon Programs involve development of neutron generators.
- Technology Transfer develops processes with part and process suppliers.
- Production Support and Capability Assurance activities involve production of neutron generators including components.
- Other programs, include research and development, process development, and certification testing of neutron generators and components.

The production of neutron generators involves fabricating and assembling major components, including a neutron tube, miniature accelerator, power supply, and timer.

Potential tritium emissions are associated with various aspects of equipment calibration, destructive testing, outgassing of components, prototype development, manufacturing, and material handling. A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (including hydrogen), liquid, and solid forms in relatively small quantities are used in many of these specific processes. Chemical emissions, including corrosives, alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, material processing, manufacturing, testing, and quality control. Small sealed radioactive sources, nondestructive testing (X-rays), and lasers are used in the facility.



Source: SNL/NM 1998a

Figure FD–1. Neutron Generator Facility (NGF)

The NGF is used for fabricating neutron generators and prototype switch tabs. The neutron generator consists of a neutron tube and a power supply to operate it. The generation of neutrons is accomplished by the fusion of isotopes of hydrogen (deuterium and tritium) by ion acceleration.

MICROELECTRONICS DEVELOPMENT LABORATORY (MDL)

Function and Description:

The mission of the MDL, located in Building 858 in Technical Area-I, is to provide the microelectronics research and engineering capabilities to support industry, government, and other programs of national interest. The MDL contains 30,000 ft^2 of clean room, consisting of 22 independent bays separated by 8-ft-wide utility chases. Laboratory space outside the clean room area is used for wafer test equipment, die packaging, scanning electron microscopy, device radioactive source exposure, and device inspection. The basement of the facility contains acid waste neutralization equipment used in the neutralization of process wastewater. The MDL includes the Emergency Response Center, which has the equipment necessary to respond to facility emergencies.

Specific Processes, Activities, and Capabilities:

A variety of processes are used to produce microelectronic and micromechanical devices that may vary according to the needs of a particular project. These processes, however, can be grouped within the following four broad categories of iterative processes:

- Film deposition—processes that prepare the surface of a silicon chip with conductive and nonconductive layers and polymers.
- Photolithography—processes that transfer a larger master pattern of components onto the film layers, similar to photographic processes in concept.
- Etching—processes that carve out the image created on the films and that can expose selected portions of the surface of the silicon chip.
- Ion implantation—processes that place electrically active chemicals of various types into the exposed portions of the silicon chip surface.

MDL operations support the following types of programs and activities:

- Direct stockpile activities conduct research and development in microelectronics devices for nuclear weapon applications.
- Enhanced Surveillance Programs examine corrosion in select components.
- Technology Transfer and Education Programs develop microelectronic systems and processes.
- Advanced Manufacturing, Design and Production Technologies develop new processes and building prototypes.
- Weapons Programs activities develop microelectronic devices for weapon components.

Large quantities of acids and caustics and a wide variety of toxic and corrosive gases are used in clean rooms to clean, develop, and etch wafer surfaces and to create the films and chemical ions for implantation. While chemical quantities are less than those of a commercial manufacturing operation, the types of materials and chemicals used in these processes are generic to the semiconductor industry. Chemical air emissions occur during various points of the processes identified above, including the use or application of chemical developers and reactant liquids. Small sealed sources are also contained in equipment used in radiation hardening testing.

Source: SNL/NM 1998a

Figure FD–2. Microelectronics Development Laboratory (MDL)

The MDL was built in 1988 as a world-class facility dedicated to the advancement of microelectronic research, development, and application initiatives of strategic interest. Advanced manufacturing technologies can be tested at the MDL. Here, this worker wears a special uniform to protect microcircuits from lint and dust.

ADVANCED MANUFACTURING PROCESSES LABORATORY (AMPL)

Function and Description:

The mission of the AMPL, located in Technical Area-I, is to develop and apply advanced manufacturing technology to produce products in support of Sandia National Laboratories/New Mexico's national security missions. The AMPL, comprised of 11 laboratories or divisions, can prototype and do limited manufacture of many of the specialized components of nuclear weapons. The advanced manufacturing technology development in the AMPL is focused on enhancing capabilities in four broad areas: manufacture of engineering hardware, emergency and specialized production of weapon hardware, development of robust manufacturing processes, and design and fabrication of unique production equipment.

Specific Processes, Activities, and Capabilities:

The activities conducted in the AMPL are typically laboratory and small-scale manufacturing operations involving materials and process research. The equipment used is commercial or custom-built laboratory and small-scale instrumentation. Operations range from standard wet chemistry to high-tech chemical techniques. Operations include, but are not limited to, development of processes and applications using plastics and organics, nonexplosive powders, adhesives, potting compounds, ceramics, laminates, microcircuits, lasers, machine shop equipment, electronic fabrication, multichip modules, thin-film brazing and deposition, and plating and glass technology.

AMPL operations support the following types of programs and activities:

- Direct stockpile activities program develops and applies advanced processes for nuclear weapon applications.
- System Components Science and Technology Program supports materials processing needs of Defense Programs (metals, polymers, ceramics, and galss).
- Technology Transfer and Education Programs develop advanced manufacuring processes through coordination with industrial partners.
- Production Support and Capability Assurance Program activities develop and produce active ceramic components for neutron generators.
- Advanced Manufacturing, Design, and Production Technologies develop and improve processes for weapon production.
- Work for other Federal Agencies, Private Corporations, and Institutions develop advanced manufacturing techniques and processes, electronics, materials, and systems.

These activities involve the use of a variety of chemicals (including corrosives, solvents, organics, inorganics, and gases) in relatively small amounts. All activities are perfromed in well-ventilated areas or fume hoods to prevent employee exposure. Most of the wastes generated in these activities are spent solvents, corrosives, and inert purge gases (such as nitrogen and helium). Neutron generators and other related components containing tritium are handled at the AMPL; however, the tritium contained in these components is completely sealed within a welded tube. No radioactive air emissions are produced at this facility.

Source: SNL/NM 1998a

Figure FD–3. Advanced Manufacturing Processes Laboratory (AMPL)

Activities at the AMPL include development of weapons hardware and design of production equipment.

INTEGRATED MATERIALS RESEARCH LABORATORY (IMRL)

Function and Description:

The mission of the IMRL, located in Technical Area-I, is to conduct materials and advanced components research. The IMRL facility is a 140,000-ft^2, multiple-story facility, which develops new and superior materials to meet the needs of government and private industry. This low-hazard, nonnuclear facility houses most of the advanced materials research and development functions at Sandia National Laboratories/New Mexico (SNL/NM). These research activities include laboratory studies in chemistry, physics, and alternative energy technologies. Experimental work is augmented by advanced computer modeling and simulation techniques, another SNL/NM area of expertise.

Specific Processes, Activities, and Capabilities:

IMRL research and development efforts are focused on meeting multiple program management objectives through manufacturing process development and integration of new and advanced products with advanced process development. In process development, IMRL concentrates on materials and processes to support long-term stockpile needs for limited-life components. In material sciences, work includes scientifically tailoring materials, studying defects, and researching impurities in materials.

Numerous techniques and highly specialized processes are developed to improve light gas membranes, improve fuel and chemical production, and develop thin films (each a few angstroms thick). These thin films include mixtures of semiconductors to enhance electronic and optical properties not exhibited in purer form. Thin-film techniques include depositing chemicals (in vapor form) to surfaces to reduce friction, corrosion, and wear and enhance performance of materials like superconductors and optical materials.

To accomplish these tasks, IMRL uses electron microscopy for analytical and high resolution imaging and an electron microprobe to analyze very small structures. Also IMRL uses X-ray diffraction, X-ray fluorescence, and vibrational spectroscopy for surface and material analysis especially for material defects along with computer-aided design, synthesis, characterization, and testing. A variety of operations are carried out involving laser, electron beam, pulsed, and inertial welding equipment designed to join different types of metals. Small-lot fabrication of foams and membranes are also made. Synthesis of novel polymers, experimental and theoretical studies on polymer degradation, and catalysis development and improved material separation to reduce impurities and defects are accomplished using numerous analytical techniques including dielectric and ferroelectric testing, electrooptic characterization, and ultra-fast optical spectroscopy.

IMRL operations support the following types of programs and activities:

- Advanced Industrial Materials Research Program conducts materials research and development.
- Catalysis and Separations Science and Engineering chemistry and materials research and development.
- Materials Processing by Design.
- Materials Sciences uses advanced characterization instrumentation for research into relationships between materials properties and structure, and development of new and favorable material properties through advanced synthesis and nanoscale structuring of materials.
- Advanced Design and Production Technologies develops and characterizes advanced materials and production processes.

- Direct Stockpile Activities conducts research and development of engineered materials for nuclear weapon applications.

- Technology Transfer and Education Activities conduct materials development and testing in conjunction with industry partners in technology development.

A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (including hydrogen), liquid, and solid forms in relatively small quantities are used in many of these specific processes. Chemical air emissions, including corrosives, alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, material processing, manufacturing, testing, and quality control. Small sealed radioactive sources, nondestructive testing (X-rays), and lasers are used in the facility.

Source: SNL/NM 1998a

Figure FD–4. Integrated Materials Research Laboratory (IMRL)

Various weapons materials are tested at the IMRL.

EXPLOSIVE COMPONENTS FACILITY (ECF)

Function and Description:

The mission of the ECF, located just outside and to the south of Technical Area (TA)-I, is to conduct research and development on a variety of energetic components. The facility comprises a main building (Building 905) and six explosives storage magazines (Buildings 905A through F). The ECF consolidates a number of activities formerly conducted in TA-II related to energetic component research, testing, and development. The ECF is a low-hazard, nonnuclear, state-of-the-art facility.

Specific Processes, Activities, and Capabilities:

The ECF is primarily a test facility performing the following activities:

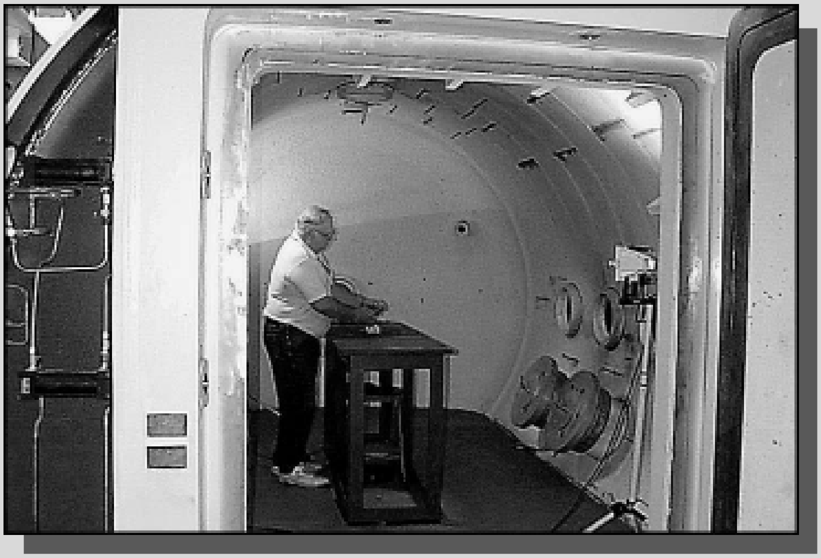
- physical and chemical testing of explosives, pyrotechnics, and propellants;
- development of advanced explosive components;
- research, development, and testing of neutron-generating devices;
- research, development, and testing of batteries; and
- stockpile surveillance of explosives, pyrotechnics, and propellants.

The ECF operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities involve research and development (R&D), energetic materials, and other components.
- Special projects, conducted with the U.S. Department of Defense, include projects for the purpose of reducing operational hazards associated with energetic materials, advanced initiation and fuse development, and material studies along with computer simulation.
- Other projects involve a wide variety of experimental testing, R&D, analyses, technology transfer, and technology development related to explosives, explosive materials, explosive components, and other materials.

A broad range of energetic-material R&D and application activities are conducted at the ECF. Advanced diagnostic equipment is used during experiments ranging from 1 kg tests to sophisticated spectroscopic studies on milligram-size samples that probe fundamental processes of detonation.

A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous, liquid, and solid forms in relatively small quantities are used in many different processes. Air emissions result from the use of corrosives, alcohols, ketones, and other solvents. Sealed radioactive sources, X-rays, and lasers are used in the facility. Low-level tritium emissions are associated with various aspects of neutron generator development and testing.



Source: SNL/NM 1998a

Figure FD–5. Explosive Components Facility (ECF)

SNL/NM's new 91,000-ft^2 ECF is a U.S. Department of Energy-designated user facility and makes state-of-the-art testing and evaluation capabilities available to industry.

TERMINAL BALLISTICS COMPLEX

Function and Description:

The mission of the Terminal Ballistics Complex, located in Technical Area-III, is to conduct environmental, safety, and survivability testing for nuclear weapon applications. The Terminal Ballistics Complex is a low-hazard facility that includes a main building (Building 6750), two smaller buildings (Buildings 6752 and 6753), and four explosive storage magazines. Building 6750 houses a small machine shop, office space, a control area, and an indoor firing range. Building 6753 is used for large propellant charge assembly and temperature conditioning of propellants. Building 6752 is an unoccupied storage shed for nonhazardous materials. The storage magazines are used for long-term storage of propellants and explosives.

Specific Processes, Activities, and Capabilities:

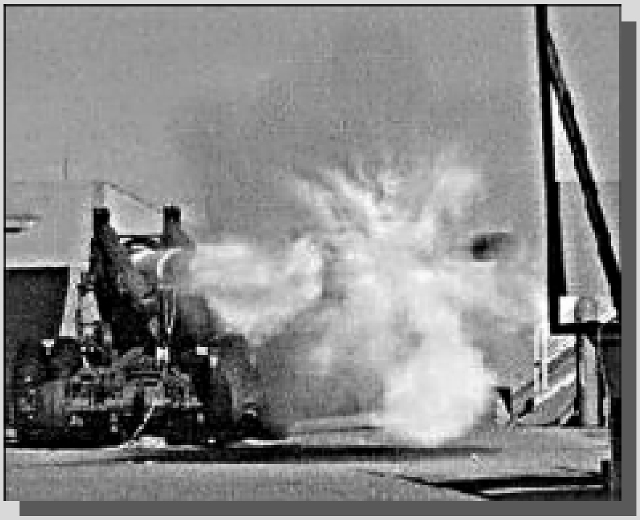
Processes at the Terminal Ballistics Complex are centered on the evaluation of test materials, primarily the physical examination, cleaning, and general quality assurance of munitions and components. In addition, the Terminal Ballistics Complex provides unique test environments and capabilities including the following:

- an outdoor, large-caliber gun range with a 155-mm “Long Tom” artillery gun permanently mounted in a revetment;
- static-fire rocket stands used to measure the thrust force of small rockets;
- test environments for ballistic studies and solid-fuel rocket motor tests; and
- secure, remote indoor and outdoor test facilities.

The Terminal Ballistics Complex operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities, include development and survivability testing of nuclear weapon subsystems and components by using firearms and projectiles to determine material effects and responses.
- Special projects reduce operational hazards associated with explosives, explosive initiators, hard target penetration, computer simulation.
- Science and Technology include material response evaluations.
- Other projects include experiments on shipping containers and storage facilities.

The Terminal Ballistics Complex maintains a small chemical inventory and no radioactive material inventory. Various aspects of the preparation and evaluation of test materials can result in emissions from a variety of solvents including alcohols and ketones. Radioactive air emissions are not produced at this facility.



Source: SNL/NM 1998a

Figure FD–6. Terminal Ballistics Complex

At the Terminal Ballistic Complex's outdoor firing range, a 155-mm "Long Tom" gun fires a projectile.

DROP/IMPACT COMPLEX

Function and Description:

The mission of the Drop/Impact Complex, located in Technical Area-III, is to conduct hard-surface impacts, water impacts, and underwater tests of weapon shapes, substructures, and components. This work is performed to verify design integrity and performance and fuzing functions performance. Such tests help ensure that the nation's nuclear weapons systems meet the highest standards of safety and reliability. This is a low-hazard, nonnuclear facility consisting of two towers: a 185-ft drop tower next to a hard surface and a 300-ft drop tower next to a water-filled pool, 120 ft wide, 188 ft long, and 50 ft deep. A 600-ft-long rocket sled track is located at the end of the pool opposite the tower for testing rocket pull-down accelerated impacts into the water pool.

Specific Processes, Activities, and Capabilities:

The Drop/Impact Complex is primarily a test facility with operations that include conducting drop tests, rocket pull-down tests, submersion tests, and underwater explosive effects tests. Testing involves the following processes and support activities:

- receiving, storing, and handling explosives; pyrotechnics; propellants; nuclear radioactive, and chemical materials;
- setting up explosive tests, explosive arming and firing, explosives ordnance disposal;
- testing electronic instrumentation and data recording, photometrics, and telemetry;
- conducting hazard area control and checking fire-control system support;
- transporting test assemblies to test sites, rocket arming and launching, post-launch and firing procedures, diving operations; and
- recovering radioactive and chemical material.

The Drop/Impact Complex operations are allocated, but not limited, to the following programs and activities.

- Direct Stockpile Activities conduct environmental, safety, and survivability testing for nuclear weapon systems and components.
- Science and Technology activities involve testing of materials, components, and weapon systems.
- Model Validation efforts involve high-velocity impact testing on hard surfaces, water impact tests, and underwater tests to validate models.
- Other projects include testing prototype nuclear materials packaging, and other projects not associated with the U.S. Department of Energy.

During a drop test, a test object is dropped from the top of the tower for gravity acceleration to a hard impact surface. In a water test, objects are dropped from the top of the tower by gravity or rockets are used to boost acceleration.

The Drop/Impact Complex contains a small chemical inventory and no radioactive material inventory. Cleaners, lubricants, solvents, paints, and agents are used in small quantities. Compressed gases are used in the assembly areas, including acetylene and oxygen (for welding), argon, and helium. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Small amounts of airborne emissions, including carbon monoxide and lead, are released during explosives tests. Although the most common radioactive material used is depleted uranium, other nuclear and radioactive materials associated with test objects may include uranium alloys, thorium alloys and compounds, and tritium. Radioactive air emissions are not produced at this facility.

Source: SNL/NM 1998a

Figure FD–7. Drop/Impact Complex

The Drop/Impact Complex is used to conduct hard-surface and water impact tests.

SLED TRACK COMPLEX

Function and Description:

The Sled Track Complex, located in Technical Area-III, supports the verification of design integrity, performance, and fuzing functions of weapon systems through the simulation of high-speed impacts of weapon shapes, substructures, and components. Sandia National Laboratories/New Mexico (SNL/NM) test facilities such as the Sled Track Complex have been specifically designed for the validation of analytical modeling and the functional certification of weapons systems. The facility is also used to subject weapon parachute systems to aerodynamic loads to verify parachute design integrity and performance. In addition, SNL/NM Energy & Environment Programs use the Sled Track Complex to verify designs in transportation technology, reactor safety, and Defense Programs transportation systems.

Specific Processes, Activities, and Capabilities:

Operations at the Sled Track Complex include a variety of tests and test article preparation such as conducting rocket sled and rocket launcher tests, free-flight testing, and explosive testing. Each rocket sled test involves the acceleration of a rocket down a sled track. A test may involve impacting an object onto a target, or launching a parachute from an ejector accelerated along the track. Each explosive detonation is used to subject test articles to shock waves and propel missiles into test articles. Rocket launches are used to accelerate test objects along a beam on a carriage that is stopped at the end of the beam, releasing test objects into free flight at specific targets. In free-flight launches, test objects are launched directly into free flight from portable launch rails.

These operations also include:

- receiving, storing, and handling explosives; pyrotechnics; propellants; and nuclear, radioactive, and chemical materials;
- fabricating and assembling rocket sleds including payloads and rockets;
- setting up explosive tests, electronic instrumentation, and data recording and special equipment including lasers, tracking equipment, and X-ray;
- reducing hazards through area, systems, and personnel control;
- disposing of explosives ordnance; and
- recovering radioactive and chemical materials.

Specific programs and activities supported by the Sled Track Complex include, but are not limited to, the following:

- Direct Stockpile Activities and Performance Assessment and Technology Programs conduct environmental, safety, and survivability testing for nuclear weapon applications.
- Energy Programs certify designs in transportation technology and reactor programs.
- Work for Other Federal Agencies in impact, functional, and explosives effects testing.

Small amounts of chemicals are maintained for use in assembling rocket sleds and test payloads in Buildings 6741, 6743, and 6736. For example, various adhesives and epoxies are used to fasten transducers and similar items. Cleaners, lubricants, solvents, paints, and other such agents may also be used in small quantities. Compressed gases are used in the assembly areas, including acetylene and oxygen (for welding), argon, and helium; and dry nitrogen and carbon dioxide are used for pneumatic actuators.

Source: SNL/NM 1998a

FD–8. Sled Track Complex

One of the more unique testing sites available for use at SNL/NM is a high-speed sled track used for rocket sled and launcher testing, free-flight testing, and explosive testing.

CENTRIFUGE COMPLEX

Function and Description:

The Centrifuge Complex, located in Technical Area-III, is used to validate analytical models and to certify the functioning of large test objects under high acceleration conditions. The complex is also used to certify designs in transportation technology. The Centrifuge Complex has been classified a low-hazard, nonnuclear facility. Typical test objects in the Centrifuge Complex include weapons systems, satellite systems, reentry vehicles, geotectonic loads, rocket components, and sensing devices.

Specific Processes, Activities, and Capabilities:

Test preparation processes include machine shop welding operations, surface treatments, welding, and other means to attach parts. Test objects are attached to one end of a boom that rotates around a central shaft. Counterweights are attached to the other end of the boom to counterbalance the test objects. Hydraulic drive motors rotate the central shaft and boom to the revolutions per minute required to achieve the test acceleration. Other tests involve combining vibration and acceleration of oversized or hazardous test objects, including explosive payloads. Sometimes a centrifuge is used to accelerate small objects to high velocity with subsequent release to impact on targets. The Centrifuge Complex has two centrifuge units.

- The 29-ft indoor centrifuge, located inside Building 6526, can subject test objects weighing up to 16,000 lb to 100 times the acceleration of gravity (100 *g*). An acceleration of 300 *g* can be achieved with proportionally lighter test objects.

- The 35-ft outdoor centrifuge, located adjacent to Building 6526, can subject test objects weighing up to 10,000 lb to an acceleration of 45 *g*. An acceleration of 240 *g* can be achieved with proportionally lighter test objects.

Each centrifuge test involves subjecting a test object to a specified level of acceleration for a specified duration. In each impact test, a small object is accelerated and released from the arm of the 35-ft centrifuge on a tangential trajectory to impact targets.

The Centrifuge Complex operation are allocated, but not limited, to the following programs and activities:

- Direct stockpile activities include survivability testing of nuclear weapon systems and components.

- Energy Programs conduct certification testing of transportation systems through impact tests.

- Other programs test satellite systems.

The Centrifuge Complex contains a small chemical inventory but no radioactive materials. Cleaners, lubricants, solvents, paints, and agents are used in small quantities. Compressed gases used in the assembly areas include acetylene and oxygen (for welding), argon, and helium. Chemical emissions, including alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Small amounts of airborne emissions, including carbon monoxide and lead, are released during explosives tests. Radioactive air emissions are not produced at this facility. Noise from centrifuge operation, collision impacts, and explosive testing does occur. Fragments resulting from centrifuge-launched explosives are recovered shortly after test events.

Source: SNL/NM 1998a

FD–9. Centrifuge Complex

This 35-ft outdoor centrifuge can test objects weighing up to 10,000 lb to an acceleration of 45 g.

SATURN ACCELERATOR

Function and Description:

The mission of the SATURN accelerator, located in Building 981 in Technical Area-IV, is to conduct development and survivability testing of nuclear weapon subsystems and components. SATURN was designed and built to provide X-ray radiation environments with enhanced simulation fidelity as well as providing improved test exposure levels and test areas. SATURN can also operate in a plasma radiation source configuration, generating ultra-high intensity soft X-ray environments. The SATURN facility consists of a laboratory building (including a high bay, office space, shop areas, light laboratories, a mechanical room, a radiation exposure cell, and a basement) and storage tanks and transfer systems for large quantities of transformer oil and deionized water.

The accelerator is a symmetric, parallel-current driver consisting of 36 identical pulse-compression and power-flow modules arranged like the spokes of a wheel. It can easily be configured to drive either annular electron beam or Z-pinch loads. The pulsed-power components are housed in an open-air tank that is 96 ft in diameter and 14 ft high. The tank is divided into energy storage, pulse compression, power flow, and power combination sections. The concrete- and earth-shielded exposure cell is located in a basement room beneath the accelerator.

Specific Processes, Activities, and Capabilities:

Activities in the SATURN involve testing the survivability of nuclear weapon systems by simulating the X-rays produced by a nuclear weapon detonation. SATURN is used to simulate the effects of nuclear countermeasures on electronic and material components, as a pulsed-power and radiation source, and as a diagnostic test bed for accelerator component development. This work would include, but not be limited to, improvements or changes to energy storage systems, pulse-forming systems, voltage conditioning networks, and other accelerator components. The SATURN accelerator is designed as a modular, high-power, variable-spectrum, X-ray simulation source that can be operated with two different X-ray controllers or any one of several plasma radiation sources.

Areas of application include the following:

- satellite systems;
- electronic and materials devices, components, and subsystems; and
- reentry vehicle and missile subsystems.

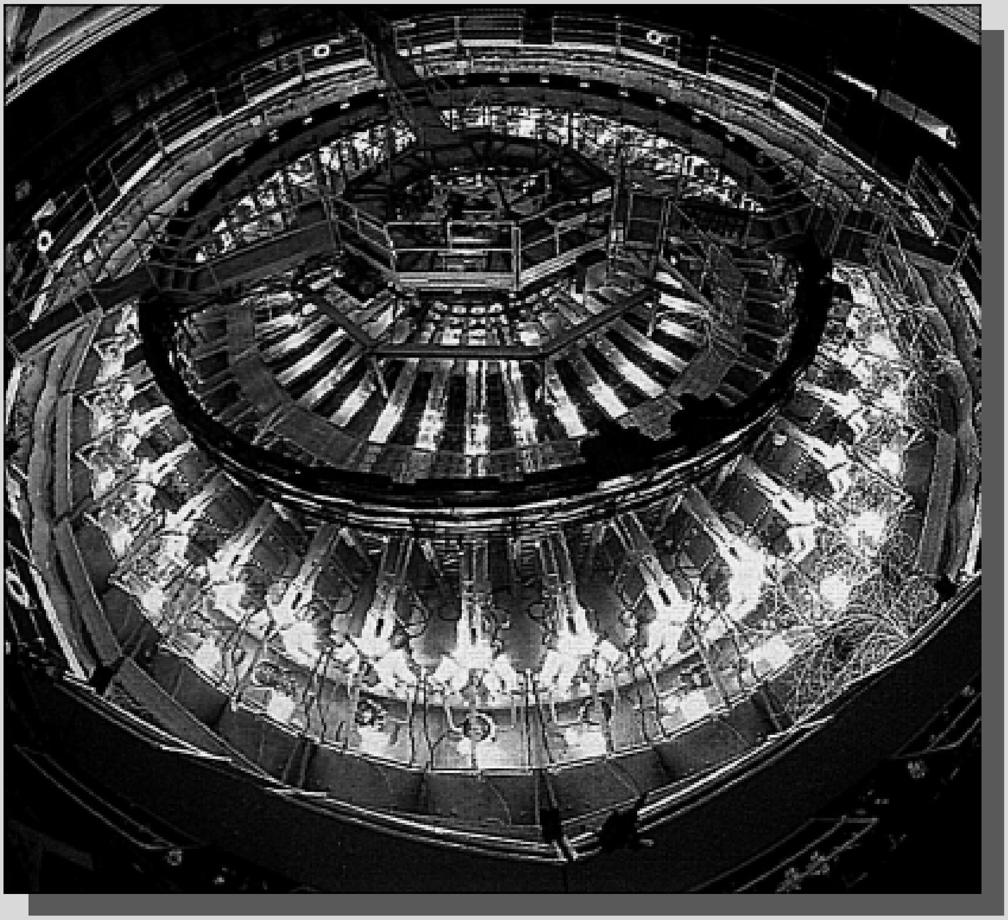
SATURN facility operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities conduct development and survivability testing of nuclear weapons subsystems and components by simulating the X-ray radiation effects of nuclear weapons on nonnuclear components of U.S. Strategic Systems.
- Testing of satellite systems.
- Strategic Defense Initiative tests space assets, reentry vehicles, and missile subsystems.
- Inertial Confinement Fusion Programs involves Z-pinch plasma tests and weapons physics research.

The SATURN facility contains a small chemical inventory and a small radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Sulfur hexafluoride is used as the insulator gas in switching components. Sulfur hexafluoride gas is passed through switches under continuous pressure. It is hazardous in enclosed areas because it does not support respiration. Some tests involve the installation of beryllium filters or shields that can be damaged during a shot, causing release of beryllium particulates. Radioactive air emissions are not produced at this facility. Small sealed radioactive sources (calibration and monitoring), nondestructive testing (X-rays), and lasers are used in the facility.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–10. SATURN Accelerator

The SATURN accelerator is a modular, high-power, variable-spectrum, X-ray simulation source. SATURN is used to simulate the radiation effects of nuclear countermeasures on electronic and material components, as a pulsed-power and radiation source, and as a diagnostic test bed.

HIGH-ENERGY RADIATION MEGAVOLT ELECTRON SOURCE UNIT III (HERMES III)

Function and Description:

HERMES III, a major facility in the Simulation Technology Laboratory (STL), Building 970, is a short-pulse (20- to 30-nsec), high-energy (20-MeV) accelerator that was designed and built to provide intense gamma ray fields over very large areas. This testing provides very realistic conditions associated with some aspects of a nuclear explosion radiation environment. The radiation can be used to test the response of electronics, weapon system components, and entire systems. The accelerator can also be reconfigured to accelerate light ions.

The 55,000-ft^2 (5,110-m^2) HERMES III facility includes the accelerator, indoor and outdoor test cells, and ancillary support systems, including oil storage tanks. The heavily shielded indoor test cell, which is used for most tests, has a usable test area 25 ft deep by 37 ft wide, and can support a load of 100 lb/ft^2, which makes it suitable for testing of most parts and components. The unique shielded outdoor test cell allows testing of large assemblies and entire weapon systems or a variety of other large systems such as tanks.

Specific Processes, Activities, and Capabilities:

Gamma rays are created by discharging the energy storage systems in a manner that increases their voltage. Then, intermediate storage systems and transmission lines add voltage and form a pulse, and a diode section generates an electron beam and converts the beam into gamma rays. The diode section can also be configured to generate a variety of light ion beams and associated ionizing and nonionizing radiation depending on the type of ion accelerated, the target material, and radioactive decay mode. Objects to be irradiated are placed in either the indoor or outdoor test cells and the radiation environment created by operating the accelerator is tailored to the needs of the test.

HERMES III operations support the following types of programs and activities:

- Direct Stockpile Activities conduct the development and survivability testing of nuclear weapon subsystems and components.
- Experimental Activities in radiation testing and associated diagnostics determine the deleterious or beneficial effects of radiation on electronic, material, and biological systems.
- Inertial Confinement Fusion Program activities validate advanced hydrodynamic radiography techniques and applications to address stockpile stewardship issues on the compact, cost-effective, multi-axis Advanced Hydrotest Facility expected to be located at Los Alamos National Laboratory.
- Performance Assessment Science and Technology Program supports hostile (radiation) environmental testing of weapon components.
- Pulsed-Power Technology Program activities support new pulsed-power components and designs involving modifications to the HERMES III machine for pulsed-power research, development, testing, and evaluation.

A large amount of transformer oil is used as an insulator in the energy storage sections of the facility, but only small amounts of hazardous chemicals, such as solvents, are used. Inert gases are used in switching devices and stored in the facility in sufficient quantities to warrant controls for asphysixiant hazards. Lasers are used to align accelerator components and in switching mechanisms. Radioactive air emissions may be generated by activation of oxygen or nitrogen in air while operating in the gamma ray production mode, particularly with outdoor shots; however, these emissions are at very low levels and decay within seconds.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.

Source: SNL/NM 1998a

FD–11. High-Energy Radiation Megavolt Electron Source Unit III (HERMES III)

The HERMES III accelerator is the world's most powerful gamma simulator. It is used primarily for simulating the effects of prompt radiation for a nuclear burst on electronics and complete military systems.

SABRE

SANDIA ACCELERATOR & BEAM RESEARCH EXPERIMENT (SABRE)

Function and Description:

The mission of the SABRE pulsed accelerator, located in Building 970 in Technical Area-IV, is to support the Inertial Confinement Fusion (ICF) Program for advanced extraction ion controller research and for target and focusing studies. The accelerator can also be configured for radiography experiments and used as the driver that provides a flash radiography source. SABRE is a pulsed accelerator located within the Simulation Technology Laboratory (STL), along with the High-Energy Radiation Megavolt Electron Source Unit III (HERMES III) accelerator and, soon to be constructed, the Radiographic Integrated Test Stand (RITS) accelerator. The SABRE is comprised of the accelerator itself, a lead- and concrete-shielded test cell, a basement trench where the diode capacitor banks are located, and several screen rooms and work areas located nearby.

Specific Processes, Activities, and Capabilities:

For the ICF Program, the SABRE is the workhorse of the light ion program for investigating extraction diodes and magnetically insulated transmission line coupling; for testing surface and subsurface cleaning, improved vacuum conditions, and advanced ion sources; and for studying lithium ion transport. It uses the inductive voltage adder technology also used on the HERMES III. New high-magnetic-field capability was tested in fiscal year 1996 as part of the Advanced Hydrodynamic Radiography Program in the Sandia National Laboratories/New Mexico Pulsed-Power Sciences. For Stockpile Support activities in testing weapons components, test objects are placed within the accelerator test cell and irradiated by the accelerator-produced radiation. Afterwards, the test objects are examined to determine their survivability from exposure to radiation.

Areas of application include

- computer science,
- simulation of X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing, and
- robotics.

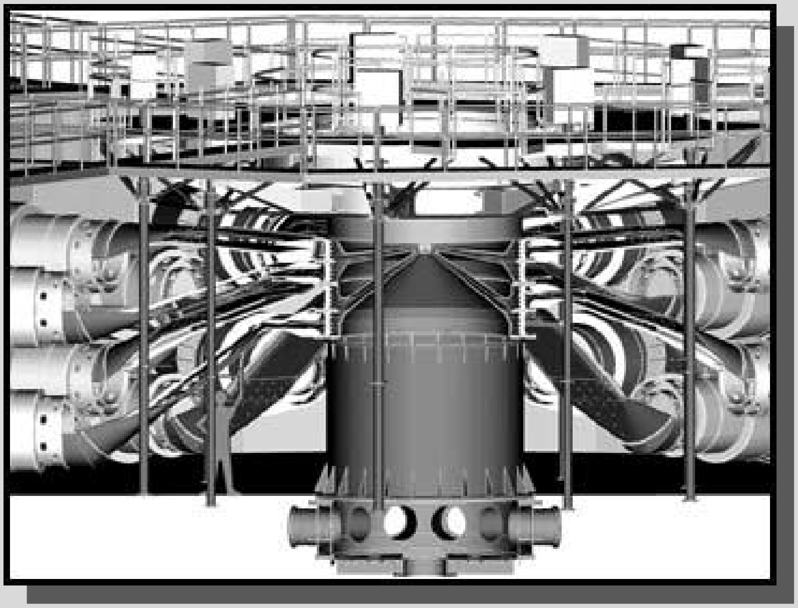
SABRE operations are allocated, but not limited, to the following programs and activities:

- Direct Stockpile Activities, include survivability testing of nuclear weapon subsystems and components.
- Performance Assessment Science and Technology Program supports developing pulsed-power technology to provide advanced radiographic characterization techniques useful to applications such as Dual-Axis Radiographic Hydrotesting.
- Inertial Confinement Fusion Program involves light-ion program activities, lithium ion transport, and high-magnetic field testing.

The SABRE facility contains a small chemical inventory and a small radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility. Small, sealed radioactive sources (calibration and monitoring), nondestructive testing (X-rays), and lasers are used in the facility.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–12. Sandia Accelerator & Beam Research Experiment (SABRE)

The SABRE is located in TA-IV and is used to support the ICF Program.

SPHINX

SHORT-PULSE HIGH INTENSITY NANOSECOND X-RADIATOR (SPHINX)

Function and Description:

The mission of the SPHINX facility, located in Building 981 in Technical Area-IV, is to provide radiation environments for testing components of nuclear weapons and for confirming codes used in the certification of nuclear weapons components. Because of the moratorium on underground nuclear testing, the nuclear stockpile integrity must be assured by various simulation testing including computer modeling. The SABRE creates a radiation environment used to validate computer simulations and verify stockpile integrity. The SPHINX accelerator is a high-voltage, high-shot-rate X-ray and electron beam accelerator that is used primarily to measure X-ray–induced photo currents from short, fast-rise-time pulses in integrated circuits and associated heat handling response in materials. The facility, including a concrete-shielded enclosure adjacent to the SATURN accelerator in Building 981, consists of an 18-stage, low-inductance generator; several pulse conduits; and radiation barriers.

Specific Processes, Activities, and Capabilities:

The SPHINX is used primarily as a research facility. The operations and activities taking place in the SPHINX are diverse, although the dominant activity is related to pulsed-power technology. SPHINX is applied as a high-shot-rate, hot–X-ray–effects simulator capable of testing piece parts or components that require small-area exposure. The SPHINX can operate in two distinct modes: as an X-ray source and as an electron beam source. In the X-ray source mode, researchers study the response of electronics to pulsed high-energy X-ray environments. The electron beam mode is used to study the heat handling response of materials to pulsed radiation. It has high usage to support development work in tactical, strategic satellite systems.

Areas of application include

- computer science,
- simulation of X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing, and
- robotics.

SPHINX operations are allocated, but not limited, to support to the following programs and activities:

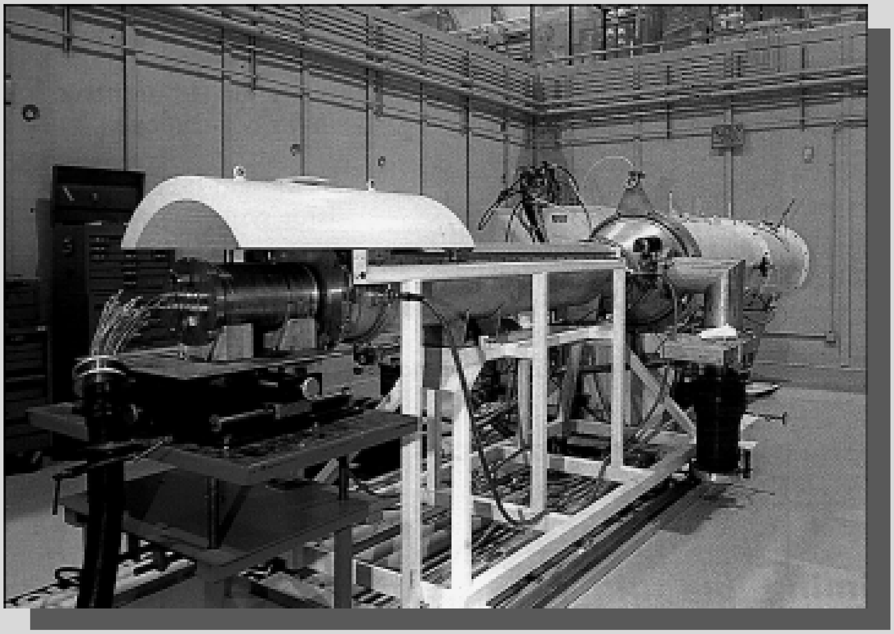
- Experimental activities involve testing with high-shot-rate (accelerator firings) and simulating hot X-ray effects for testing of parts and components.
- Performance Assessment Science and Technology Program applications provide high intensity X-ray and electron beam sources for weapons effects studies.
- Studies on the thermostructural response of materials to pulsed radiation.

- Tactical and strategic satellite systems development work.
- Various research and development work for other Federal agencies using SPHINX facility capabilities.

The SPHINX facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–13. Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)

The SPHINX is a new addition to SNL/NM radiation facilities and was placed in operation in 1992. SPHINX is primarily used to measure the X-ray–induced photocurrents from short, fast-rise-time pulses in integrated circuits.

REPETITIVE HIGH ENERGY PULSED-POWER UNIT I (RHEPP I)

Function and Description:

The mission of the RHEPP I accelerator, located in Building 986 in Technical Area-IV, is to serve as a tool for the technology development of continuous-operation, pulsed-power systems to demonstrate high-energy ion beams and industrial pulsed-power applications. The RHEPP I facility includes a high-energy generator; computer-controlled, pulsed-power equipment; specialized voltage enhancement equipment; specialized electrical current control and storage equipment; and a material test chamber for ion source testing and development. The electrical current control equipment and materials test chamber are located in a below-grade, radiation-shielded test cell under the voltage-enhancement equipment.

Specific Processes, Activities, and Capabilities:

The RHEPP I is primarily a research facility. Its operations and activities are diverse, although the dominant activity is related to pulsed-power technology. During normal operation, the RHEPP systems produces pulses of electrons that may be stopped, converted to ions, or extracted, depending upon the configuration of the accelerator. The RHEPP I was the first Sandia National Laboratories/New Mexico (SNL/NM) accelerator used for the basic technology development of the RHEPP technical concept. It is now used for applications at lower energies and for technology development and some experimental work with materials and organic sterilization processes. Testing in RHEPP I includes exposing test materials (metals and plastics) located in the test cell to shots of proton energy generated by the accelerator. Test objects are then evaluated to determine the effects of the low-level radiation. A new activity for the RHEPP I would be to use ion beams to melt and resolidify near-surface material on small amounts of depleted uranium.

Areas of application include

- computer science,
- simulation of the X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing, and
- robotics.

RHEPP I operations support the following types of programs and activities:

- Nonproliferation and Verification Research and Development Program design of advanced accelerators for applications related to the defeat of biological (nonpathenogenic) and chemical agents.
- Performance Assessment Science and Technology Program develops unique pulsed-power materials-processing techniques for weapons applications.
- Pulsed-Power Technology Program technology development and related experimental activities.

The RHEPP I facility contains a small chemical inventory and a small radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.

Source: SNL/NM 1998a

FD–14. Repetitive High Energy Pulsed-Power Unit I (RHEPP I)

The RHEPP I facility is an operational test bed for the development of technology used to melt and resolidify metals and ceramics for a variety of potential industrial applications.

RHEPP II

REPETITIVE HIGH ENERGY PULSED-POWER UNIT II (RHEPP II)

Function and Description:

The mission of the RHEPP II accelerator, located in Building 963 in Technical Area-IV, is the development of radiation processing applications using high-dose-rate electron or X-ray beams. The RHEPP II accelerator is also a test center for the continued development of high-power magnetic switches and repetitive magnetically insulated transmission lines.

The RHEPP II facility contains the RHEPP II accelerator and the additional components of the microsecond pulse compressor, water-insulated pulse equipment, voltage enhancement equipment, and a high-power electron beam controller.

Specific Processes, Activities, and Capabilities:

The RHEPP II is primarily a research facility in the area of pulsed-power technology. It is used for basic magnetic switching technology development and as a U.S. Department of Energy (DOE) user facility for high-energy-per-pulse applications. RHEPP technology has been used for ion beam surface treatment to harden material surfaces and for advanced research supporting sterilization projects for organic materials (for example, food products and lumber). Testing in RHEPP II includes exposing test materials in the test cell to high doses of X-rays to both simulate the conditions of nuclear weapon detonation as well as the effects of outer space on satellite components. While RHEPP I testing is confined largely to the surface of materials, RHEPP II produces an X-ray environment used to irradiate the entire test material.

Areas of application include

- computer science,
- simulation of the X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing,
- commercial application and technology transfer, and
- robotics.

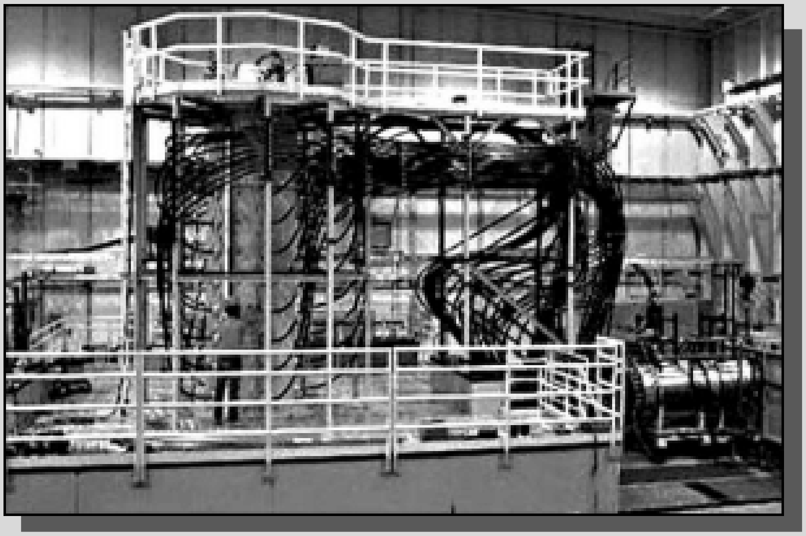
RHEPP II operations support the following types of programs and activities:

- Performance Assessment Science and Technology Program develops pulsed-power technologies and applications for DOE Defense Programs and work for other Federal agencies.
- Initiatives for Proliferation Prevention Program and Nonproliferation and Verification Research and Development Program activities involve developing advanced accelerators for biosterilization of such items as food and lumber, mentioned earlier.
- Pulsed-Power Technology Program activities involve basic switching technology development, high-energy pulse applications, ion-beam surface treatment for hardened materials, advanced research in support of the programs mentioned above, and the sterilization of organic materials.

The RHEPP II facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–15. Repetitive High Energy Pulsed-Power Unit II (RHEPP II)

RHEPP II, which began operation in July 1994, is a modular accelerator capable of operation up to 300 kW. Scheduled experiments include food pasteurization studies and direct bonding of ceramics.

Z-MACHINE

Function and Description:

The mission of the Z-Machine facility, formerly known as the Particle Beam Fusion Accelerator II (PBFA II) and located in Building 983 in Technical Area-IV, primarily provides weapons systems survivability testing by simulating the X-rays produced by nuclear weapon detonation.

The Z-Machine facility includes the accelerator high bay, support area high bays, laser and facility support systems including water and oil tank farms, low bay light laboratories, and the control room. The Z-Machine consists of 36 modules arranged radially around a central experiment vacuum chamber. The accelerator is located in a tank approximately 108 ft in diameter and 20 ft high, divided into 3 annular regions.

Specific Processes, Activities, and Capabilities:

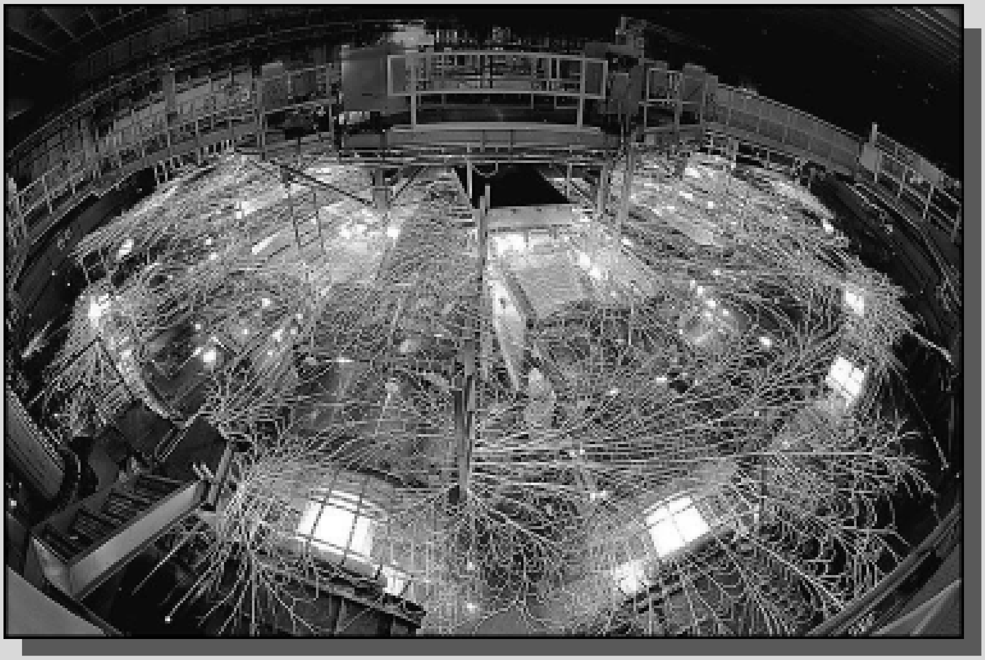
Operating on the principle of pulsed-power, the Z-Machine stores electrical energy over a period of minutes then releases that energy in a concentrated burst. The accelerator produces a single, extremely short, extremely powerful pulse of energy that can be focused on a target. The primary operating mode of the Z-Machine produces a pulse that lasts 100 nsec with approximately 5 MJ of electrical energy and a peak power of 50 TW. Materials are not irradiated within the Z-Machine, but rather the accelerator provides a radiation environment used to validate computer modeling of the effects of certain X-rays on weapons components. Experiments at the facility are primarily research and development in nature.

Z-Machine operations are allocated, but not limited, to accelerator shots, or firings, in support of the following types of programs and activities:

- Performance Assessment Science and Technology Program develops advanced pulsed-power sources for weapons effects testing and weapons physics experiments.
- Inertial Confinement Fusion (ICF) Program studies involve 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 provide high-temperature, large-volume hohlraums and cold X-ray environments for weapons physics and ICF applications.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–16. Z-Machine

Raw Power: Time exposure photography of electrical discharges illuminating the surface of the Z-Machine, the world's most powerful X-ray source, during a recent accelerator shot.

TESLA

TERA-ELECTRON VOLT ENERGY SUPERCONDUCTING LINEAR ACCELERATOR (TESLA)

Function and Description:

The mission of the TESLA facility, located in Building 961 in Technical Area-IV, is to test plasma-opening switches for pulsed-power drivers. The TESLA accelerator facility includes the accelerator high bay, light laboratories, offices, and the screen room. The facility is contained in a rectangular tank, 25 ft wide by 14 ft long by 10 ft high, with a vacuum chamber extension represented by two coaxial cylinders. The TESLA test cell includes electrical charge storage, a magnetically controlled plasma-opening switch, and electron beam storage. The oil tank contains 10,000 gals of transformer oil and a generator, which can store a maximum of 740 kJ in 48 capacitors and is equipped with a mechanical shorting system. The water tank contains 15,000 gals of deionized water and a 150-kilojoule intermediate storage capacitor. Two-foot-thick concrete block walls surround the test cell.

Specific Processes, Activities, and Capabilities:

The electron beam storage consists of an electron diode with a graphite converter. Testing at TESLA is primarily focused on evaluating improvements to pulsed-power technology and not on irradiating materials. The maximum possible voltage is 5 MV into a very high impedance load.

TESLA operations support, but are not limited to, the following types of programs and activities:

- Pulsed-Power Technology Program activities including radiation-producing shots (electron-beam into carbon load) and pulsed-power shots into dummy loads (shots that do not produce radiation).

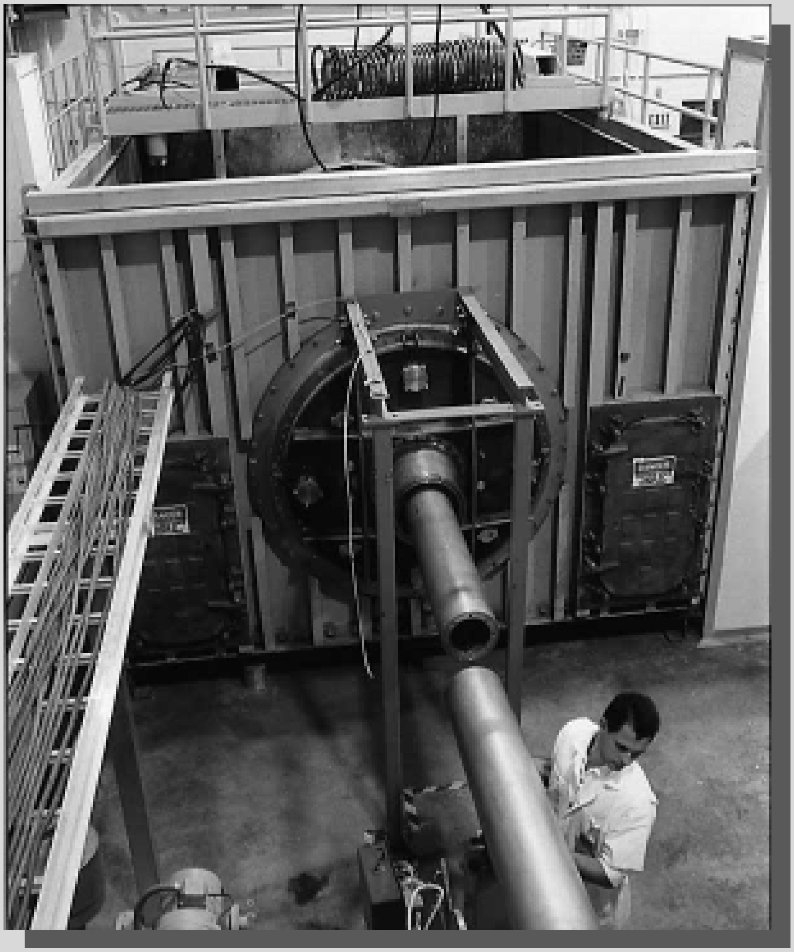
- Performance Assessment Science and Technology Program activities dedicated to advanced pulsed-power development.

The TESLA facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.

TESLA



Source: SNL/NM 1998a

FD–17. Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA)

The TESLA facility is used to test switches for pulsed-power drivers.

ADVANCED PULSED-POWER RESEARCH MODULE (APPRM)

Function and Description:

The mission of the APPRM, located in the Building 963 in Technical Area-IV, is to evaluate the performance of new pulsed-power components and component alignments to improve the performance of future accelerators. The APPRM is a relatively small, single-pulse accelerator that serves as a test center for other scientific projects and can be used for conducting general pulsed-power research. Pulsed-power technology being tested at the APPRM is a potential candidate technology for future accelerator development beyond Sandia National Laboratories/New Mexico's (SNL/NM's) Z-Machine.

Specific Processes, Activities, and Capabilities:

The operations and activities taking place in the APPRM are diverse, although the dominant activity is related to pulsed-power technology. APPRM is primarily used as a test bed for investigating physical design and pulsed-power issues associated with future accelerator design. None of the research involves the use of radioactive materials. Even in the "full system" configuration of the accelerator, the activation of materials from firing the accelerator is negligible.

Areas of application include

- computer science,
- simulation of X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing, and
- robotics.

APPRM operations support the following types of programs and activities:

- Experimental programs develop pulsed-power modules designed to study power storage, high-voltage switching, power flow for advanced applications, and advanced technologies in support of new designs.
- Performance Assessment Science and Technology Program develops pulsed-power sources for future incorporation into pulsed-power machines designed for weapons effects and weapons physics experiments.
- Inertial Confinement Fusion Program activities are similar to a gas switch design that eliminates the shock generated in the module and is useful to designs of future pulsed-power facilities such as the X-1 accelerator, for which the APPRM is the design prototype.

The APPRM facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are not produced at this facility.

Accelerator Hazards:

All areas of the facility have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers are provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.

Source: SNL/NM 1998a

FD–18. Advanced Pulsed-Power Research Module (APPRM)

Pulsed-power components are evaluated at the APPRM.

RADIOGRAPHIC INTEGRATED TEST STAND (RITS)

Function and Description:

The RITS is a proposed new accelerator that would be installed in the Technical Area (TA)-IV, Building 970, high bay. The purpose of this new accelerator, planned for fiscal year 1999, would be to demonstrate voltage enhancement technology utility for advanced water influenced radiography. The RITS would be an intense electron beam test center bed and would be used to develop and demonstrate the capabilities required for the national Advanced Hydrotest Facility (AHF). The AHF would provide experimental benchmarking for advanced full-physics, three-dimensional numerical models of nuclear weapon primaries. The resulting confidence in the codes would form the basis for confidence in the nuclear performance and safety of the enduring stockpile and provide critical data to qualify remanufacture technologies and lifecycle engineering.

Specific Processes, Activities, and Capabilities:

The operations and activities of the RITS would be diverse, although the dominant activity would be related to pulsed-power technology. Other research that the RITS would support includes validation of pulse-power architecture (power flow), equipment physics studies, weapons code validation, diagnostic development, and possible long-range research involving explosive component testing. The X-rays would be used to radiograph both static and dynamic (explosively driven) objects within the Building 970 high bay. Under future programs, explosive testing could be conducted within the accelerator test cell. Such explosive tests would be conducted using an approved explosive containment system that could handle explosive charges up to 30 lb of trinitrotoluene (TNT) equivalent.

Areas of application include

- computer science,
- simulation of the X-rays and gamma rays produced by a nuclear weapon detonation,
- flight dynamics,
- satellite processing,
- commercial application and technology transfer, and
- robotics.

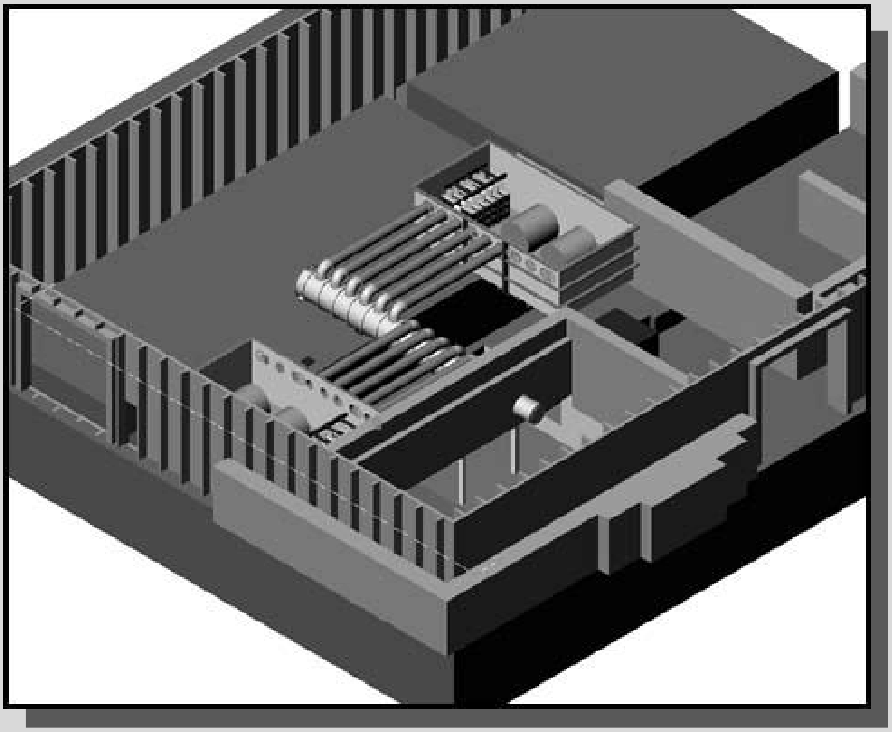
As planned, RITS operations would initially support the following Assistant Secretary for Defense Program activities:

- Radiography of both static and dynamic objects, including explosives tests in containment systems.
- Research into validating pulse-power architecture (power flow), diode physics studies, weapons code validation, and system diagnostic development.

The RITS facility would contain a small chemical inventory and a small radioactive hardware inventory. This hardware would become radioactive through high-energy activation during tests. Chemical emissions, including alcohols, ketones, and other solvents, would be possible and would be associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions would be produced when the energy releases during a test.

Accelerator Hazards:

All areas of the facility would have access control maintained by fences and gates with locking mechanisms, physical inspection, and clearing processes. In addition, confinement barriers would be provided to protect personnel and equipment from the effects of any generalized radiation or electromagnetic fields produced by the operation of the accelerator.



Source: SNL/NM 1998a

FD–19. Radiographic Integrated Test Stand (RITS)

The RITS is a proposed accelerator to replace the existing Proto II accelerator.

NEW GAMMA IRRADIATION FACILITY (NGIF)

Function and Description:

The mission of the NGIF, located in Technical Area (TA)-V, is to provide test cells for the irradiation of experiments with high-intensity gamma ray sources. Currently under construction, the NGIF will be a single-story structure located in the northeast area of TA-V. The main features of the NGIF will be the deep water pool and two dry irradiation cells. The facility will include a special air handling system, water recirculation system, and water makeup subsystem to maintain optimal operational conditions and to prevent the potential release of materials. The pool will be able to store up to 2.4 MCi of cobalt-60 or an equivalent source (40 kw) of other gamma-ray sources. The sources will be in the form of pins and could be shared between in-cell irradiation facilities and in-pool irradiation facilities. Ancillary spaces in the high bay will include offices, setup/light laboratories, and restrooms.

The NGIF consolidates several existing Sandia National Laboratories/New Mexico (SNL/NM) gamma sources into a single facility. The planned facility could include sources relocated from the existing Gamma Irradiation Facility, which is a two-cell dry irradiator located in the Annular Core Research Reactor (ACRR) high bay in TA-V. The NGIF would also include gamma sources relocated from the low-intensity cobalt array, which is located in SNL/NM's TA-I. This would consolidate gamma irradiation sources in a single dedicated facility in a remote area, reducing the potential for radiation exposure of nonoperations personnel. The main hazard associated with the facility would be the potential for inadvertent exposure of operations personnel to the high-intensity radioactive sources.

Specific Processes, Activities, and Capabilities:

Testing in the NGIF facility would include irradiation of test packages in one of the available test cells for 13,000 test hours per year (approximately 26 weeks continuous irradiation in each of 3 cells). The key consumable resources in the NGIF facility would be the radioisotope sources that provide the gamma radiation necessary to conduct the tests. The radioactivity of these radioisotope sources would diminish over time regardless of whether or not tests were being conducted. The NGIF has been designed for highly specialized high-intensity gamma ray source experiment work.

Areas of application include

- thermal and radiation effects studies,
- degradation testing of weapon components,
- material and component testing for nuclear reactor accident tests,
- electronic component certification and testing
- survivability and certification tests for military and commercial applications,
- radiation effects on material properties,
- radiation effects on organic materials (such as food or sludge),
- hazardous waste destruction, and
- mixed environment testing (such as steam and radiation or heat and radiation).

The NGIF facility would contain a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents, would be possible and would be associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions would not be produced at this facility.

Source: SNL/NM 1998a

FD–20. New Gamma Irradiation Facility (NGIF)

The three new cells being developed at the NGIF would allow complete systems to be tested during irradiating experiments.

GAMMA IRRADIATION FACILITY (GIF)

Function and Description:

The mission of the GIF, located in Technical Area-V, is to provide test cells for the irradiation of experiments with high-intensity gamma ray sources. The GIF facility shares the high bay with the Annular Core Research Reactor (ACRR) in Building 6588 and includes a deep water pool and two dry irradiation cells. The pool is a rectangular, reinforced concrete structure with a stainless steel liner, approximately 8 ft wide by 14.5 ft long by 16 ft deep. The facility also includes a special air handling system, water recirculation system, and water makeup subsystem to maintain optimal operational conditions and to prevent the potential release of materials. The main hazard associated with the facility is the potential for inadvertent exposure of operations personnel to the high-intensity radioactive sources.

Specific Processes, Activities, and Capabilities:

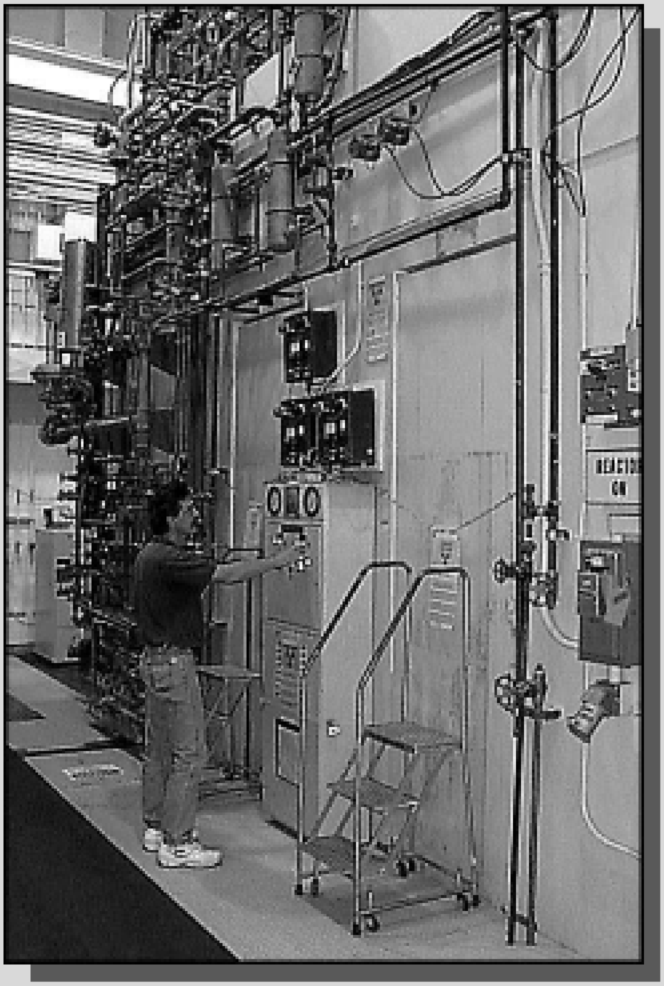
Testing in the GIF facility includes irradiation of test packages in one of the two available test cells for 1,000 test-hours (approximately 40 days of continuous irradiation in each of the two cells) per year. Current plans call for test hours to reach zero by 2003 as the New Gamma Irradiation Facility begins operation. The key consumable resource in the GIF is the radioisotope sources that provide the gamma radiation necessary to conduct the tests. The radioactivity of the radioisotope sources diminishes over time regardless of whether or not tests are being conducted. The GIF is designed for highly specialized high-intensity gamma ray source experiment work.

Areas of application include

- radiation testing of electronic components in satellite and weapon systems,
- dosimetry calibration,
- studies of radiation damage to materials,
- hostile (gamma radiation) environmental testing,
- underwater transfer of material from the reactor to transfer casks, and
- reactor fuel and other radioactive components storage.

The radioactive sources that the GIF uses are pins of cobalt-60, which are sealed in stainless steel cladding with welded end caps. Stainless steel is used as cladding because of its high strength and resistance to corrosion in water. The GIF inventory of sources includes 107 pins of cobalt-60 with a total strength of 109,100 Ci.

The GIF facility contains a small chemical inventory and no radioactive material inventory. Chemical emissions, including alcohols, ketones, and other solvents are possible and are associated with various aspects of surface preparation, cleaning, and material processing, including quality control. Radioactive air emissions are not produced at this facility.



Source: SNL/NM 1998a

FD–25. Gamma Irradiation Facility (GIF)

The GIF provides two cobalt cells for total dose irradiation environments and is used mainly for radiation certification of satellite and weapons systems electronic components, dosimetry calibration, and radiation damage to materials studies.

SANDIA PULSED REACTOR (SPR)

Function and Description:

The mission of the SPR, which includes the fast-burst reactors SPR II and SPR III, is to provide unique near-fission spectrum radiation environments for testing a wide variety of technologies that support both defense and nondefense activities. The facility, located in Technical Area-V, produces high-neutron fluence or pulsed high-neutron doses for the testing of electronic subsystems and components.

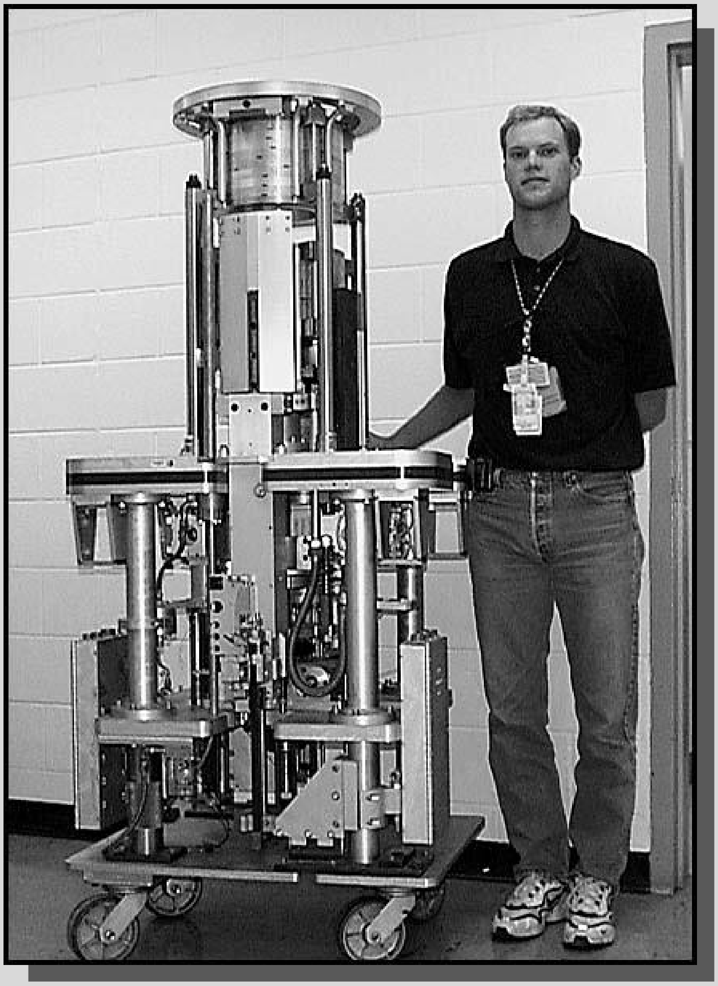
The SPR facility is located in the reactor building, a large, thick-walled, steel-reinforced concrete structure referred to as the Kiva. It is cylindrical, with an outside diameter of about 39 ft, covered with a hemispherical shell. Access to the reactor building is provided by a concrete and steel door, which remains closed for most operations. Experiment support facilities, including the reactor maintenance building and the instrument rooms, are adjacent to the reactor building. Also, several storage vaults, which are integral units in adjacent buildings, are available for the storage of the reactor and fissionable and radioactive materials.

Specific Processes, Activities, and Capabilities:

SPR III uses an unmoderated cylindrical assembly of solid uranium metal, enriched to 93 percent uranium-235 with 10 weight-percent molybdenum. SPR III can be operated at steady-state power levels; however, the capability of the nitrogen cooling system and administrative restrictions effectively limit power and total energy generated in a given period. Normally, steady-state power operations are limited to a maximum of 10 kw, although higher power levels can be achieved.

The SPR facility currently houses the SPR-II and SPR-III and is used for reactor critical experiments. Also, SPR provides a source of pulsed high-energy radiation to simulate neutron and gamma radiation effects and provide data for certifying weapons and components for hostile environments. SPR-II and SPR-III are designed to produce a neutron spectrum very similar to the fission spectrum. The primary experiment chambers are central cavities that extend through the cores. Experiments may also be placed around the reactors. Beam ports are used to transport neutron flows outside the Kiva for other experimental needs.

The SPR facility contains a small chemical inventory and a radioactive nuclear material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are produced at this facility when the energy releases during a test interact with air and produce argon-41. Small sealed radioactive sources are used for calibration and monitoring in the facility.



Source: SNL/NM 1998a

FD–24. Sandia Pulsed Reactor (SPR)

The Sandia Pulse Reactors II and III (SPR-II and SPR-III) are fast-burst core reactors capable of pulse and limited steady-state operation. SPR-II and SPR-III are used primarily for high-dose-rate testing of electronic devices.

ANNULAR CORE RESEARCH REACTOR (ACRR) – DEFENSE PROGRAMS (DP) CONFIGURATION

Function and Description:

The mission of the ACRR, operating in the DP configuration, is to provide neutron and sustained gamma pulsed environments to perform experiments, including those for DP system's components electronics testing. Part of a larger complex located in Technical Area-V, the ACRR is located in Building 6588 and is primarily a low-power research reactor facility. The facility is comprised of the reactor room, low bay, control room, building utilities, several small laboratories, and support staff offices.

The ownership of the ACRR was transferred to the U.S. Department of Energy, Office of Nuclear Energy, for application to radioisotope production. As a result, there are two options for providing an ACRR neutron effects test capability for DP if that should be required in the future: the current molybdnenum-99 ACRR could be reconfigured to allow pulse testing for a "window" of time in the molybdnenum-99 operation; or the DP configuration could be reconstituted using the existing fuel in a new tank in another location in TA-V (a detailed description is being developed).

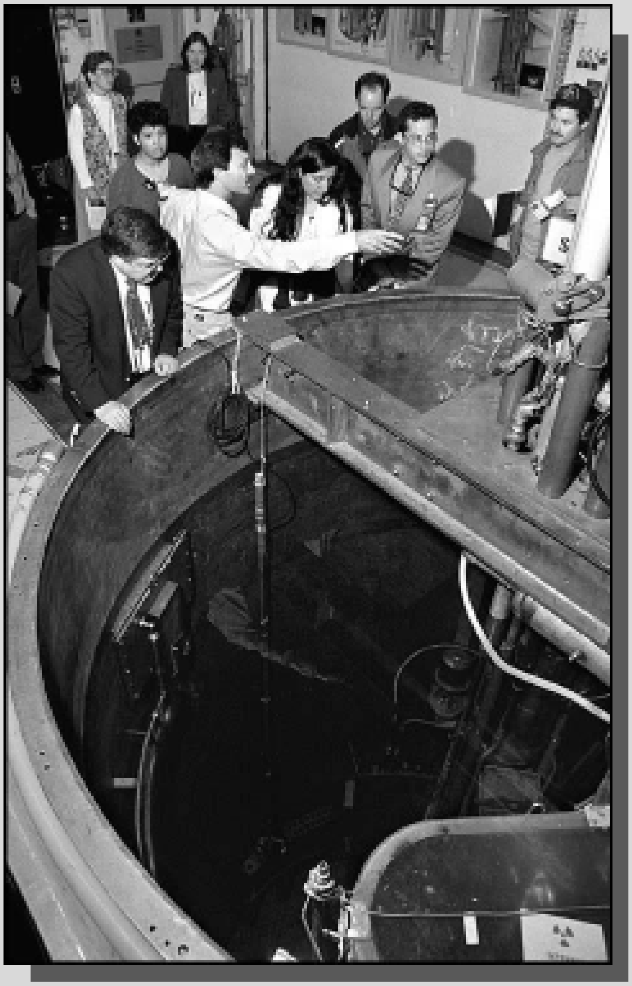
Specific Processes, Activities, and Capabilities:

The ACRR in the DP configuration is a water-moderated and -reflected, low-power research reactor that uses enriched uranium oxide-beryllium oxide cylindrical fuel elements arranged in a close-packed hexagonal lattice around a central experiment cavity. The reactor has several features for conducting experiments, including a dry cavity in the central core region and a radiography tube, and is capable of producing a high yield of high-energy neutrons in the central dry cavity over a very short period of time. The reactor is operated by means of the reactor instrumentation and control system in either the short-duration, steady-state power mode at 2 megawatts or less, or the fast-pulse mode. Specific research activities involve neutron effects on fissile components, radiation effects on various types of electronics, radiography, and testing of materials and systems.

The DOE has identified a recent short-term need to conduct a single test series related to certification of some weapons components (Weigand 1999a). This test would be conducted in the existing ACRR facility, which would have to be temporarily reconfigured to restore DP testing capability (for 12 to 18 months following the Record of Decision) (Weigand 1999b). During this time, medical isotopes preparation and validation testing would be integrated with the weapons certification testing schedule. The reconfiguration to ACRR-DP would be done so that conversion back to ACRR-medical isotope production would be more efficient.

The reconfiguration activities to restore the ACRR to the DP test configuration would mainly consist of replacing the central cavity, enabling the pulse mode of operation, reconfiguring the core fuel, reinstalling the appropriate fuel-ringed external cavity (if required), and executing the necessary battery of tests, documentation, and reviews to certify that the reconfigured reactor is operational. Tests conducted for DP could include weapons systems and components or other DP hardware. After irradiation, test packages could be stored in the ACRR storage holes or similar storage and handling space in the Sandia Pulsed Reactor facility while awaiting shipment, disposal, or examination. Following the test, these changes would be reversed to restore the reactor for isotopes production. Each reconfiguration (isotopes production-to-DP or DP-to-isotopes production) would likely take several months to complete. If a DP test is needed after a new isotopes production core (fuel elements with no pulse test capability) has been installed, the total reconfiguration time would be increased to allow for a complete core refueling to switch back to the uranium oxide-beryllium oxide fuel.

The ACRR facility contains a small chemical inventory and a radioactive nuclear material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are produced at this facility when the energy released during a test interacts with air and produces argon-41. The nuclear material inventory includes enriched uranium fuel, plutonium-239, and cobalt-60.



Source: SNL/NM 1998a

FD–21. Annular Core Research Reactor (ACRR)–Defense Programs (DP) Configuration

The ACRR is a pool-type research reactor capable of steady-state, pulse, and tailored-transient operation.

ANNULAR CORE RESEARCH REACTOR (ACRR) – MEDICAL ISOTOPES PRODUCTION CONFIGURATION

Function and Description:

The mission of the ACRR, operating in the medical and research isotopes production configuration, is the production of medical and research isotopes, primarily molybdenum-99, whose daughter, technetium-99m, is used in nuclear medicine applications. The potential exists for expanding the range of isotopes produced to cover the broad field of medical isotopes and various research isotopes. Located in Building 6588 in Technical Area-V, the ACRR is part of a larger complex that includes two other major structures, Buildings 6580 and 6581. Building 6588 comprises the reactor room, low bay, control room, building utilities, several small laboratories, and support staff offices. Operating in the medical isotopes production configuration, the facility is primarily a low-power medical isotopes production reactor facility.

Specific Processes, Activities, and Capabilities:

In the medical isotopes production configuration, the ACRR would operate for 52 weeks to irradiate targets to produce approximately 30 percent of the U.S. demand (on average) for molybdenum-99 and other isotopes such as iodine-131, xenon-133, and iodine-125. The estimates for the years 2003 and 2008 assume that the Sandia National Laboratories/New Mexico medical isotopes production program operates primarily as a backup to Nordion, Inc., the current supplier for the U.S. market, producing a nominal 30 percent of U.S. demand level. This would require the irradiation of about 375 highly enriched uranium targets per year.

The isotopes production needs may require varying scenarios 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, it is anticipated that the annual total would not exceed approximately 1,300 targets irradiated in a particular year (100 percent production level). The irradiation schedule could require reactor operations that vary from as little as a single worker shift (typically an 8-hour shift) for only a few days per week to 24-hour-per-day, 7-day-per-week operation. The U.S. Department of Energy has evaluated this program in an environmental impact statement (DOE/EIS-0249F) and has issued a record of decision that addresses operations and production levels to meet the entire U.S. demand continuously at this facility.

The long-term, steady-state operation of the reactor for isotopes production allows the associated use of the reactor for neutron irradiation, radiography experiments, and other activities that are suitable for concurrent use of the ACRR while it is in operation for the production of isotopes.

The ACRR in the medical isotopes production configuration contains a small chemical inventory and a radioactive nuclear material inventory. Chemical emissions, including alcohols, ketones, and other solvents, are possible and are associated with various aspects of surface preparation, cleaning, and material processing including quality control. Radioactive air emissions are produced at this facility when the energy released during operation interacts with air and produces argon-41. The nuclear material inventory includes enriched uranium fuel and cobalt-60.

Source: SNL/NM 1998a

**FD–22. Annular Core Research Reactor (ACRR)–
Medical Isotopes Production Configuration**

Production Site–Jeff Wemple of Isotopes Project and Compliance Initiatives Dept. 9361 peers toward the center of the ACRR where targets are placed for irradiation.

HOT CELL FACILITY (HCF)

Function and Description:

The mission of the HCF, located in Technical Area-V, is to operate primarily as a medical isotopes production facility that supports the U.S. Department of Energy's (DOE) Isotopes Production and Distribution Program (IPDP). Among other activities, the IPDP has responsibility for ensuring that the U.S. health care community has access to a reliable supply of molybdenum-99. The IPDP activities at Sandia National Laboratories/New Mexico (SNL/NM) would provide the only domestic capability to produce a continuous supply of molybdenum-99 and related medical isotopes and is currently under modification for enhanced production capability. Targets produced at Los Alamos National Laboratory are irradiated in the Annular Core Research Reactor (ACRR) and then transferred to the HCF for processing. Besides molybdenum-99, other isotopes produced in the process include iodine-131, xenon-133, and iodine-125.

Specific Processes, Activities, and Capabilities:

A few days after its production, molybdenum-99 decays to form metastable technetium-99m, the most widely used medical radioisotope in the U.S. The primary operations and capabilities of the HCF are geared to support efficient isotopes production. Experiments and chemical and material science analysis activities with radioactive and other hazardous materials can be accommodated, but would impact isotopes production. If isotopes production is low during a period, it may be possible to accommodate some limited experiments in support of other programs.

Isotopes production operations and associated capabilities of the HCF include receipt, extraction, and separation processing of molybdenum-99 from the irradiated targets. In addition, isotopes product packaging and quality sample extraction is also performed. Quality control analysis samples are produced in the ventilation hoods, using small quantities of prepared chemicals. Isotopes product final packaging is performed in the product packaging and shipping area. Finally, radioactive waste neutralization and solidification is done at the HCF prior to offsite disposal.

The HCF would process approximately 30 percent of the U.S. demand for molybdenum-99 and other isotopes, such as iodine-131, xenon-133, and iodine-125. This would require the processing of about 375 irradiated highly-enriched uranium targets per year. The production needs may require varying scenarios 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, it is anticipated that the annual total would not exceed approximately 1,300 targets processed in a particular year. The HCF associated facilities would be in use continuously for activities that fall within their operating parameters.

The predominant HCF radiological air emissions result from the chemical separation of molybdenum-99 from irradiated fission targets including isotopes of iodine, krypton, and xenon. A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (including hydrogen), liquid, and solid forms, in relatively small quantities, are used in many of these specific processes. Chemical emissions, including corrosives, alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, material processing, manufacturing, testing, and quality control.

Source: SNL/NM 1998a

FD–23. Hot Cell Facility (HCF)

The HCF at SNL/NM is a highly shielded area for the remote handling, processing, storage, and analysis of radioactive materials.

CONTAINMENT TECHNOLOGY TEST FACILITY - WEST

Function and Description:

The Containment Technology Test Facility - West conducts containment model testing for the U.S. Nuclear Regulatory Commission and the Nuclear Power Engineering Test Center, Tokyo, Japan. The facility is located in the Coyote Test Field and includes two scale-model containment buildings. One model is a 1:4 to 1:6 scale representation of a two-buttress, prestressed concrete containment structure with a flat concrete base, cylindrical sides, and hemispheric dome. The other model is a 1:8 to 1:10 scale steel containment structure that will be fabricated in Japan and shipped to Sandia National Laboratories/New Mexico for testing. All support facilities will be temporary and portable.

Both the prestressed concrete containment structure and the steel containment structure will be tested to failure by pneumatic over-pressurization with nitrogen gas. Following the test program, the sites will be restored (SNL/NM 1997b).

Specific Processes, Activities, and Capabilities:

The Containment Technology Test Facility-West operations are allocated, but not limited, to the following:

- Nuclear Regulatory Commission activities involve testing the reactor containment building.
- Other projects not associated with the U.S. Department of Energy include work for the Nuclear Power Engineering Corporation, Tokyo, Japan, and consist of activities needed to support reactor containment research and development.

Both the prestressed concrete containment structure and steel containment were constructed to be tested to failure by pneumatic overpressurization with nitrogen gas. Operations include planning, analysis, instrumentation, pressure testing, and data acquisition.

A variety of chemicals (adhesives, corrosives, solvents, organics, and inorganics) in gaseous, liquid, and solid forms in relatively small quantities will be used in material handling and maintenance. Small quantities of air emissions result during operations. Radioactive air emissions are not produced at this facility. Noise generation during construction should be moderate, and the sound pressure wave from catastrophic failure testing of the models will dissipate to below 145 dB at the boundary of the exclusion zones.

Source: SNL/NM 1998a

FD–26. Containment Technology Test Facility - West

EXPLOSIVES APPLICATIONS LABORATORY (EAL)

Function and Description:

The mission of the EAL, located in Building 9930 in the Coyote Test Field, is to support the design, assembly, and testing of explosive experiments. The facility is essentially a laboratory used to design, assemble, and test explosives. The EAL is a low-hazard, nonnuclear facility.

Specific Processes, Activities, and Capabilities:

The EAL is used to test the performance of explosive or energetic materials together with materials and components as part of various systems or subsystems. Other activities include fabrication and assembly of explosion test packages and operation of a small machine shop.

Operations at the EAL support the following programs and initiatives:

- U.S. Department of Energy (DOE) Direct Stockpile Activities in support of research, development, application, and surveillance of energetic materials and components.

- Experimental activities support the development and testing of a full range of explosive devices, components, subsystems, and complete systems. The site is also used for activities that support Nuclear Safety testing requirements, Nuclear Emergency Search Team activities and other similar programs

- Work for other agencies not associated with the DOE in the development and testing of explosive devices, components, subsystems, and complete systems in support of nuclear safety testing requirements.

A variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous (acetylene for welding), liquid, and solid forms, in relatively small quantities, are used for surface preparation, cleaning, material processing, fabrication of test parts, pre-explosive testing, and quality control. Associated emissions include corrosives, alcohols, ketones, and other solvents. Additional emissions are associated with the conduct of outdoor explosive tests. Nondestructive tests, using X-rays and lasers, are conducted within the facility.

Source: SNL/NM 1998a

FD–26. Explosives Applications Laboratory

The EAL is used to design, assemble, and test explosives.

AERIAL CABLE FACILITY

Function and Description:

The primary mission of the Aerial Cable Facility, located in the Coyote Test Field, is to help ensure that the nation's nuclear weapons systems meet the highest standards of safety and reliability. The Aerial Cable Facility is a restricted-access field test facility consisting of several cables spanning Sol Se Mete canyon. The Aerial Cable Facility comprises a control building, explosives assembly building, instrument bunker, and several explosive storage facilities (magazines and igloos). The complex conducts precision testing of full-scale, air-deliverable weapon systems using realistic target engagement scenarios for verification of design integrity and performance. Activities at the facility include explosives storage and assembly, rocket motor staging and assembly, and test data collection.

Specific Processes, Activities, and Capabilities:

Testing activities at the Aerial Cable Facility include gravitational accelerated (drop) tests and rocket sled pull-down tests. The rocket pull-down technique uses towing cables to accelerate rocket sleds carrying the test items. The test items are released from the overhead cable as the rockets are ignited and directed toward a target. Multiple types of targets can be simulated for worst-case scenarios involving weapons systems, defensive systems, shipping containers, and transportation systems.

Operations at the Aerial Cable Facility support the following programs and initiatives:

- U.S. Department of Energy (DOE) programs in support of Direct Stockpile Activities involving environmental, safety, and survivability testing for nuclear weapons applications.

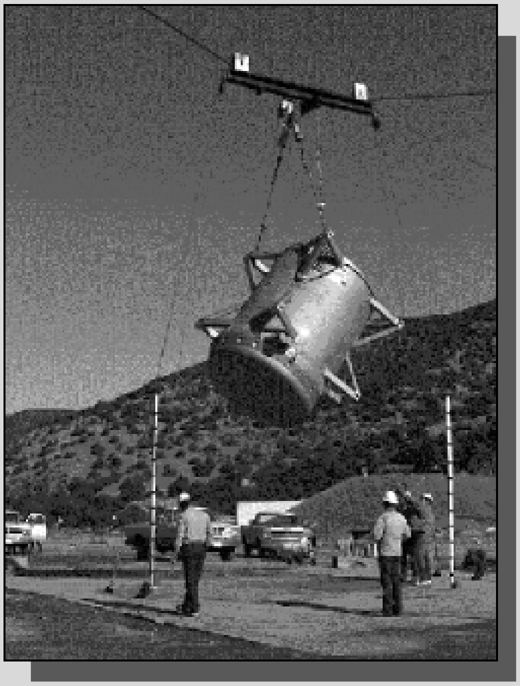
- Joint-funded Research and Development Special Projects between the DOE and the U.S. Department of Defense to exploit and transfer the technology base resident at the DOE national laboratories for the development of advanced, cost-effective, nonnuclear munitions.

- Performance Assessment, Science, and Technology support to the DOE to provide full-scale, highly instrumented impact environments, aircraft crash environments, captive flight, and missile intercept simulation, as well as providing elevated hoisting capability for advanced sensor development and parachute testing.

- Support to Major Program Initiatives such as sustaining Critical Progress in Model Validation designed to provide controlled environments for high-velocity experiments in code validation, such as penetrator performance in frozen soil.

- Work for other entities that are not associated with the DOE, including aerial targets tests and drop/pull-down tests.

Operations require the use of a variety of chemicals (corrosives, solvents, organics, and inorganics) in gaseous, liquid, and solid forms, in relatively small quantities. No radioactive emissions are produced at this facility. Compressed gases used in the assembly areas include acetylene and oxygen (for welding), argon, and helium. There are some chemical emissions, including alcohols, ketones, and other solvents. Small amounts of airborne emissions, including carbon monoxide and lead, are released during explosives tests. Operations associated with preparation of test payloads, fixtures, and rocket sleds involve machining that generates residues, bonding of parts with epoxies, cleaning of parts, and wiping of excess materials.



Source: SNL/NM 1998a

FD–27. Aerial Cable Facility

The Aerial Cable Facility is used for drop tests and rocket sled pull-down tests.

LURANCE CANYON BURN SITE

Function and Description:

The mission of the Lurance Canyon Burn Site, located in the Coyote Test Field, is to help ensure that the nation's nuclear weapons systems meet the highest standards of safety and reliability. The facility is specifically designed for the validation of analytical modeling and the functional certification of weapons systems. The Lurance Canyon Burn Site is also used to test and evaluate the design integrity and performance of weapon components and shipping containers in the event of their accidental exposure to various fires. In addition, the Lurance Canyon Burn Site is used extensively for transportation package certification and to verify designs in transportation technology.

Specific Processes:

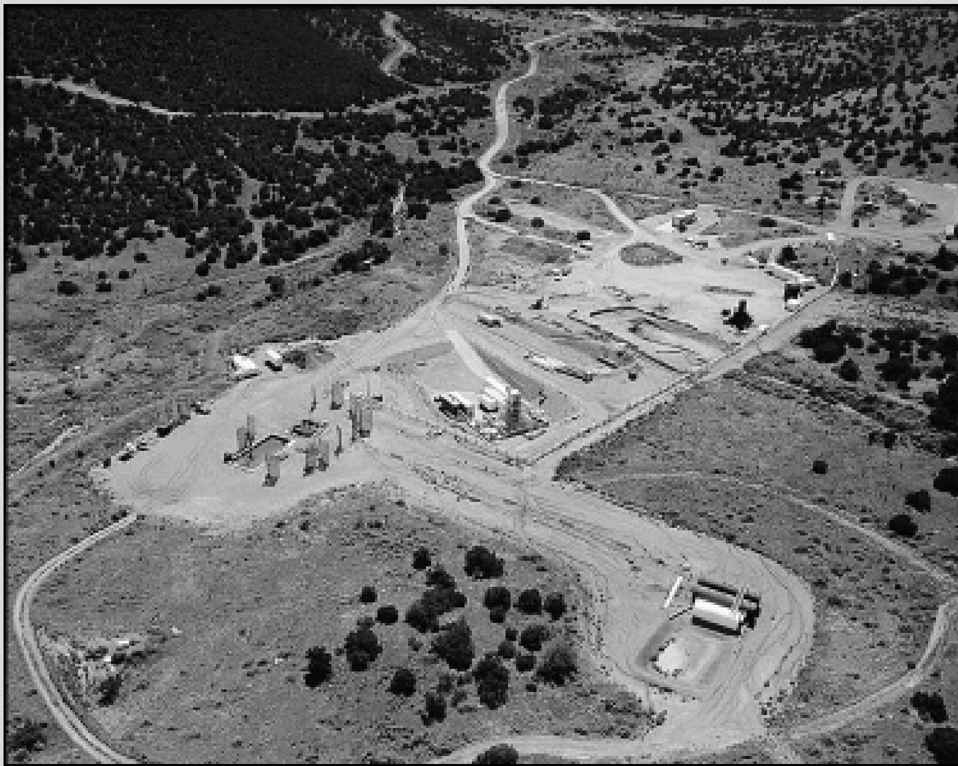
Aviation fuel fire tests are conducted at a combination of outdoor and indoor test facilities. There are four outdoor test areas with water pools to simulate the burning of fuels spilled on open water surfaces. Various test objects may be placed on pool surfaces during test events. Duration of test fires vary from 60 to 150 minutes. The principal emission products from aviation fuel fires are carbon dioxide, carbon soot, and very small amounts of carbon monoxide.

There are three indoor test facilities used for conducting tests similar to those performed outdoors (that is, on the surface of water), but under more controlled conditions (that is, no wind), per test specifications and to provide emission controls when required. Operations at the Lurance Canyon Burn Site support the following programs and initiatives:

- U.S. Department of Energy (DOE) Direct Stockpile Activities in support of Environmental, Safety, and Survivability testing for nuclear weapon applications.
- DOE Performance Assessment Science and Technology Programs to simulate fuel fire environments for testing and certification of weapon systems and components.
- DOE Programs in support of Environmental Technology Management.
- Support to Major Program Initiatives such as sustaining Critical Progress in Model Validation to verify models for fire characterization such as air and fuel mixing, vortices, soot production and destruction, soil and fuel interactions, and enclosure fires driving a hot-gas layer as a function of ventilation; and model validation of component and system response, such as fire-induced response of polyurethane foam, devolitization processes, and burn front movement.
- Work for other entities not associated with the DOE for research and development activities in the national interest. Major Program Initiatives such as Energy Programs including support to Transportation Package Certification Programs to verify designs in Transportation Technology.

There is also an outdoor test facility that uses wood fires or crib fires for certifying U.S. Department of Transportation explosive component shipping containers.

To support test preparations, the Lurance Canyon Burn Site contains a small chemical inventory but no radioactive material. Chemical emissions, including alcohols, ketones, and other solvents, are associated with various aspects of surface preparation, cleaning, and material processing including quality control of test packages. The Lurance Canyon Burn Site has been classified a low-hazard, nonnuclear facility.



Source: SNL/NM 1998a

FD–28. Lurance Canyon Burn Site

The Lurance Canyon Burn Site is used to test shipping containers and weapons components.

THUNDER RANGE COMPLEX

Function and Description:

Historically, the mission of the Thunder Range Complex, located southeast of Technical Area-III, has been environmental, safety, and survivability testing of nuclear weapon components. Current activities at the site are primarily associated with the disassembly, inspection, and documentation of special items, such as nonnuclear munitions. The complex includes other capabilities, such as outdoor explosives or shock-tube testing, although none is scheduled or planned in the foreseeable future.

Specific Processes, Activities, and Capabilities:

The specific processes at the Thunder Range Complex are focused on the evaluation of test materials. Evaluation activities involve physical examination, cleaning, mechanical disassembly, physical measurement, sampling, and photography of test materials.

The Thunder Range Complex also has a combination of essential characteristics not available at any other single Sandia National Laboratories/New Mexico location. These include

- conductive floors and grounding provisions for handling explosives;
- explosive storage bunkers;
- alarms and security provisions for "vault classification," allowing for classified work;
- established explosive quantity distance boundaries; and
- a 4,000-lb explosive materials handling rating.

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

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 a year for this activity, or used only 1 to 2 days per month throughout the year. Operations and activities occurring at the Thunder Range Complex support the following programs and initiatives:

- Direct Stockpile Activities conduct survivability testing of nuclear weapon systems and components.
- Arms Control and nonproliferation activities include conventional weapon disassembly and inspection work.
- Special Projects include projects not associated with the U.S. Department of Energy (DOE) involving disassembly, inspection, and evaluation.
- Work for other agencies not associated with the DOE for the disassembly, inspection, and documentation of special items, including special nonnuclear munitions, and joint work with the U.S. Air Force Research Laboratory (formerly called Phillips Laboratory or Air Force Weapons Laboratory). Use of Thunder Range for the placement of targets for testing airborne sensors may also be performed in support of various U.S. Department of Defense (DoD) agencies.

- DOE Programs in Arms Control and Nonproliferation for disassembly and inspection.
- DOE and DoD support to Nonproliferation Verification Research and Development, including aerial observation activities.

The Thunder Range Complex maintains a small inventory of chemicals, but no radioactive material inventory. Various aspects of the preparation and evaluation of test materials can result in emissions from a variety of solvents, including alcohols and ketones. Although sealed sources are not part of any permanent inventory at the Thunder Range Complex, they may also be present at the complex as part of a test sponsor's radiation monitoring device. Radioactive air emissions are not produced at this facility.

Source: SNL/NM 1998a

FD–29. Thunder Range Complex

The Thunder Range Complex is used for testing explosives.

STEAM PLANT

Function and Description:

The mission of the steam plant is to provide uninterrupted steam supply through a steam distribution system to all of Sandia National Laboratories/New Mexico Technical Area (TA)-I and Kirtland East. The steam is used for heating domestic hot water and for building heat and freeze protection. The steam is also essential to various other programmatic missions, such as those conducted at the Standards Laboratory and the Microelectronics Development Laboratory.

Specific Processes, Activities, and Capabilities:

The steam plant consists of five operational boilers with supporting systems that supply steam to TA-I buildings, U.S. Department of Energy buildings, and U.S. Air Force buildings from Eubank to Pennsylvania Boulevards and from O Street to the Wyoming Boulevard base gate. For the majority of buildings in TA-I, steam is the only heating medium used; therefore, during winter months, the plant is a critical operation because it could have a direct impact on the mission of the laboratories.

The five boilers in the plant are all dual-fired (dual-fuel capability) and collectively have the capacity to provide 370,000 lb per hour of steam to the distribution system. This capacity is much greater than the current or anticipated supply requirements. The boilers are primarily fired on natural gas and use #2 diesel fuel as an emergency backup during natural gas pressure interruptions.

The steam plant contains a chemical inventory and no radioactive material inventory. Chemicals include phosphate, sulfite, amine, and salt to maintain water and steam quality. Chemical emissions include alcohols, ketones, and other solvents. Emissions from other cleaning agents are possible and are associated with various aspects of boiler preparation, cleaning, and steam production quality control. Criteria pollutants are produced from the burning of an estimated 779 million standard cubic feet of natural gas to supply 544 million pounds of steam annually. Radioactive air emissions are not produced at this facility. For backup fuel, 1.5 million gallons of diesel fuel are stored in reserve.

Source: SNL/NM 1998a

FD–30. Steam Plant

The steam plant provides steam to TA-I and Kirtland East.

HAZARDOUS WASTE MANAGEMENT FACILITY (HWMF)

Function and Description:

The HWMF, located in Technical Area–II, performs safe handling, packaging, short-term storing, and shipping (for recycling, treatment, or disposal) of all nonradioactive *Resource Conservation and Recovery Act* (RCRA)-regulated and other hazardous and toxic waste categories (except explosives). The HWMF is a low-hazard facility that consists of two permanent buildings: the Waste Packaging Building (Building 959) and the Waste Storage Building (Building 958). Both buildings are located within an 8-ft-high single fence enclosure. Additionally, the following structures are located at the facility within the fenced area:

- six supply sheds,
- two self-contained prefabricated storage structures,
- a waste oil storage area,
- a catchment pond, and
- three office trailers.

Specific Processes, Activities, and Capabilities:

Hazardous, nonradioactive chemical waste (excluding explosive waste), which is generated by Sandia National Laboratories (SNL) operations described in the RCRA Part B Permit, is collected and transported to the HWMF for packaging and short-term (less than 1 year) storage prior to offsite transportation for recycling, treatment, or disposal at a licensed facility. The waste is managed in accordance with the RCRA Part B Permit. The HWMF also manages small amounts of waste from other SNL or U.S. Department of Energy (DOE) operations, such as SNL's Advanced Materials Laboratory on the University of New Mexico campus in Albuquerque or the DOE's Albuquerque Operations Office.

In the normal conduct of business, contract personnel use a variety of power equipment such as hydraulic drum handlers and empty drum compactors, forklifts, lift trucks, flatbed trucks, and hauling trucks. Personnel routinely handle containers of various nonradioactive hazardous waste, including oxidizers, flammable waste, and irritants. Personnel typically handle waste on a day-to-day basis.

No radioactive materials and no explosive materials are managed at the HWMF. Chemical emissions are small and related to the waste handled in the HWMF.

Source: SNL/NM 1998a

FD–31. Hazardous Waste Management Facility (HWMF)

The HWMF is used for handling, packaging, short-term storing, and shipping of nonradioactive RCRA waste and other hazardous and toxic waste.

RADIOACTIVE AND MIXED WASTE MANAGEMENT FACILITY (RMWMF)

Function and Description:

The RMWMF at Sandia National Laboratories (SNL)/New Mexico serves as a centralized facility for receipt, characterization, compaction, treatment, repackaging, certification, and storage of low-level waste (LLW), transuranic (TRU) waste (including mixed TRU), and low-level mixed (LLMW) waste. The RMWMF is used for extended storage until disposal (or treatment) sites are identified that could accept these materials. The RMWMF is located in the southeastern portion of Technical Area-III and includes Buildings 6920, 6921, and 6925, and the land, structures, and systems on the paved area within the compound fence. Building 6920 is known as the Waste Management Facility; Building 6921 is the Waste Assay Facility; and Building 6925 is the Waste Storage Facility. Other structures include prefabricated, skid-mounted storage buildings (used for storage of reactive waste, flammable waste, and compressed gas cylinders); a paved outdoor LLW and LLMW storage area; an unpaved (gravel) outdoor storage area for LLW; a lined retention pond designed to hold site surface water runoff, the sprinkler discharge from a design fire, and fire-hose streams; and office trailers.

Building 6920 is designed to manage classified and unclassified waste and includes waste storage and staging areas, drum compactor rooms, and areas for *Resource Conservation and Recovery Act* (RCRA)-regulated hazardous waste treatment. Buildings 6921 and 6925 are used for limited RCRA-regulated hazardous waste storage and treatment activities. Building 6921 provides waste characterization capabilities. The maximum storage capacity at the RMWMF is approximately 285,000 ft^3.

Specific Processes, Activities, and Capabilities:

Activities at the RMWMF include unpacking, sorting, repackaging, sampling, storing, staging, treating (dewatering, separating, neutralizing, solidifying, stabilizing, amalgamating, cutting, decontaminating, and compacting), and preparing waste for offsite shipment to a permitted disposal site. Most of this waste is generated by SNL. Small amounts may be generated by other SNL or U.S. Department of Energy (DOE) activities such as DOE funded research at the lovelace Respiratory Research Institute at Kirtland Air Force Base.

Most LLMW stored in Buildings 6920 and 6921 exhibits the characteristic of toxicity (for example, from heavy metals), or contains RCRA F-listed constituents (such as paper products contaminated with trace quantities of solvents). Negligible quantities of corrosive, ignitable, or reactive waste are stored in Buildings 6920 and 6921. Reactive, ignitable, and flammable waste and combustible liquid waste are stored in skid-mounted storage sheds that are located at a safe distance from the buildings. Liquid waste is stored with secondary containment.

Hazard control at the RMWMF is maintained by using the following engineered features, as needed: waste containers, secondary containment, glove boxes, fume hood, air supply and exhaust systems, high-efficiency particulate air filters, air monitoring systems, radiation area monitor system, breathing air supply, fire detection and notification system, fire suppression system, and backup electrical power generator.

Operations that generate radioactive air emissions include preparation of tritium waste for shipment in Building 6920. Radioactive air emissions are monitored through the use of stack monitors. All detectable releases are from tritium, based on sampling the stack effluent. Small sealed radioactive sources are stored at the RMWMF. Some sealed radioactive sources are used for calibrating equipment, such as emission stack monitors. Chemical emissions are small and related to the waste handled in the RMWMF.

Source: SNL/NM 1998a

FD–32. Radioactive And Mixed Waste Management Facility (RMWMF)

The RMWMF is used for characterization, repackaging, and certification of radioactive waste.

THERMAL TREATMENT FACILITY (TTF)

Function and Description:

The TTF, located in the northeast corner of Technical Area-III, is used to thermally treat (burn) small quantities of waste explosive substances, waste liquids (for example, water and solvents) contaminated with explosive substances, and waste items (for example, rags, wipes, and swabs) contaminated with explosive substances. No radioactive waste is treated at the Thermal Treatment Facility.

The TTF consists of a square burn pan of 3/8-inch steel, 29.25 inches on each side and 5-5/8 inches deep. A remotely operated metal lid can be raised to open or lowered to cover the burn pan. A grated metal cage, which is open to the air and is approximately 4 ft on each side and 8 ft tall, encloses the burn pan. The burn cage sits in the center of a steel-lined concrete pad approximately 13 ft on each side with a 4-inch-high curb at the perimeter. The concrete pad is surrounded on the west, south, and east sides by an 8-ft-tall earthen berm. An 8-ft-high chain link security fence surrounds the entire TTF. Three gates, located on the north side of the fence, provide access to the facility. A door on the north side of the burn cage provides access to the burn pan.

Specific Processes, Activities, and Capabilities:

The TTF conducts thermal treatment of CHNO (comprised entirely of elemental carbon, hydrogen, nitrogen, and oxygen) explosives; waste propellants and pyrotechnics; waste items that are contaminated with CHNO high explosives, waste propellants, and pyrotechnics; and liquids that are contaminated with CHNO high explosives, waste propellants, and pyrotechnics.

Emissions include carbon monoxide, nitrogen compounds, sulfur compounds, and other compounds associated with the specific type of explosive material treated.

Source: SNL/NM 1998a

FD–33. Thermal Treatment Facility (TTF)

CHAPTER 3

Alternatives for Continuing Operations at SNL/NM

This chapter describes the three alternatives the U.S. Department of Energy (DOE) has analyzed in detail regarding continuing operations at Sandia National Laboratories/New Mexico (SNL/NM). It describes the activities and the level of activities, which will vary depending on the alternative analyzed, at SNL/NM's selected facilities. In addition, the chapter identifies the alternatives the DOE has considered, but not analyzed in detail because they were not reasonable. It concludes by summarizing the comparison of the environmental consequences of the three alternatives.

3.1 INTRODUCTION

Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508) require that the DOE and other Federal agencies use the review process established by the *National Environmental Policy Act* (NEPA) of 1969, as amended (42 United States Code [U.S.C.] 4321 *et seq.*) and the DOE regulations implementing NEPA (10 CFR Part 1021) to evaluate not only the proposed action, but also to identify and review reasonable alternatives to the proposed action, as well as a "no action" alternative. This comprehensive review ensures that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The alternatives are central to an environmental impact statement (EIS).

The proposed action for the Site-Wide Environmental Impact Statement (SWEIS) is to continue to operate SNL/NM as a DOE national laboratory. The DOE, with public input, developed three alternatives to accomplish this proposed action and assess environmental impacts of activities at SNL/NM. This chapter examines and compares the three alternatives. For clarity and brevity, the descriptions of the alternatives in the text (Sections 3.2, 3.3, and 3.4) and in the tables (Section 3.6) focus on significant distinguishing features that characterize the variation of activities across alternatives. More complete descriptions of the activities at SNL/NM are provided by facility in Chapter 2. All of the activities discussed in Chapter 2 were used in evaluating the impacts of each alternative. The alternatives are defined below.

- *No Action Alternative (Section 3.2)*
- *Expanded Operations Alternative (Section 3.3)*
- *Reduced Operations Alternative (Section 3.4)*

These three alternatives represent the range of levels of operation necessary to carry out DOE mission lines, from the minimum levels of activity that maintain core capabilities (Reduced Operations Alternative) to the highest reasonable activity levels that could be supported by current facilities, and the potential expansion and construction of new facilities for specifically identified future actions (Expanded Operations Alternative).

DOE work assignments to SNL/NM are based on using existing personnel and facility capabilities, as described in Chapters 1 and 2. The DOE has examined the various activity levels typical of past SNL/NM operations (generally within the past few years), and assumes that future work descriptions will resemble current and recent activities.

The three alternatives represent the range of operating levels that could be reasonably implemented in the 10-year time frame of the SWEIS analysis (1998-2008). Many of SNL/NM's ongoing and planned activities do not vary by alternative. The No Action Alternative reflects currently planned activities or projects, some of which may already have NEPA documentation and analysis (Section 2.3.3).

Table 3.1–1 provides a brief summary of the facilities evaluated in this SWEIS. Table 3.6–1 (see Section 3.6) provides an expanded look at the materials used and wastes generated at each facility.

In order to provide comprehensive baseline data from which operational levels could be projected, the DOE gathered the best-available data representing the facilities' normal levels of operation. In most cases, the base year for data was 1996. For some facilities, several years of data were gathered in order to determine normal trends. Facilities that have base years other than 1996 are noted in the tables in Section 3.6. Also, note that projected activity levels under the Reduced Operations Alternative could be above the base years' because some facilities were operating below the minimum levels of activity necessary to maintain core capabilities or facilities were not yet in full operation (Section 3.4).

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Neutron Generator Facility	Development or production of devices, processes, and systems	Neutron generators	Neutron generators	600	2,000	2,000	2,000	2,000
Microelectronics Development Laboratory	Development or production of devices, processes, and systems	Microelectronic devices and systems	wafers	4,000	5,000	7,000	7,500	2,666
Advanced Manufacturing Processes Laboratory	Development or production of devices, processes, and systems	Materials, ceramics/glass, electronics, processes, and systems	operational hours	248,000	310,000	310,000	347,000	248,000
Integrated Materials Research Laboratory	Other	Research and development of materials	operational hours	395,454	395,454	395,454	395,454	363,817
Explosive Components Facility	Test activities	Neutron generator tests	tests	200 (FY 1998)	500	500	500	500
		Explosive testing	tests	600	750	850	900	300
		Chemical analysis	analyses	900	950	1,000	1,250	500
		Battery tests	tests	50	60	60	100	10

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
PHYSICAL TESTING AND SIMULATION FACILITIES								
Terminal Ballistics Complex	Test activities	Projectile impact testing	tests	50	80	100	350	10
		Propellant testing	tests	25	40	50	100	4
Drop/Impact Complex	Test activities	Drop test	tests	18	20	20	50	0
		Water impact	tests	1	1	1	20	1
		Submersion	tests	1	1	1	5	0
		Underwater blast	tests	0	2	2	10	0
Sled Track Complex	Test activities	Rocket sled test	tests	10	10	15	80	2
		Explosive testing	tests	12	12	12	239	0
		Rocket launcher	tests	3	4	4	24	0
		Free-flight launch	tests	40	40	40	150	0
Centrifuge Complex	Test activities	Centrifuge	tests	32	46	46	120	2
		Impact	tests	0	10	10	100	0

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
ACCELERATOR FACILITIES								
SATURN	Test activities	Irradiation of components or materials	shots	65	200	200	500	40
HERMES III	Test activities	Irradiation of components or materials	shots	262	500	500	1,450	40
Sandia Accelerator & Beam Research Experiment	Test activities	Irradiation of components or materials	shots	187	225	225	400	0
Short-Pulse High Intensity Nanosecond X-Radiator	Test activities	Irradiation of components or materials	shots	1,185	2,500	2,500	6,000	200
Repetitive High Energy Pulsed Power Unit I	Test activities	Accelerator tests	tests	500	5,000	5,000	10,000	100
Repetitive High Energy Pulsed Power Unit II	Test activities	Radiation production	tests	80	160	160	800	40
Z-Machine	Test activities	Accelerator shots	shots	150	300	300	350	84
Tera-Electron Volt Semiconducting Linear Accelerator	Test activities	Accelerator shots	shots	40	1,000	1,000	1,300	40

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Advanced Pulsed Power Research Module	Test activities	Accelerator shots	shots	500	1,000	1,000	2,000	40
Radiographic Integrated Test Stand	Test activities	Accelerator shots	shots	0	400	600	800	100
REACTOR FACILITIES								
New Gamma Irradiation Facility	Test activities	Tests	hours	0	13,000	13,000	24,000	0
Gamma Irradiation Facility	Test activities	Tests	hours	1,000	0	0	8,000	0
Sandia Pulsed Reactor	Test activities	Irradiation tests	tests	100	100	100	200	30
Annular Core Research Reactor (DP for No Action and Reduced Operations Alternatives, ACPR-II for Expanded Operations Alternative)	Test activities	Irradiation tests	test series	0	1	0	2 to 3	0
		Fissile component tests	tests	0	0	0	2	0
		Materials/ electronics tests	tests	0	0	0	6	0

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Annular Core Research Reactor (medical isotopes production configuration)	Test activities	Irradiation of production targets	targets	8	375	375	1,300	40
Hot Cell Facility	Development or production of devices, processes, and systems	Processing of production targets	targets	8	375	375	1,300	40
OUTDOOR TEST FACILITIES								
Aerial Cable Facility	Test activities	Drop/pull-down	tests	21	32	38	100	2
		Aerial target	tests	6	6	6	30	0
		Scoring system tests	series	0	1	1	2	0
Lurance Canyon Burn Site	Test activities	Certification testing	tests	12	12	12	55	1
		Model validation	tests	56	56	56	100	0
		User testing	tests	37	37	37	50	0
Containment Technology Test Facility - West	Test activities	Survivability testing	tests	1	1	0	2	1
Explosives Applications Laboratory	Test activities	Explosive testing	tests	240	240	240	275 to 360	50

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Thunder Range Complex	Other	Equipment disassembly and evaluation	days	60	82	82	144	42
	Test activities	Ground truthing tests	test series	1	5	8	10	1
INFRASTRUCTURE FACILITIES								
Steam Plant	Infrastructure	Generate and distribute steam to DOE, TA-I, KAFB East, Coronado Club	lb	544 M	544 M	544 M	544 M	362 M
Hazardous Waste Management Facility	Infrastructure	Collection, packaging, handling, and short-term storage of hazardous and other toxic waste[b]	kg	203,000	192,000	196,000	214,000	175,000
	Waste managed[c]	RCRA hazardous waste	kg	55,852	70,469	74,358	92,314	53,123
Radioactive and Mixed Waste Management Facility	Infrastructure	Receipt, packaging, and shipping of radioactive waste[d]	lb	1.6 M	2.1 M	2.1 M	2.7 M	0.8 M
	Waste managed[c]	Low-level waste	ft^3 (m^3)	11,874 (337)	15,436 (438)	15,436 (438)	19,592 (556)	5,937 (168)

Table 3.1–1 Summary of Facility Activity Levels Used as the Basis of Alternatives Analysis (concluded)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (per year)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE (2008)	REDUCED OPERATIONS ALTERNATIVE (2008)
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Thermal Treatment Facility	Infrastructure	Treatment of waste	lb	Minimal	336	336	1,200	Minimal

Source: SNL/NM 1998a
ACPR: Annular Core Pulsed Reactor
DOE: U.S. Department of Energy
DP: Defense Programs
FTE: full-time equivalent
FY: fiscal year
HERMES: High Energy Radiation Megavolt Electron Source
KAFB: Kirtland Air Force Base
lb: pound
RCRA: *Resource Conservation and Recovery Act*
TA: technical area
TSCA: *Toxic Substances Control Act*
[a] Base year is the year selected as most representative of normal operations (SNL/NM 1998ee).
[b] Larger number is a total including TSCA waste, other solid waste, recyclable materials, and inventory (non-RCRA).
[c] Numbers do not represent totals (generation), only quantities to be managed by the specific facility.
[d] Includes inventory.

The DOE is not revisiting any programmatic decisions previously made in other NEPA documents, such as those addressing weapons complex consolidation and reconfiguration, materials disposition, or waste management. The SWEIS includes these programmatic activities in order to provide the DOE and the public with an overall understanding of the activities at SNL/NM.

Many of the selected facilities are primarily engaged in activities supporting the DOE's national security mission. Other facilities are engaged in neutron science and research and development (R&D) efforts, such as materials research, radiochemistry, and health research. The DOE examined specific activities performed at SNL/NM facilities that relate to issues identified from public input, the DOE mission lines, and the potential for environmental impacts.

The DOE has not selected a preferred alternative, but will identify the preferred alternative in the Final SWEIS. The preferred alternative could be a hybrid or combination of the three alternatives presented in the Draft SWEIS. At this time, the DOE does not know what this combination might be.

> **Organization of Chapter 3**
>
> **Sections 3.2** through **3.4** describe the activities that would occur at selected facilities under each of the three alternatives.
>
> **Section 3.5** describes alternatives that were considered but eliminated from detailed analysis.
>
> **Section 3.6** compares the environmental consequences of the three alternatives.

3.2 NO ACTION ALTERNATIVE

Summary Description

Under the No Action Alternative, ongoing DOE and interagency programs and activities at SNL/NM would continue the status quo, that is, operating at planned levels as reflected in current DOE management plans. In some cases, these planned levels include increases over today's operating levels. This would also include any recent activities that have already been approved by DOE and have existing NEPA documentation.

The CEQ's NEPA implementing regulations (40 CFR Parts 1500-1508) require analyzing the No Action Alternative to provide a benchmark against which the impacts of the activities presented in the other alternatives can be compared. The No Action Alternative analysis includes current operations and ongoing and planned environmental restoration activities. Some of these activities have already had NEPA review. It also includes any approved and interim actions and facility expansion or construction, where detailed design and associated NEPA documentation were completed by the end of March 1998. The analysis also includes facilities, including new construction and upgrades, for which NEPA documents have been prepared, decisions made, and funds allocated in the fiscal year 2000 planning year budget (submitted in 1998).

3.2.1 Basis for Current Planned Operations

DOE management plans include continued support of major DOE programs, such as Defense Programs (DP), Nuclear Energy, Fissile Material Disposition, Environmental Management, and Science. They also include projects to maintain existing facilities and capabilities and projects for which a NEPA determination has been made (for example, the Medical Isotopes Production Project).

Other plans used to prepare the description of the No Action Alternative include the site development plans for SNL/NM, interagency agreements between the DOE and the U.S. Department of Defense (DoD), programmatic environmental impact statements (PEISs), Presidential Decision Directives, and DOE Work for Others (WFO) proposals and guidance. Some documents have future projects included for planning purposes; others have been deleted due to lack of funding or other reasons. The activities reflected in this alternative include planned increases in some SNL/NM operations and activities over previous years' levels (for example, medical isotopes production). There may also be decreases in some SNL/NM activities (for example, a decrease in certain outdoor testing activities).

The *Facilities and Safety Information Document* (SNL/NM 1997b, SNL/NM 1998ee) and facility source documents (SNL/NM 1998a) provide in-depth information concerning the activities, operations, and hazards of selected facilities. These documents have been used extensively to describe the following facility activities in this chapter. The facilities discussed below are also described in detail in the Facility Descriptions following Chapter 2. For most facilities, the base year considered is 1996. The base year for the Neutron

Generator Facility (NGF) is 1998, the first year in which the facility will have achieved its initially planned level of production.

3.2.2 Selected Facilities in Technical Areas-I and -II

Under the No Action Alternative, the following activities would take place at the facilities in Technical Areas (TAs)-I and -II.

3.2.2.1 Neutron Generator Facility

Under all alternatives, the NGF, TA-I, would continue to be used to fabricate neutron generators and neutron tubes. Support activities would include a wide variety of manufacturing, testing, and product development techniques and processes. An addition to an existing building would be constructed to meet production projections. Additionally, Building 870 would undergo extensive renovations. Approximately 2,000 neutron generators and associated neutron and switch tubes would be manufactured per year by 2008.

3.2.2.2 Microelectronics Development Laboratory

The Microelectronics Development Laboratory (MDL), TA-I, would continue to be used to conduct R&D activities on microelectronic devices for nuclear weapons. A broad range of microtechnology development and engineering activities, including integrated circuit and wafer production, would occur. Approximately 4,000 wafers would be produced in the base year, increasing to 5,000 wafers by 2003 and 7,000 wafers by 2008.

3.2.2.3 Advanced Manufacturing Process Laboratory

Advanced manufacturing technologies are developed and applied at the Advanced Manufacturing Process Laboratory (AMPL), TA-I. Under this alternative, AMPL activities would include hardware manufacturing, emergency and prototype manufacturing, development of manufacturing processes, and design and fabrication of production equipment. The activities conducted in the AMPL would be typical of other laboratories and small-scale manufacturing plants working with ceramics, glass, plastics, electronics, and other materials. There would also be a slight increase in WFO. Operational hours under the No Action Alternative would be 248,000 hours per year in the base year (1996-1997), increasing to 310,000 hours per year in 2003 and 2008. Personnel would increase from 150 in the base year to 184 in 2003 and 2008.

3.2.2.4 Integrated Materials Research Laboratory

Research on materials and advanced components would continue to be conducted at the Integrated Materials Research Laboratory (IMRL), TA-I. A wide variety of materials would be investigated, including metallic alloys, semiconductors, superconductors, ceramics, opticals, and dielectric materials. Basic research activities would continue in chemistry, physics, and energy technologies. The 1998 number for operational hours was derived by multiplying the number of workers in the IMRL by the number of hours worked by one employee during a year. This totals approximately 395,000 hours per year for 1998, 2003, and 2008.

3.2.2.5 Explosive Components Facility

The Explosive Components Facility (ECF), TA-II, would continue to be used to support the work performed at the NGF and the R&D performed on a variety of energetic components. Energetic component research, testing, development, and quality control activities focus in four areas: neutron generators, explosives, chemicals, and batteries. Expected operating levels at the ECF would include 200 neutron generator tests in the base year, increasing to approximately 500 neutron generator tests per year through 2008. Other tests would involve 600 explosive tests in the base year, growing to 750 tests in 2003 and 850 tests in 2008. Chemical analyses would increase from 900 analyses in the base year to 1,000 in 2008. Battery tests would range from 50 tests in the base year to 60 tests in 2003 and 2008.

3.2.3 Physical Testing and Simulation Facilities

TA-III incorporates four principal testing facilities: the Terminal Ballistics Complex, Drop/Impact Complex, Sled Track Complex, and Centrifuge Complex, described below.

3.2.3.1 Terminal Ballistics Complex

Ballistic studies and solid-fuel rocket motor tests would continue to be conducted at the Terminal Ballistics Complex. Testing capabilities would include research in areas of armor penetration, vulnerability, acceleration, flight dynamics, and accuracy. Projectile impact tests would include all calibers of projectiles, from small arms to the 155-mm gun. For projectile impact testing, 50 tests would occur in the base year, increasing to approximately 80 tests each year by 2003 and 100 tests annually by 2008. Approximately 25 propellant tests would occur in the base year, increasing to 40 tests annually by 2003 and 50 tests annually by 2008.

3.2.3.2 Drop/Impact Complex

Tests designed for the validation of analytical modeling and weapons system certification would continue to be conducted at the Drop/Impact Complex. Test activities would focus on water and underwater tests, design verification, and performance assessments. After the base year activity level of 18 tests, up to 20 tests would be conducted each year through 2008. One water impact test, one submersion test, and as many as two underwater blast tests would be planned annually through 2008.

3.2.3.3 Sled Track Complex

The Sled Track Complex is a test facility that simulates high-speed impacts of weapon shapes, substructures, and components to verify design integrity, performance, and fuzing functions. Sled Track Complex capabilities would continue to include testing parachute systems, transportation equipment, and reactor safety. Tests would include rocket sleds; short-duration, free-flight launches; rocket launches; and explosives using SNL/NM instrumentation capabilities in lasers, photometrics, telemetry, and other data collection techniques. Current plans would number 10 to 15 rocket sled tests per year through 2008. Other tests would number 40 short-duration, free-flight launches, up to 4 rocket launches, and 12 explosive detonations per year through 2008.

3.2.3.4 Centrifuge Complex

The Centrifuge Complex would continue to be used to test objects weighing up to 5 tons or more with over 100 *g* of force. Following 32 tests in 1998, this would increase to an estimated 46 tests annually in 2003 and 2008 on a variety of test objects. Although no impact tests have occurred, 10 tests per year are planned for 2003 through 2008.

3.2.4 Accelerator Facilities

3.2.4.1 SATURN

Under the No Action Alternative, the SATURN accelerator would continue to be used to produce X-rays to simulate the radiation effects of nuclear bursts on electronic and material components. SATURN capabilities would be used to test satellite systems, weapons materials and components, and re-entry vehicle and missile subsystems. Accelerator activities would include an estimated activity of 65 shots in 1998, increasing to 200 shots per year by 2003. Accelerator activity would remain at this level (200 shots) through 2008.

3.2.4.2 High-Energy Radiation Megavolt Electron Source III

High-Energy Radiation Megavolt Electron Source III (HERMES III) would continue to be used to provide gamma ray effects testing capabilities. HERMES III would test electronic components and weapon systems and would include high-fidelity simulation over large areas in near nuclear-explosion radiation environments. Activity levels would be approximately 262 shots per year in 1998, increasing to approximately 500 shots per year through 2003 and 2008.

3.2.4.3 Sandia Accelerator & Beam Research Experiment

The Sandia Accelerator & Beam Research Experiment (SABRE) would continue to be used to provide X-ray and gamma ray effects testing capabilities. SABRE capabilities would allow testing of pulsed-power technologies, fusion systems, and weapons systems. Other activities would include computer science, flight dynamics, satellite systems, and robotics testing. Approximately 187 shots would occur in 1998, increasing to approximately 225 shots per year in 2003 and 2008.

3.2.4.4 Short-Pulse High Intensity Nanosecond X-Radiator

The Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) accelerator would continue to be used to produce high-voltage accelerations to measure X-ray-induced currents in integrated circuits and heat response in materials. The SPHINX would provide testing capabilities in radiation environments for a variety of weapons components. Approximately 1,185 shots would occur in 1998, increasing to approximately 2,500 shots per year in 2003 through 2008.

3.2.4.5 Repetitive High Energy Pulsed Power I

The Repetitive High Energy Pulsed Power (RHEPP) I would continue to be used for the development of pulsed-power technology, including high-power energy tests. Activities would include basic scientific research, development, and testing. The RHEPP I averaged approximately 500 tests per year over 1996 and 1997. This would increase to approximately 5,000 tests per year by 2003 through 2008.

3.2.4.6 Repetitive High Energy Pulsed Power II

The RHEPP II would continue to be used to develop radiation processing applications using powerful electron or X-ray beams. Activities would include testing of high power magnetic switches and specialty transmission lines. Operations in 1996 included 80 tests per year. As many as 4 tests per week for 40 weeks (160 tests per year) would be completed at the RHEPP II by 2003 through 2008.

3.2.4.7 Z-Machine

The Z-Machine would continue to be used to produce extremely short, extremely powerful energy pulses at various targets. The Z-Machine capabilities simulate special atmospheric conditions and fusion reaction conditions. The average activity in 1996 and 1997 was approximately 150 shots per year. A projected 165 accelerator firings would occur per year using tritium, deuterium, plutonium, and depleted uranium (DU). An additional 135 accelerator firings would support performance assessment and development of advanced pulsed-power sources, for a total of 300 shots per year by 2003 through 2008.

3.2.4.8 Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA)

The Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA) facility would continue to be used to test plasma opening switches for pulsed-power drivers. Other activities would include basic research science, material development, and material testing. TESLA activities in 1998 increased to 40 shots. Following a base year of 40 test shots, as many as 1,000 test shots per year would be completed for pulsed-power technology development in 2003 through 2008.

3.2.4.9 Advanced Pulsed Power Research Module

The Advanced Pulsed Power Research Module (APPRM) would be used to evaluate the performance and reliability of components including next-generation accelerators. Activities would include research and development in pulsed-power technologies such as power storage, high-voltage switching, and power flow. Following base year operations of 500 shots, the APPRM would fire approximately 1,000 shots per year in 2003 and 2008.

3.2.4.10 Radiographic Integrated Test Stand

The Radiographic Integrated Test Stand (RITS) accelerator is anticipated to start operations in 1999. It would be used to develop and demonstrate capabilities for future accelerator facility design. The DOE categorically excluded the project. The proposed accelerator would replace the existing Proto II accelerator. Capabilities would focus on demonstrating inductive voltage technology. It is estimated that there will be 200 shots in the startup year (1999). Approximately 400 shots would occur per year in 2003, increasing to 600 shots per year in 2008.

3.2.5 Reactor Facilities

3.2.5.1 New Gamma Irradiation Facility

Under the No Action Alternative, the New Gamma Irradiation Facility (NGIF) would be used to perform a wide variety of gamma irradiation experiments under both dry and water-pool conditions. The NGIF would replace the Gamma Irradiation Facility (GIF) prior to 2003. The NGIF would provide capabilities for studies in thermal and radiation effects, weapons component degradation, nuclear reactor material and components, and other nonweapon applications. The NGIF was not operational in 1998. This facility would be constructed after the No Action baseline time frame; hence, there are no activities planned prior to 2003. Operations would begin in 2000 or 2001, depending on operational approval. By 2003, a wide variety of test packages would be conducted each year. Approximately 13,000 test hours per year would be expected from 2003 through 2008.

3.2.5.2 Gamma Irradiation Facility

The GIF would continue to be used to perform gamma irradiation experiments until the NGIF begins operation. The facility would irradiate test packages for approximately 1,000 test hours per year. Operating levels by 2003 would decrease to zero, coinciding with the startup and operation of the NGIF. The decision to reuse, modify, or demolish the GIF will be addressed in future NEPA documentation.

3.2.5.3 Sandia Pulsed Reactor

The Sandia Pulsed Reactor (SPR) would continue to provide multiple fast-burst reactor, near-fission spectrum radiation environments. Testing activities would include a wide variety of technologies that support both defense and nondefense projects. Approximately 100 tests per year would be expected through 2008.

3.2.5.4 Annular Core Research Reactor–Medical Isotopes Production or Defense Programs (DP) Testing Configuration

The ACRR may be operated in either of two ways: to produce medical isotopes or to support Defense Programs. Descriptions of these two operating configurations follow. The impacts for each of these configurations are presented separately in Table 3.6–1 and Chapter 5.

Annular Core Research Reactor (ACRR)–medical isotopes production configuration activities would produce medical and research radioactive isotopes. Research activities that are compatible and capable of being conducted concurrently with production would continue. Under the No Action Alternative, the ACRR would operate for 52 weeks to irradiate targets to produce approximately 30 percent of the U.S. demand (on average, not necessarily a "fixed" amount each week) for molybdenum-99 and other medical and research isotopes, such as iodine-131, xenon-133, and iodine-125. The 2003 and 2008 estimates assume that the SNL/NM medical isotopes production program would operate primarily as a backup to Nordion, Inc. At the 30 percent of U.S. demand production level expected for the 2003 and 2008 scenarios, it is assumed that the reactor would be operated for 16 hours per day, 5 days per week (4,160 hours per year) at a maximum power level of 4 MW (approximately 16,640 MWh per year).

The production needs could require varying scenarios 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). Under the No Action Alternative, irradiation of eight targets is planned in the base year, increasing to 375 targets in 2003 through 2008.

ACRR – Defense Programs (DP) testing configuration capabilities would be maintained. The DOE also has identified a recent, short-term need to conduct a single test series related to the certification of some weapons components (Weigand 1999a). The ACRR would be reconfigured to pulse-mode operation for a limited-duration test period (12 to 18 months following the Record of Decision) (Weigand 1999b). This test campaign would be conducted in the existing ACRR facility, which would have to be temporarily reconfigured to restore DP testing capability. The reconfiguration activities required to change the reactor to the DP test configuration would mainly consist of replacing the central cavity, enabling the pulse mode of operation, reconfiguring the core fuel, reinstalling the appropriate fuel-ringed external cavity (if required), executing the necessary battery of tests, preparing documentation, and conducting reviews to certify that the reconfigured reactor is operational. The reconfiguration to ACRR-DP would be done so that conversion back to ACRR-medical isotope production would be more efficient. The DOE is evaluating the potential need for long-term DP test requirements for ACRR, but currently the DOE has no plans for such tests. Any future long-term test campaigns would undergo the appropriate NEPA reviews. The readiness capability to maintain the DP-testing configuration is described in detail in the April 1996, *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b).

The DOE considered the possibility of conducting this short-term test series at other DOE sites. Only Transient Reactor Test Facility (TREAT), Idaho National Engineering & Environmental Laboratory (INEEL), was a possible alternate, but was dismissed because of the limited timeframe needed to complete the test campaign (Minnema 1999). The DOE is also evaluating the possibility of using nondestructive simulations (computer modeling) to accomplish certification.

3.2.5.5 Hot Cell Facility

The Hot Cell Facility (HCF) would primarily support medical isotopes production. Isotopes production operations and associated capabilities include isotope extraction and separation, isotope product purification, product packaging, and quality control. The base year level of activity would include 8 targets per year and would increase to 375 by 2003, continuing at the same rate until 2008.

3.2.6 Outdoor Test Facilities

3.2.6.1 Aerial Cable Facility

The Aerial Cable Facility would be used to conduct a variety of impact tests involving weapon systems and aircraft components. Capabilities include free-fall drop, rocket pull-down, and captive flight tests with state-of-the-art instrumentation, data recording, and simulation technologies. Under this alternative, approximately 21 drop/pull-down tests would be completed in the base year, increasing to 32 tests in 2003 and 38 tests in 2008. Approximately one-half dozen other tests would be completed each year.

3.2.6.2 Lurance Canyon Burn Site

The Lurance Canyon Burn Site is a group of facilities that would be used to test, certify, and validate material and system tolerances. Test objects would be burned for short periods of time under controlled conditions. Approximately 12 certification tests would be conducted each year through the year 2008, with 56 model validation tests and 37 user tests.

3.2.6.3 Containment Technology Test Facility - West

Planning for the two tests at the Containment Technology Test Facility-West began in 1991. Each test would involve a series of successive events leading up to ultimate failure of the two test vessels. The first test was completed in 1997, and the second test is scheduled for completion in 2000. After the second test, there are no further plans for additional testing.

3.2.6.4 Explosives Applications Laboratory

The Explosives Applications Laboratory (EAL) would continue to design, assemble, and test explosive materials, components, and equipment for multiple programs. Work at the facility would involve arming, fuzing, and firing of explosives and testing of components. The EAL would use X-ray analysis, fabrication technology, photographic analysis, and machine shop techniques to complete energetic material research and development. Approximately 240 tests would be completed each year through 2008.

3.2.6.5 Thunder Range Complex

The Thunder Range Complex capabilities would range from disassembly and evaluation to calibration and verification testing of special nuclear and nonnuclear systems. Examination and testing of objects would involve cleaning, physical examination, disassembly, measurement, sampling, photography, and data collection. Equipment disassembly would take place during 60 days per year in the base year, increasing to 82 days per year in 2003 through 2008. Ground-truthing tests consist of one test series in the base year, increasing to five test series in 2003 and eight test series in 2008.

3.2.7 Infrastructure Facilities

3.2.7.1 Steam Plant

The steam plant would continue to produce and distribute steam to SNL/NM and Kirtland Air Force Base (KAFB) facilities. The steam would be primarily used for domestic hot water and building heat. Approximately 544 M lb would be produced each year.

3.2.7.2 Hazardous Waste Management Facility

The Hazardous Waste Management Facility (HWMF) would handle, package, short-term store, and ship hazardous, toxic, and nonhazardous chemical wastes. The HWMF is a *Resource Conservation and Recovery Act* (RCRA), Part B-permitted facility that would support waste generators throughout SNL/NM. The HWMF would prepare wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would operate one shift. Quantities of RCRA hazardous waste managed (see Section 3.6, Table 3.6–1) would range from 55,852 kg in the base year to 74,358 kg through 2008. Infrastructure-related activities are rated at approximately 200,000 kg per year (see Section 3.6, Table 3.6–1).

3.2.7.3 Radioactive and Mixed Waste Management Facility

The Radioactive and Mixed Waste Management Facility (RMWMF) would continue to serve as a centralized facility for receipt, characterization, compaction, treatment, repackaging, certification, and storage of low-level waste (LLW), transuranic (TRU) waste, low-level mixed waste (LLMW), and mixed transuranic (MTRU) waste. A new prefabricated storage building would be constructed to replace an existing building to improve flexibility and operational efficiencies. The replacement of the existing facility is covered by Categorical Exclusion B6.10 (10 CFR Part 1021). Like the HWMF, the RMWMF would support waste generators throughout SNL/NM. The RMWMF would prepare waste for offsite treatment and disposal at permitted and licensed facilities. The facility would operate one shift. Total wastes by waste type are presented in Section 3.6, Table 3.6–1. Annual quantities of radioactive waste managed (see Section 3.6, Table 3.6–1) would range from 11,874 ft^3 (337 m^3) for LLW (only 3,322 ft^3 [94 m^3] are generated; the remainder is legacy waste [see Section 3.6, Table 3.6–2]) in the base year to 15,436 ft^3 (438 m^3) for LLW (only 5,993 ft^3 [170 m^3] are generated; the difference is legacy waste [see Section 3.6, Table 3.6–2]) through 2008. Annually, for LLMW, TRU, and MTRU, the quantities to be managed (see Section 3.6, Table 3.6–1) through the RMWMF, including legacy waste and the expected quantities to be generated (see Section 3.6, Table 3.6–2), are as follow: 5,353 ft^3 (152 m^3) to 6,959 ft^3 (197 m^3) LLMW managed; 153 ft^3 (4.33 m^3) to 258 ft^3 (7.31 m^3)

LLMW generated; 214 ft^3 (6.1 m^3) to 278 ft^3 (7.9 m^3) TRU managed; zero ft^3 (zero m^3) to 26 ft^3 (0.74 m^3) TRU generated; and 16 ft^3 (0.45 m^3) to 23 ft^3 (0.65 m^3) MTRU managed; 16 ft^3 (0.45 m^3) to 23 ft^3 (0.65 m^3) MTRU generated. Infrastructure-related activities are rated at 2.1 M lb per year (see Section 3.6, Table 3.6–1).

3.2.7.4 Thermal Treatment Facility

The Thermal Treatment Facility (TTF) would thermally treat (burn) small quantities of explosive materials and explosives-contaminated waste. Quantities would range from minimal in the base year to 336 lb of waste through 2008. This assumes that the RCRA permit is reissued.

3.3 EXPANDED OPERATIONS ALTERNATIVE

The Expanded Operations Alternative assumes implementation of assignments that would result in the highest reasonable activity levels that could be supported by current facilities and the potential expansion and construction of new facilities. Appropriate NEPA documentation would be prepared prior to any new construction. This alternative addresses the same selected existing facilities described under the No Action Alternative. Under this alternative, operations could increase to the highest reasonably foreseeable levels over the next 10 years, The following sections describe the activities that would occur at specific facilities as a result of implementing assignments under the Expanded Operations Alternative.

3.3.1 Selected Facilities in Technical Areas-I and -II

3.3.1.1 Neutron Generator Facility

Under all alternatives, the NGF, TA-I, would continue to be used to fabricate neutron generators and neutron tubes. Support activities would include a wide variety of manufacturing, testing, and product development techniques and processes. An addition to an existing building would be constructed to meet production projections. Additionally, Building 870 would undergo extensive renovations. Approximately 2,000 neutron generators and associated neutron and switch tubes would be manufactured per year by 2008.

3.3.1.2 Microelectronic Development Laboratory

Under this alternative, the MDL would continue present activities, but would increase production to 7,500 wafers per year, using 3 shifts. Use of new technologies and manufacturing processes would be expected to meet expanded activities.

3.3.1.3 Advanced Manufacturing Processes Laboratory

Activities at the AMPL would be similar to those under the No Action Alternative. Operations would increase beyond a single shift, adding 54 employees. Operations would increase to 347,000 hours per year.

3.3.1.4 Integrated Materials Research Laboratory

Activities at the IMRL would be the same as under the No Action Alternative (approximately 395,000 hours per year). Currently, the IMRL is operating at maximum capacity. No expansion would be anticipated.

3.3.1.5 Explosive Components Facility

Activities at the ECF would be similar to those under the No Action Alternative. Operations would be maximized to complete 500 neutron generator tests, 900 explosive tests, 1,250 chemical analyses, and 100 battery tests annually.

3.3.2 Physical Testing and Simulation Facilities

3.3.2.1 Terminal Ballistics Complex

Activities would be the same as under the No Action Alternative. No additional capabilities or new activities would be undertaken. The operating level would be increased to 350 projectile impact tests and 100 propellant tests per year.

3.3.2.2 Drop/Impact Complex

The Drop/Impact Complex tests would be expanded for all four capabilities: drop test, water impact, submersion, and underwater blasting. The projected increase would be beyond historic use but within the complex capabilities. Approximately 50 drop tests, 20 water impact tests, 5 submersion tests, and 10 underwater blast tests would occur each year.

3.3.2.3 Sled Track Complex

Activities would be the same as those described under the No Action Alternative. Operating levels would be increased to approximately 80 rocket sled tests, 239 explosive tests, 24 rocket launches, and 150 free-flight launches per year.

3.3.2.4 Centrifuge Complex

The Centrifuge Complex activities would be the same as those described under the No Action Alternative. However, the number of tests per year would increase to 120 centrifuge tests and 100 impact tests.

3.3.3 Accelerator Facilities

3.3.3.1 SATURN

Under the Expanded Operations Alternative, the accelerator output would increase by 3 shots or firings every other day for a maximum of 500 shots annually. Activities would be the same as those described under the No Action Alternative.

3.3.3.2 High-Energy Radiation Megavolt Electron Source III

The HERMES III capabilities would remain the same under the Expanded Operations Alternative. The maximum number of shots per year would be 1,450. This level of activity would be achieved through the addition of multiple shifts.

3.3.3.3 Sandia Accelerator & Beam Research Experiment

Testing at the SABRE would increase to 400 shots per year. Activities would be the same as those described in the No Action Alternative.

3.3.3.4 Short-Pulse High Intensity Nanosecond X-Radiator

The SPHINX would operate at a maximum of 6,000 shots per year. Activities would be the same as those described under the No Action Alternative. This would be an increase from 1,185 shots in the 1997 base year. This increase would be achieved through multiple shifts.

3.3.3.5 Repetitive High Energy Pulsed Power I

The tests projected for the RHEPP I would be in both the single and repetitive pulse modes. The RHEPP I would provide support for approximately 10,000 tests per year. No new capabilities or activities would be expected.

3.3.3.6 Repetitive High Energy Pulsed Power II

The RHEPP II capacity would be maximized at 20 tests per week for 40 weeks per year (800 tests). Activities would be similar to those described under the No Action Alternative.

3.3.3.7 Z-Machine

The Z-Machine capability would be maximized to 350 firings per year. Approximately 78 percent would involve nuclear materials identified under the No Action Alternative. Upgrades would be planned to maximize the Z-Machine's operations.

3.3.3.8 Tera-Electron Volt Energy Superconductor Linear Accelerator (TESLA)

The operating levels at the TESLA would be increased to 1,300 shots per year.

3.3.3.9 Advanced Pulsed Power Research Module

The APPRM activity would increase to 2,000 shots per year.

3.3.3.10 Radiographic Integrated Test Stand

The RITS would operate at a maximum of approximately 800 tests per year. Capabilities would remain the same as those described under the No Action Alternative.

3.3.4 Reactor Facilities

3.3.4.1 New Gamma Irradiation Facility

The NGIF would irradiate test packages for approximately 24,000 test hours per year. Capabilities would remain the same as those described under the No Action Alternative.

3.3.4.2 Gamma Irradiation Facility

GIF operations would continue under the Expanded Operations Alternative. Actual operations would expand to complete tests in two available cells. The GIF would supplement the capabilities of the NGIF. Approximately 8,000 test hours would be expected.

3.3.4.3 Sandia Pulsed Reactor

Several new, yet-to-be-designed reactors would be added to the SPR facility. Modifications would be completed to enhance and expand current capabilities. Operating levels would increase to 200 tests per year.

3.3.4.4 Annular Core Pulse Reactor II

The Annular Core Pulse Reactor (ACPR-II) would be an additional pulse-power reactor similar to the ACRR. The ACPR-II would operate in pulse mode using the same fundamental design as the ACRR prior to its conversion to the medical isotopes production configuration. The Expanded Operations Alternative assumes that there would be an ongoing need for DP testing in a pulsed-power reactor facility. Approximately two major fissile component tests and approximately six material irradiation, electronics effects tests would be performed each year. These tests would involve setup, calibration, and operation sequences that could require from 1 to 2 days to several weeks, depending on the conditions of the test. To meet this need, an additional ACPR facility would be reconstituted using the same fundamental design as the ACRR facility. If this additional ACPR facility is proposed at some time in the future, the DOE would prepare a separate project-specific NEPA review.

The specially designed uranium oxide-beryllium oxide fuel from the existing ACRR medical isotopes production configuration would be used for the reconstituted ACPR-II to support DP test requirements. New fuel of a more standard design would be purchased for the original ACRR medical isotopes production configuration to support ongoing isotope production activities.

Under the Expanded Operations Alternative for DP testing in the ACPR-II, approximately two or three test campaigns (consisting of several individual tests) would be conducted each year. A test campaign would consist of a test setup period of a few days to 2 weeks and a test duration (time in reactor) of 1 day to 2 weeks. These tests would typically use the ACPR-II in its pulse mode or steady-state operations that would not exceed a few days in duration. Hence, a minimal amount of resources such as uranium fuel and water would be expended for these tests for high-use, steady-state operation.

3.3.4.5 Annular Core Research Reactor–Medical Isotopes Production Configuration

The ACRR medical isotopes production configuration would be operated for 24 hours per day, 7 days per week, at a maximum power level of 4 MW (approximately 35,000 MWh per year) to meet the entire U.S. demand for molybdenum-99 and other isotopes such as iodine-131, xenon-133, and iodine-125. This would require the irradiation of about 25 highly enriched uranium targets per week (1,300 per year).

3.3.4.6 Hot Cell Facility

Under the Expanded Operations Alternative, the HCF would continuously process 100 percent of the U.S. demand for molybdenum-99 and other isotopes such as iodine-131, xenon-133, and iodine-125. This would require the processing of about 25 irradiated, highly enriched uranium targets per week (1,300 per year).

3.3.5 Outdoor Test Facilities

3.3.5.1 Aerial Cable Facility

The Aerial Cable Facility drop, pull-down, aerial target, and system testing capabilities would remain the same as under the No Action Alternative. Drop tests of joint test assemblies that contain DU, enriched uranium, and insensitive high explosives would represent a new test activity at the complex. These test articles would contain less than 45 lb of DU, less than 120 lb of enriched uranium, and less than 104 lb of insensitive high explosives (plastic-bonded explosive [PBX]-9502 or press-moldable explosive [LX]-17). Test articles would be designed using insensitive high explosives because of the low probability of detonation under test conditions. In addition, the nuclear material contained in the test article would be configured in a manner that prevents a criticality event from occurring. The number of tests using this kind of test article (containing DU, enriched uranium, and insensitive high explosives) could range from one to five per year depending upon programmatic requirements. The total number of drop/pull-down tests would increase to an estimated 100 experiments per year. Aerial target tests would increase to 30 tests per year. Two series of scoring system tests would be conducted each year.

3.3.5.2 Lurance Canyon Burn Site

The Lurance Canyon Burn Site activities in certification, model validation, and user testing would remain similar to those described under the No Action Alternative. The number of certification tests would increase to an estimated 55 tests per year under the Expanded Operations Alternative. Model validation tests and user tests would increase to 100 and 50 per year, respectively.

3.3.5.3 Containment Technology Test Facility - West

The Containment Technology Test Facility - West would perform two survivability tests per year under the Expanded Operations Alternative. No new programs would be anticipated.

3.3.5.4 Explosives Applications Laboratory

Activities at the EAL would increase slightly under the Expanded Operations Alternative. The number of explosive tests would range from 275 to a maximum of 360 tests per year.

3.3.5.5 Thunder Range Complex

Activities at the Thunder Range Complex would increase slightly to 10 test series per year in 2008. Equipment disassembly would increase to 144 days per year. A moderate increase in workload would occur and the number of facility personnel would increase slightly.

3.3.6 Infrastructure Facilities

3.3.6.1 Steam Plant

The steam plant would require upgrades of several boilers, steam distributors, and natural gas supply systems. The actual boiler upgrade would potentially include a technology change to co-generation units. Steam production, however, would remain similar (544 M lb per year) to that under the No Action Alternative.

3.3.6.2 Hazardous Waste Management Facility

The HWMF activities would remain the same as under the No Action Alternative. Operating conditions would include increasing from one to three shifts. Quantities of RCRA hazardous waste managed (see Section 3.6, Table 3.6–1) would be 92,314 kg each year. Infrastructure-related activities are rated at 214,000 kg per year (see Section 3.6, Table 3.6–1).

3.3.6.3 Radioactive Mixed Waste Management Facility

The RMWMF capabilities would remain the same as under the No Action Alternative. A new prefabricated building would be constructed to replace an existing building to improve flexibility and operational efficiencies. The facility would be increased from one to two shifts. Annual quantities of radioactive waste managed (see Section 3.6, Table 3.6–1) would be 19,592 ft^3 (556 m^3) for LLW (only 9,897 ft^3 [280 m^3] are generated; the remainder is legacy waste [see Section 3.6, Table 3.6–2]). Annually, for LLMW, TRU, and MTRU, the quantities to be managed (see Section 3.6, Table 3.6–1) through the RMWMF, including legacy waste and the expected quantities to be generated (see Section 3.6, Table 3.6–2), are as follow: 8,833 ft^3 (251 m^3) LLMW managed; 258 ft^3 (7.31 m^3) LLMW generated; 353 ft^3 (10 m^3) TRU managed; 26 ft^3 (0.74 m^3) TRU generated; and 37 ft^3 (1.05 m^3) MTRU managed; 37 ft^3 (1.05 m^3) MTRU generated. Infrastructure-related activities are rated at 2.7 M lb per year (see Section 3.6, Table 3.6–1).

3.3.6.4 Thermal Treatment Facility

Activities at the TTF would remain the same as under the No Action Alternative; quantities of wastes treated, however, would increase. Approximately 1,200 lb of waste per year would be thermally treated. This rate assumes that 60 burns are performed at 20 lb of waste per burn. This rate also assumes that the RCRA permit is reissued.

3.4 REDUCED OPERATIONS ALTERNATIVE

The Reduced Operations Alternative reflects minimum levels of activity required to maintain a facility's assigned capability. In some specific facilities, the Reduced Operations Alternative includes activity levels that represent an increase over the base period activity levels (typically 1996). The facilities are those that, during the base period, have not been operated at a level sufficient to maintain capability or to satisfy DOE-assigned theoretical or experimental R&D product requirements.

This alternative does not eliminate assigned missions or programs, but could entail not meeting technical program requirements or could increase program or technological risk (for example, not meeting program deliverables, reduced technology demonstration activities, or a decline in technological capability). However, under this alternative, SNL/NM operations would not be reduced beyond those required to maintain safety and security activities, such as maintaining nuclear materials, high explosives, or other hazardous materials in storage or use.

The following sections describe the activities that would occur at specific facilities as a result of implementing the Reduced Operations Alternative.

3.4.1 Selected Facilities in Technical Areas-I and -II

3.4.1.1 Neutron Generator Facility

Under all alternatives, the NGF, TA-I, would continue to be used to fabricate neutron generators and neutron tubes. Support activities would include a wide variety of manufacturing, testing, and product development techniques and processes. An addition to an existing building would be constructed to meet production projections. Additionally, Building 870 would undergo extensive renovations. Approximately 2,000 neutron generators and associated neutron and switch tubes would be manufactured per year by 2008.

3.4.1.2 Microelectronics Development Laboratory

All existing capabilities would remain to produce a reduced number of wafers. Operations would be single-shift only. Approximately 2,700 wafers would be manufactured each year.

3.4.1.3 Advanced Manufacturing Processes Laboratory

The level of effort projected for the Reduced Operations Alternative would be similar to that under the No Action Alternative because the facility would be operating with the minimum number of personnel (minus administrative staff) required to maintain operational capability in each of the various areas of expertise. Approximately 248,000 operational hours would be expected.

3.4.1.4 Integrated Materials Research Laboratory

The level of effort projected under the Reduced Operations Alternative would be slightly lower than that under the No Action Alternative. A reduction in capabilities would not occur; however, there could be a slight reduction in the number of personnel and operational hours (approximately 364,000 per year).

3.4.1.5 Explosive Components Facility

Existing activities would continue at reduced levels. Activities at the ECF would include 500 neutron generator tests, 300 explosive tests, 500 chemical analyses, and 10 battery tests per year.

3.4.2 Physical Testing and Simulation Facilities

3.4.2.1 Terminal Ballistics Complex

All existing capabilities would remain under the Reduced Operations Alternative. Operating levels would be reduced to a minimum to support those capabilities. An estimated 10 projectile impact tests and 4 propellant tests would be conducted each year.

3.4.2.2 Drop/Impact Complex

All existing capabilities would remain under the Reduced Operations Alternative. No drop tests would be conducted, but one water impact test would be conducted annually to maintain operational capability. No submersion or underwater blasts would occur.

3.4.2.3 Sled Track Complex

All existing activities would remain viable under the Reduced Operations Alternative. Approximately two rocket sled tests would occur each year. While other types of tests would not be conducted, the capability would be maintained.

3.4.2.4 Centrifuge Complex

Existing activities would be reduced to a minimum level of testing required to maintain operational capability. Testing would cease for certification of weapon modifications and special items. At least two annual centrifuge tests would be conducted. No impact testing would be done under the Reduced Operations Alternative.

3.4.3 Accelerator Facilities

3.4.3.1 SATURN

The SATURN capabilities would remain at a sufficient level to maintain operational readiness. The number of shots would decrease to 40 each year.

3.4.3.2 High-Energy Radiation Megavolt Electron Source III

Existing capabilities would be maintained at the HERMES III facility. Annual tests would be reduced to an estimated 40 shots per year.

3.4.3.3 Sandia Accelerator & Beam Research Experiment

Under the Reduced Operations Alternative, the SABRE would be placed in standby mode. No test shots would be required to keep the facility operational. With minimal testing and general maintenance, operational capabilities would remain in place.

3.4.3.4 Short-Pulse High Intensity Nanosecond X-Radiator

Under the Reduced Operations Alternative, approximately 200 test shots would be completed each year. All existing capabilities would remain in a state of operational readiness.

3.4.3.5 Repetitive High Energy Pulsed Power I

All existing capabilities would be maintained. The number of tests would be reduced to 100 per year.

3.4.3.6 Repetitive High Energy Pulsed Power II

Activities would continue at the RHEPP II facility; however, the number of tests would decrease to 40 tests per year.

3.4.3.7 Z-Machine

Under the Reduced Operations Alternative, an estimated 84 tests per year would be required to maintain existing capabilities.

3.4.3.8 Tera-Electron Volt Energy Superconductor Linear Accelerator (TESLA)

All existing capabilities would be maintained under the Reduced Operations Alternative. To maintain operational readiness, an estimated 40 shots would be completed each year.

3.4.3.9 Advanced Pulsed Power Research Module

The level of activity necessary to maintain the operational capabilities would be 40 shots per year.

3.4.3.10 Radiographic Integrated Test Stand

Under the Reduced Operations Alternative, the minimum level of shots required to ensure operational capability in both the pulse-power and explosive modes would be an estimated 1 to 3 per week over the 40-week operational year. A total of 100 shots per year would be necessary to maintain operational capacity.

3.4.4 Reactor Facilities

3.4.4.1 New Gamma Irradiation Facility

Under the Reduced Operations Alternative, the NGIF would not conduct any irradiation tests.

3.4.4.2 Gamma Irradiation Facility

Under the Reduced Operations Alternative, the GIF would not conduct irradiation tests.

3.4.4.3 Sandia Pulsed Reactor

Under the Reduced Operations Alternative, the SPR facility would conduct 30 tests to maintain existing capabilities. No new reactors would be added to the facility.

3.4.4.4 Annular Core Research Reactor–Medical Isotopes Production Configuration

Under the Reduced Operations Alternative, the ACRR medical isotopes production configuration would irradiate the minimum number of targets required to maintain the facility, staff, processes, and material inventories needed to restart production activities on short notice. This would consist of the irradiation of approximately 40 targets per year. Although the ACRR would not be used in the DP configuration, the readiness capability to operate would be maintained.

3.4.4.5 Hot Cell Facility

Under the Reduced Operations Alternative, the HCF would process the minimum number of targets required to maintain the facility, staff, processes, and material inventories needed to restart production activities on short notice. This would consist of the processing of approximately 1 target per week over 40 weeks, or 40 targets per year. The HCF-associated facilities would be maintained at the minimum operational level. Occasional activities would be performed to support those programs that require the capabilities of these facilities. Total wastes by waste type are presented in Section 3.6, Table 3.6–1.

3.4.5 Outdoor Test Facilities

3.4.5.1 Aerial Cable Facility

All existing capabilities would remain as described under the No Action Alternative. Some activities would be reduced to zero tests per year. Two drop/pull-down tests would be conducted annually.

3.4.5.2 Lurance Canyon Burn Site

All existing capabilities would be maintained with minimal testing (one certification test per year).

3.4.5.3 Containment Technology Test Facility - West

To maintain the existing capability, at least one test would be required over a period of several years. A typical test cycle would be 6 years.

3.4.5.4 Explosives Applications Laboratory

Maintaining the site capability and qualifications would require approximately 50 tests per year to ensure minimum qualifications for arming, fuzing, and firing of explosives and explosives components.

3.4.5.5 Thunder Range Complex

All existing capabilities would be maintained. One test, ranging in duration from 1 to 30 days, would be completed each year. Equipment disassembly would be reduced to 42 days per year.

3.4.6 Infrastructure Facilities

3.4.6.1 Steam Plant

Steam plant production would decline to 362 M lb per year.

3.4.6.2 Hazardous Waste Management Facility

The HWMF capability would be maintained through the life of the current permit. The facility would be operated with one shift. Quantities of RCRA hazardous waste managed (see Section 3.6, Table 3.6–1) would be 53,123 kg each year. Infrastructure-related activities are rated at 175,000 kg per year.

3.4.6.3 Radioactive Mixed Waste Management Facility

The RMWMF capability would be maintained consistent with the applicable permit requirements. The facility would be operated with one shift. Annual quantities of radioactive waste managed (see Section 3.6, Table 3.6–1) would be 5,937 ft^3 (168 m^3) for LLW (only 3,616 ft^3 [102.4 m^3] are generated; the remainder is legacy waste [see Section 3.6, Table 3.6–2]). Annually, for LLMW, TRU, and MTRU, the quantities to be managed (see Section 3.6, Table 3.6–1) through the RMWMF, including legacy waste and the expected quantities to be generated (see Section 3.6, Table 3.6–2), are as follow: 2,677 ft^3 (76 m^3) LLMW managed; 134 ft^3 (3.79 m^3) LLMW generated; 107 ft^3 (3 m^3) TRU managed; no TRU generated; and 8 ft^3 (0.23 m^3) MTRU managed; 8 ft^3 (0.23 m^3) MTRU generated. Infrastructure-related activities are rated at approximately 0.8 M lb per year.

3.4.6.4 Thermal Treatment Facility

The TTF capability would be maintained at minimal operational levels without treating waste.

3.5 ALTERNATIVES THAT WERE CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The CEQ regulations implementing NEPA require that all reasonable alternatives be evaluated in an EIS (40 CFR §1502.14[a]). The term *reasonable* has been interpreted by CEQ to include those alternatives that are practical or feasible from a common sense, technical, and economic standpoint. The range of reasonable alternatives is, therefore, limited to continued SNL/NM operations. DOE mission line assignments to SNL/NM define the agency's purpose and need for action, as discussed in Chapter 1.

The DOE carefully considered public input and comments received during the pre-scoping and scoping processes. Some alternatives suggested for SNL/NM's future operations were not considered in detail in the SWEIS because they were deemed unreasonable within the next 10 years. These alternatives are defined and the reasons why they were eliminated from detailed analysis are presented in the following sections.

3.5.1 Shutdown of Sandia National Laboratories/New Mexico

Under this alternative, SNL/NM operations would shut down and all facilities would be subject to decontamination and decommissioning (D&D). All DOE property would be transferred following D&D.

PL 103-160, the *National Defense Authorization Act of 1994,* and Presidential policy statements on the future of the laboratories (The White House 1995) require maintaining a safe and reliable nuclear weapons stockpile as a cornerstone of the nation's nuclear deterrent for the near future. The continued viability of all three DOE weapons laboratories, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and SNL, is essential to ensuring national security. Unique competencies and facilities at SNL/NM provide for R&D, surveillance, testing, reliability and safety assessment, certification, and manufacturing associated with nuclear weapons.

Because continuing operations at SNL/NM are essential to DOE's implementation of Public Law (PL) 103-160, Presidential Decision Directives, U.S. compliance with treaties, as well as Congressional guidance and national security policy, the shutdown of SNL/NM is not a reasonable alternative and is not analyzed in the SWEIS.

SNL/NM's continued operations fulfill national security requirements for stockpile stewardship and management (based on PL 103-160, the DoD Nuclear Posture Review, Presidential Decision Directives, and the Nuclear Weapon Stockpile Memorandum), and it is not economically feasible to reassign certain SNL/NM activities to other DOE laboratories (see PL 103-160 and the Stockpile Stewardship and Management (SSM) PEIS, Volume I, Sections 2.2 and 2.3 [DOE 1996a]).

3.5.2 Expansion of Nonweapons Environmental and Renewable Energy Research

During the public scoping process, the DOE received a suggestion that it consider changing the focus of SNL/NM's mission statement from ensuring the safety, reliability, and security of the nuclear weapons stockpile to expanding SNL/NM's capabilities in the areas of improving energy and material efficiency; renewable resources, waste management and recycling research; and biodegradable and reusable material development.

The DOE's mission lines and funding come from Congress and the President. In the course of the implementation process, the DOE assigns aspects of its mission lines to its laboratory and plant facilities across the country, based on the unique skills and capabilities of each facility. SNL/NM is one of only three national laboratories whose primary mission from DOE is to contribute its specialized capabilities to the assurance of a safe, secure, and reliable nuclear weapons stockpile. The 1996 SSM PEIS reaffirmed the continuation of SNL/NM's role in DOE's nuclear weapons program. To fulfill its primary mission, SNL/NM has developed and perfected unique capabilities, such as high explosives R&D and testing, radiation effects experimentation through the use of accelerators and research reactors, neutron generator production, engineering and production of nonnuclear components, and microelectronics and photonics research.

Notwithstanding SNL/NM's primary mission, the energy crisis in the 1970s and other events caused the DOE to request that SNL/NM apply its knowledge and expertise to support its other mission lines (Section 2.1). SNL/NM accomplished this task by expanding its research, developed primarily as an offshoot of weapons research, into a number of environmental and energy fields. Areas where SNL/NM has been active include waste management, environmental restoration, energy efficiency, renewable energy, magnetic fusion, and nuclear, fossil, and solar energy.

This alternative was not analyzed in detail because the three alternatives analyzed in detail evaluate and bound levels of *activity* (Section 3.1) for facilities where ongoing environmental and energy research activities are conducted. If, during the next 10 years, the DOE wants to consider increasing or reallocating existing weapons resources to any of the environmental or energy fields, the increased activities are already encompassed in the evaluation of the three alternatives described in Sections 3.2, 3.3, and 3.4.

3.6 COMPARISON OF ENVIRONMENTAL CONSEQUENCES AMONG ALTERNATIVES

The SWEIS combines the results of several studies to address consequences to the environment and risks associated with the DOE's operations at SNL/NM. The affected environment evaluated in the SWEIS includes the following 13 resource areas: land use and visual resources, infrastructure, geology and soils, water resources and hydrology, biological and ecological resources, cultural resources, air quality, human health and worker safety, transportation, waste generation, noise and vibration, socioeconomics, and environmental justice (see Chapter 4).

The following subsections summarize the environmental consequences and risks by resource area under each alternative. Tables 3.6–1 through 3.6–4 (located at the end of Chapter 3) present the comparison of environmental consequences in tabular form. Table 3.6–1 summarizes operational data from the selected facilities for each alternative. The facilities are arranged by selected facility/facility group, including the infrastructure facilities. Table 3.6–2 compares important parameters used in performing impact analyses described in Chapter 5. Table 3.6–3 compares impacts determined from these analyses for each alternative. Table 3.6–4 presents a condensed list of high-consequence impacts determined from the accidents analyses for each alternative. A complete list may be found in Appendix F.

3.6.1 Land Use and Visual Resources

No adverse impacts to land resources are expected as a result of the No Action, Expanded Operations, or Reduced Operations Alternatives. The extent of DOE land and U.S. Air Force (USAF)-permitted acreage currently available for use by SNL/NM facilities on KAFB would remain approximately the same.

Operations would remain consistent with industrial and research park uses and would have no foreseeable effects on established land use patterns or requirements. Buffer zones would continue to remain at their current size and location. New SNL/NM facilities, expansions, and upgrades would be limited and would not require changes to current land ownership or classification status because these activities would be planned in or near existing facilities, within already disturbed or developed areas, or on land already under DOE control. There would be no adverse impacts to visual resources that change the overall appearance of the existing landscape, obscure views, or alter the visibility of SNL/NM structures. New facilities, expansions, and upgrades would be planned in or near existing facilities in areas with common scenic quality. Efforts initiated by SNL/NM to incorporate a campus-style design would continue.

3.6.2 Infrastructure

Annual projected utility demands for all alternatives would be well within system capacities. Electrical consumption would range from 185,000 MWh (Reduced Operations Alternative) to 198,000 MWh per year. Projected water usage would range from 416 M gal to 495 M gal per year. Actual water usage probably would be lower because SNL/NM has implemented a conservation program to reduce usage by 30 percent by 2004. For comparison purposes, a conservation scenario is provided under the No Action Alternative. Other infrastructure-related factors, including maintenance, roads, communications, steam, natural gas, and facility decommissioning, would be similar for each alternative and would not be adversely affected by the projected levels of SNL/NM operations. Although not shown in Table 3.6–2, Expanded Operations Alternative, infrastructure analysis included a 10-percent margin to illustrate that the utility systems supporting SNL/NM have adequate capacity.

3.6.3 Geology and Soils

No activities planned for any of the alternatives would present a potential for slope destabilization. Slope instability has not been an issue in past SNL/NM operations and would likely not be a concern in the future. Existing soil contamination is being cleaned up through SNL/NM's Environmental Restoration (ER) Project, which is scheduled for completion by 2004. Under the Expanded Operations Alternative, there would be the potential for increased deposition of soil contaminants in outdoor testing areas. Potential contaminants would include DU fragments, explosive residue, and metals contained in weapons that are used in the tests. SNL/NM performs periodic sampling and radiation surveys in these testing areas. DU fragments are collected after tests. Potential contaminants have not been detected at concentrations above background at current testing levels. These areas are not accessible to the general public.

3.6.4 Water Resources and Hydrology

Groundwater contamination attributable to known SNL/NM activities is present at one site, the Chemical Waste Landfill (CWL) in TA-III. Investigation and cleanup planning are ongoing at this site, and any final plans must be approved by the New Mexico Environment Department. Under a no-cleanup scenario, the only contaminant exceeding U.S. Environmental Protection Agency concentration limits in groundwater would be trichloroethene (TCE), which occurs in a plume extending 410 ft from the CWL. It is important to note the contamination was a result of past activities and is not expected to be adversely affected by the alternatives. The TCE would not impact drinking water supplies because the nearest water supply well is approximately 4 mi from the CWL. Groundwater investigation would continue at several additional locations where the source of potential contamination has not been identified. Investigation and cleanup at locations with groundwater contamination would continue at the same rate under each of the three alternatives.

The estimated SNL/NM portion of local (in the immediate vicinity of KAFB) aquifer drawdown from 1998 to 2008 would range from 11 to 12 percent for all alternatives. Local drawdown would range from less than 1 to 28 ft across KAFB during this period. The potential consequence is considered adverse. This drawdown would not have an immediate effect on other water users, spring flow, or land subsidence. Long-term effects would be greatly mitigated by the city of Albuquerque's conversion to surface water use, scheduled to begin in 2004. Water demand under each alternative would be within existing KAFB water rights.

No contaminants attributable to SNL/NM activities have been detected in surface water samples collected onsite.

SNL/NM has little effect on the quantity of surface water in arroyos or the Rio Grande. The combined excess storm water runoff from SNL/NM facilities and

Maximally Exposed Individual

A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

discharge to Albuquerque's Southside Water Reclamation Plant would contribute from 0.06 to 0.07 percent to the annual Rio Grande flow under all alternatives, with no measurable impacts to the Rio Grande.

3.6.5 Biological and Ecological Resources

Beneficial impacts to biological and ecological resources would occur under all alternatives. Restricted access and limited development and use have benefited biological resources at the KAFB. For example, the absence of livestock grazing has improved the quality of the grasslands in relation to the region.

SNL/NM operations in TAs-I, -II, and -V would continue to occur primarily inside buildings. Under all alternatives, proposed construction (analyzed and approved in separate NEPA documents) would remove small areas of vegetation, but would not affect the viability of the plant communities. Proposed activities could result in the local displacement of wildlife. There would be slightly increased levels of noise and activity under the Expanded Operations Alternative. Observations indicate that wildlife has become accustomed to the noise and activities that currently exist. Data from raptor surveys of KAFB support this conclusion, as raptor species at KAFB return to the same nest sites each year. Outdoor activities at TA-III and the Coyote Test Field would continue to affect small localized areas.

Limited site access and management of the biological resources by SNL/NM, KAFB, and the U.S. Forest Service would continue to benefit the animals and plants, including sensitive species on KAFB.

3.6.6 Cultural Resources

Restricted access in association with activities at certain facilities would continue to have a beneficial effect on prehistoric and historic archaeological resources because it would protect the resources from vandalism, theft, or unintentional damage. For all three SWEIS alternatives, there would continue to be a potential for impacts to prehistoric and historic archaeological resources. These impacts would derive from explosive testing debris and shrapnel produced as a result of outdoor explosions, off-road vehicle traffic, and unintended fires and fire suppression. However, the potential for impacts due to these factors would be minimal under all three alternatives.

As a result of the ongoing consultation with 15 Native American tribes; no traditional cultural properties (TCPs) have been identified with SNL/NM; however, several tribes have requested that they be consulted under the *Native American Graves Protection and Repatriation Act* (NAGPRA) if human remains are discovered within the region of influence. These consultations will continue. If specific TCPs are identified, any impacts of SNL/NM activities on the TCP and any impacts of restricting access to the TCP would be determined in consultation with Native American tribes, and further NEPA review would be conducted, if appropriate.

3.6.7 Air Quality

Concentrations of criteria and chemical pollutants in air would be below regulatory standards and human health guidelines. Under a worst-case, 24-hour scenario, the maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b would represent a maximum of 96 percent of the allowable regulatory limit for several criteria pollutants (nitrogen dioxide, total suspended particulates (TSP), and particulate matter smaller than 10 microns in diameter [PM_{10}]) at a public access area (See Table 5.3.7–1).

The Federal and state regulatory standards, in general, are set to provide for an ample margin of safety below any pollutant concentration that might be of concern.

The methodology used in the criteria pollutant analysis also produces maximum concentration projections that are very conservative. For example, 100 percent of the maximum concentration of air pollutants projected for Cobisa Power Station (located 5 mi west of the National Atomic Museum) was added to the background concentration calculated for the Steam Plant location (near the museum). Also, the maximum concentrations of air pollutants, from a monitoring station measuring contributions from the surrounding community that are dominated by traffic emissions, were added to the worst-case contribution of pollutants from operating SNL/NM's diesel fuel-powered backup generators and fuel oil-powered Steam Plant boilers. Consequently, though close to the thresholds, these calculated concentrations for nitrogen dioxide, TSP, and PM_{10} are considered to be very conservative.

Based on the analysis of stationary and mobile source emissions, carbon monoxide emissions from SNL/NM would be less than 1996 emissions under any alternative.

With the exception of one chemical (chromium trioxide), concentrations of noncarcinogenic chemicals emitted from 12 facilities on SNL/NM were projected to be below screening levels based on occupational exposure limit (OEL) guidelines generally referenced to determine human health impacts. Concentrations of carcinogenic chemical emissions would pose little cancer risk (less than 1 in 1 million) to onsite workers or the general public. Chemical emissions would be highest for the Expanded Operations Alternative, although they would still be below levels that would affect public health.

The impact from emissions of criteria pollutants for the No Action and Expanded Operations Alternatives would be essentially the same. The major source of criteria pollutants (other than mobile sources) would be the steam plant that supplies steam to the facilities for heating. No increase in floor space is anticipated under the Expanded Operations Alternative; therefore, no increase in steam production would be required. The Reduced Operations Alternative would require less steam, resulting in lower emissions from the steam plant.

The radiological dose impacts due to the annual air emissions from SNL/NM facilities during normal operations under each of the alternatives would be much lower than the regulatory National Emissions Standards for Hazardous Air Pollutants (NESHAP) limit of 10 mrem/yr to a maximally exposed individual (MEI). The calculated radiological dose to an MEI would be 0.15 mrem/yr under the No Action Alternative; 0.51 mrem/yr under the Expanded Operations Alternative; and 0.02 mrem/yr under the Reduced Operations Alternative. The dose to an MEI under each alternative would be small in comparison to the average individual background radiation dose of 360 mrem/yr.

The calculated collective dose to the population within 50 mi of SNL/NM from the annual radiological air emissions due to the SNL/NM operations under each alternative would be 5.0 person-rem per year under the No Action Alternative; 15.8 person-rem per year under the Expanded Operations Alternative; and 0.80 person-rem per year under the Reduced Operations Alternative. The collective dose would be much lower than the collective dose of 263,700 person-rem to the same population from background radiation.

3.6.8 Human Health

Routine releases of hazardous radiological and chemical materials would occur during SNL/NM operations. These releases would have the potential to reach receptors (workers and members of the public) by way of different environmental pathways. The levels of exposure to chemicals and radionuclides were assessed for each environmental medium determined to be a pathway for these releases.

The SWEIS impact analyses identified air as the primary environmental pathway having the potential to transport hazardous material from SNL/NM facilities to receptors in the SNL/NM vicinity. In the assessment of human health risk from air emissions, a number of receptor locations and possible exposure scenarios were analyzed. The total composite cancer health risk is the sum of potential chemical and radiation exposures, calculated from the radiation cancer health risk to the MEI, plus the upper bound chemical cancer health risk from a hypothetical worst-case exposure scenario. This very conservative estimate of maximum health risk is greater than any of the individual health risks based on more likely exposure estimates at specific receptor locations.

Both the composite cancer health risk estimate of 1 in 385,000 and the cancer health risk estimates for specific receptor locations are below levels that regulators consider protective of public health. No adverse health effects would be expected from any of the three alternatives for SNL/NM. The small amounts of chemical carcinogens and radiation released from SNL/NM facilities would increase the maximally exposed individual lifetime risk of cancer for the hypothetical MEI by less than 1 chance in 434,000 under the No Action Alternative and by less than a possible 1 chance in 126,000 under the Expanded Operations Alternative. Noncancer health effects would not be expected based on hazard index values of less than 1. No additional nonfatal cancers, genetic disorders, or latent cancer fatalities (LCFs) would be expected in the population living within a 50-mi radius.

3.6.9 Transportation

The SNL/NM material and waste truck traffic offsite would be projected to increase from 14.5 shipments per day (1996) to 34.4 shipments per day under the Expanded Operations Alternative. However, the SNL/NM truck traffic would comprise less than 0.03 percent of the total traffic, including all types of vehicles entering and leaving the Albuquerque area by way of interstate highways. Therefore, the impact under the Expanded Operations Alternative would be minimal. The total local traffic on roadways would be expected to increase by a maximum of 3.6 percent overall under the Expanded Operations Alternative.

The overall maximum lifetime fatalities from SNL/NM annual shipments of all types of materials and wastes due to SNL/NM operations were estimated to be 1.7 fatalities under the Expanded Operations Alternative. Of these estimates, 1.2 fatalities would be due to traffic accidents; 0.33 fatalities would be due to incident-free transport of radiological materials and wastes; and 0.06 fatalities would be due to air pollution from truck emissions.

The maximum lifetime LCFs in the population within a 50-mi radius were estimated, based on a population dose of 4.93 person-rem, to be 0.0025 from the annual transport of radiological materials and wastes.

3.6.10 Waste Generation

Generation of radioactive waste, hazardous waste, process wastewater, and nonhazardous solid wastes was reviewed. The goal of the review was to determine the adequacy of existing onsite and offsite storage, treatment, and disposal capabilities. Storage capacity for all anticipated waste types would be adequate. Limited onsite hazardous and mixed waste treatment capacity would be within current permit limits. Most hazardous waste would be treated and disposed of offsite within the commercial sector. Commercial offsite capacity is currently adequate and would exceed anticipated future demand.

Recycling of wastes was not included in the modeling to bound actual projected waste quantities. Radioactive material management practices would be required to reduce quantities of material that could inadvertently become contaminated. LLW and LLMW would increase by a maximum of 198 percent (from 3,322 ft^3 to 9,897 ft^3 per year, Table 3.6–2) and 69 percent (from 153 ft^3 to 258 ft^3 per year, Table 3.6–2), respectively, under the Expanded Operations Alternative. One new operation, the Medical Isotopes Production Project, would be the major contributor to this increase. Capacity currently exists to manage the waste generated from all operations at the Expanded Operations Alternative level.

Trends for all hazardous waste clearly show a significant reduction due to the implementation of pollution prevention protocols at SNL/NM. New procedures and recycling for the solid waste and process wastewater would have similar impacts on the nonhazardous waste volumes being generated.

3.6.11 Noise and Vibration

The No Action Alternative would enable SNL/NM to operate at current planned levels, which include baseline background noise levels and short-term noise impacts from SNL/NM test activities. Impulse noise-producing test activities would increase an estimated 35 percent over the 1996 number of test activities by 2008.

Projections under the Expanded Operations Alternative indicate a 250 percent increase in the number of impulse noise tests over 1996 levels. This would result in an average of approximately 1 impulse noise event per hour for an 8-hour work day, based on a 261-day work year.

The projected frequency of impulse noise events for the Reduced Operations Alternative would be 65 percent less than the 1996 levels, resulting in an average of 1.5 impulse noise tests per day.

Only a small fraction of these tests would be loud enough to be heard or felt beyond the site boundary. The vast majority of tests would be below background noise levels for locations beyond the KAFB boundary and would be unnoticed in neighborhoods bounding the site. Ground vibrations would remain confined to the immediate test area.

3.6.12 Socioeconomics

Direct SNL/NM employment projections range from 7,422 (Reduced Operations Alternative) to 8,417 (Expanded Operations Alternative), in comparison to 7,652 full-time SNL/NM employees in the base year. These employment changes would change regional population, employment, personal income, and other socioeconomic measures in the region by less than 1 percent.

3.6.13 Environmental Justice

Based on the analyses of other impact areas, the DOE would not expect any environmental justice-related impacts from the continued operation of SNL/NM under any of the alternatives. Resource areas of potential concern were evaluated on an individual basis with respect to minority populations and low-income populations. Three resource areas evaluated individually were water resources, cultural resources, and transportation.

3.6.14 Accidents

At SNL/NM, accidents could occur that would affect workers and the public. Potential accidents with the largest impacts would involve radioactive materials in TA-V facilities and hazardous chemicals in TA-I facilities. In most instances, involved workers (those individuals located in the immediate vicinity of an accident) would incur the largest risk of serious injury or fatality. This is because, for most accidents, the magnitude of the damaging effects are highest at the point of the accident and diminish with increasing distance. This would apply, for example, to releases of radioactive and chemical materials, explosions, fires, airplane crashes, earthquakes, and similar events. In some situations, however, the mitigating effects of structural barriers, personal protection equipment, and engineered safety features may offer greater protection for close-in workers than others in the general vicinity of the accident.

In TA-I, under all three alternatives, there could be numerous situations in laboratory rooms where workers could be accidentally exposed to small amounts of dangerous chemicals. The potential also exists in TA-I for a catastrophic accident, such as an airplane crash into a facility or an earthquake, in which multiple dangerous chemicals could be released and expose onsite individuals to harmful or fatal chemical concentrations. Large quantities of hydrogen stored in outside areas of TA-I could also explode as a result of a catastrophic event and cause serious injury or fatality to involved workers and other nearby onsite individuals. The probability of a catastrophic chemical or explosive accident with serious consequences is low (less than once in a thousand years). Should such an accident occur, emergency procedures, mitigating features, and administrative controls would minimize its adverse impacts.

The potential for accidents would exist in TA-V that would cause the release of radioactive materials, causing injury to workers, onsite individuals, and the public. The magnitudes of impacts for the worst-case accident, an earthquake, would be minimal for all alternatives. If an earthquake occurred, the impacts would range from an approximate 1 in 33 increase in probability of an LCF for a noninvolved worker on the site to 1 in 120,000 for a maximally exposed member of the public. For the entire population residing within 50 mi of SNL/NM, less than one additional LCF would be expected. Involved workers, as in the case of chemical accidents, would incur the largest risk of injury or fatality in the event of almost any accident because of their close proximity to the hazardous conditions.

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Neutron Generator Facility	Development or production of devices, processes, and systems	Neutron generators	Neutron generators	600	2,000	2,000	2,000	2,000
	Expenditures		dollars	2.6 M	5.2 M	5.2 M	5.2 M	5.2 M
	Hazardous waste		kg	2,760	3,680	3,680	3,680	3,680
	Low-level waste		kg	3,000	4,000	4,000	4,000	4,000
	Low-level mixed waste		kg	150	300	300	300	300
	Nuclear consumption	Tritium	Ci	386	652	652	652	652
	Nuclear inventory	Tritium	Ci	682	836	836	836	836
	Radioactive air emissions	Tritium	Ci	94	156	156	156	156
	Personnel		FTEs	160	320	320	320	320
	Process water		gal	4.5 M	5 M	5 M	5 M	5 M
	Wastewater		gal	4.5 M	5 M	5 M	5 M	5 M
Microelectronics Development Laboratory	Development or production of devices, processes, and systems	Microelectronic devices and systems	wafers	4,000	5,000	7,000	7,500	2,666
	Boiler energy consumption	Natural gas	ft^3	34.3 M	34.3 M	34.3 M	34.3 M	34.3 M
	Hazardous waste		kg	2,520	3,150	4,410	4,738	1,688
	Low-level waste		ft^3	4	5	7	8	3
	Process electricity		kWh	28.6 M	28.6 M	28.6 M	28.6 M	28.6 M
	Process water		gal	44.1 M	55.1 M	77.2 M	77.2 M	44.1 M
	Process wastewater		gal	44 M	55 M	77 M	77 M	44 M

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Advanced Manufacturing Processes Laboratory	Development or production of devices, processes, and systems	Materials, ceramics/glass, electronics, processes, and systems	operational hours	248,000	310,000	310,000	347,000	248,000
	Expenditures		dollars	32 M	40 M	40 M	45 M	32 M
	Hazardous waste		kg	4,732	5,915	5,915	6,625	4,732
	Personnel		FTEs	150	184	184	204	150
Integrated Materials Research Laboratory	Other	Research and development of materials	operational hours	395,454	395,454	395,454	395,454	363,817
	Expenditures		dollars	45 M	55 M	60 M	62 M	48 M
	Hazardous waste		kg	2,400	2,100	1,850	2,000	2,000
	Nuclear inventory	Depleted uranium	mCi	0.93	1.0	1.0	1.0	0
	Personnel		FTEs	250	250	250	250	230
Explosive Components Facility	Test activities	Neutron generator tests	tests	200 (FY 1998)	500	500	500	500
		Explosive testing	tests	600	750	850	900	300
		Chemical analysis	analyses	900	950	1,000	1,250	500
		Battery tests	tests	50	60	60	100	10
	Boiler energy consumption	Natural gas	ft^3	24 M	27 M	27 M	29 M	16 M
	Expenditures		dollars	1.7 M	2.1 M	2.1 M	2.5 M	1.4 M

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Explosive Components Facility (continued)	Hazardous waste		kg	360	400	500	500	200
	Low-level waste		ft^3	95	190	190	190	190
	Low-level mixed waste		kg	1,000	1,000	1,000	1,000	1,000
	Nuclear inventory	Tritium	Ci	49	49	49	49	49
	Radioactive air emissions	Tritium	Ci	$1x10^{-3}$	$2x10^{-3}$	$2x10^{-3}$	$2x10^{-3}$	$2x10^{-3}$
	Personnel		FTEs	81	94	94	102	94
	Process electricity		kWh	2.9 M	3.1 M	3.1 M	3.4 M	2.5 M
	Process water		gal	6 M	6.5 M	6.5 M	7 M	4 M
	Process wastewater		gal	4.8 M	5 M	5 M	6.4 M	3.2 M
PHYSICAL TESTING AND SIMULATION FACILITIES								
Terminal Ballistics Complex	Test activities	Projectile impact testing	tests	50	80	100	350	10
		Propellant testing	tests	25	40	50	100	4
	Expenditures		dollars	8,500	9,500	11,000	12,000	3,000
	Hazardous waste		kg	0.25	0.50	0.50	0.75	0
	Personnel		FTEs	0.3	0.4	0.6	2	0.05
Drop/Impact Complex	Test activities	Drop test	tests	18	20	20	50	0
		Water impact	tests	1	1	1	20	1
		Submersion	tests	1	1	1	5	0
		Underwater blast	tests	0	2	2	10	0

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Drop/Impact Complex (continued)	Expenditures		dollars	50,000	55,000	60,000	146,000	31,000
	Personnel		FTEs	2.5	2.5	2.5	8	2.5
Sled Track Complex	Test activities	Rocket sled test	tests	10	10	15	80	2
		Explosive testing	tests	12	12	12	239	0
		Rocket launcher	tests	3	4	4	24	0
		Free-flight launch	tests	40	40	40	150	0
	Expenditures		dollars	334,000	376,000	451,000	2.0 M	190,000
	Hazardous waste		kg	15	15	15	50	3
	Personnel		FTEs	8	8	8	40	8
Centrifuge Complex	Test activities	Centrifuge	tests	32	46	46	120	2
		Impact	tests	0	10	10	100	0
	Expenditures		dollars	400,000	450,000	480,000	750,000	250,000
	Hazardous waste		kg	10	12	12	15	12
	Personnel		FTEs	3.5	4.5	4.5	10	3.5
ACCELERATOR FACILITIES								
SATURN	Test activities	Irradiation of components or materials	shots	65	200	200	500	40
	Expenditures		dollars	1.5 M	3 M	3 M	5.4 M	1.2 M
	Hazardous waste		kg	167	501	501	1,286	100
	Personnel		FTEs	5	10	10	18	4

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
HERMES III	Test activities	Irradiation of components or materials	shots	262	500	500	1,450	40
	Expenditures		dollars	2.4 M	3.0 M	3.0 M	4.4 M	1.98 M
	Hazardous waste		kg	167	316	316	915	25
	Low-level waste		ft^3	0.25	0.48	0.48	1.38	0.04
	Radioactive air emissions	Nitrogen-13	Ci	$6.55x10^{-4}$	$12.45x10^{-4}$	$12.45x10^{-4}$	$36.03x10^{-4}$	$1x10^{-4}$
		Oxygen-15	Ci	$6.55x10^{-5}$	$12.45x10^{-5}$	$12.45x10^{-5}$	$36.03x10^{-5}$	$1x10^{-5}$
	Personnel		FTEs	12	15	15	22	10
Sandia Accelerator & Beam Research Experiment	Test activities	Irradiation of components or materials	shots	187	225	225	400	0
	Expenditures		dollars	640,000	800,000	800,000	960,000	80,000
	Hazardous waste		kg	63	76	76	132	0
	Low-level waste		ft^3	4.0	4.8	4.8	8.4	0.0
	Personnel		FTEs	4.0	5.0	5.0	6.0	0.5
Short-Pulse High Intensity Nanosecond X-Radiator	Test activities	Irradiation of components or materials	shots	1,185	2,500	2,500	6,000	200
	Expenditures		dollars	300,000	500,000	500,000	710,000	70,000
	Hazardous waste		kg	21	45	45	107	3.6
	Personnel		FTEs	2.7	3.5	3.5	5	0.5
Repetitive High Energy Pulsed Power Unit I	Test activities	Accelerator tests	tests	500	5,000	5,000	10,000	100

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Repetitive High Energy Pulsed Power Unit I (continued)	Expenditures		dollars	1.5 M	2.5 M	2.5 M	5.5 M	750,000
	Hazardous waste		kg	0	5	5	10	0
	Nuclear consumption	Depleted uranium	µg	0	10	10	100	0
	Nuclear inventory	Depleted uranium	µg	0	10	10	100	0
	Personnel		FTEs	5	8	8	10	2
Repetitive High Energy Pulsed Power Unit II	Test activities	Radiation production	tests	80	160	160	800	40
	Expenditures		dollars	252,000	353,000	353,000	754,000	126,000
	Hazardous waste		kg	0	1	1	1	0
	Personnel		FTEs	0.9	1.4	1.4	3	0.45
Z-Machine	Test activities	Accelerator shots	shots	150	300	300	350	84
	Expenditures		dollars	1.2 M	3 M	3 M	40 M	800,000
	Hazardous waste		kg	750	1,000	1,000	1,250	400
	Low-level waste		ft^3	44	20	20	28	12
	Nuclear consumption	Tritium	Ci	0	2,500	2,500	7,500	0
		Deuterium[b]	L	0	3,750	3,750	5,000	0
		Plutonium-239	mg	0	800	800	2,000	0
		Depleted uranium	mg	0	800	800	2,000	0
	Nuclear inventory	Tritium	Ci	0	1,000	1,000	50,000	0
		Deuterium[b]	L	0	1,000	1,000	5,000	0

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Z-Machine (continued)	Nuclear inventory (continued)	Plutonium-239	mg	0	200	200	200	0
		Depleted uranium	mg	0	200	200	200	0
	Radioactive air emissions	Nitrogen-13	Ci	0.042	0	0	0	0
		Oxygen-15	Ci	0.005	0	0	0	0
	Personnel		FTEs	50	85	85	115	50
TESLA	Test activities	Accelerator shots	shots	40	1,000	1,000	1,300	40
	Expenditures		dollars	500,000	1 M	1 M	1.6 M	500,000
	Hazardous waste		kg	2	50	50	65	2
	Personnel		FTEs	1	3	3	5	1
Advanced Pulsed Power Research Module	Test activities	Accelerator shots	shots	500	1,000	1,000	2,000	40
	Expenditures		dollars	3.5 M	5 M	5 M	5.5 M	1.5 M
	Hazardous waste		kg	50	100	100	200	5
	Personnel		FTEs	5	7	7	7	5
Radiographic Integrated Test Stand	Test activities	Accelerator shots	shots	0[c]	400	600	800	100
	Expenditures		dollars	0	2.25 M	2.25 M	4 M	1.75 M
	Hazardous inventories	Insulator oil	gal	0	40,000	40,000	40,000	40,000
	Hazardous waste		kg	0	136	204	272	34
	Low-level waste		kg	0	60	90	120	15
	Radioactive air emissions	Nitrogen-13	Ci	0	0.08	0.12	0.16	0.02

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Radiographic Integrated Test Stand (continued)	Radioactive materials inventory	Activated hardware	kg	0	500	500	500	500
	Personnel		FTEs	0	6	6	10	4
REACTOR FACILITIES								
New Gamma Irradiation Facility	Test activities	Tests	hours	0[c]	13,000	13,000	24,000	0
	Expenditures		dollars	0	6 M	500,000	1 M	0
	Hazardous waste		ft^3	0	14	14	14	7
	Low-level waste		ft^3	0	92	92	126	56
	Personnel		FTEs	0	3	3	4	2
	Process water		gal	0	166,000	166,000	255,000	0
	Radioactive consumption	Cobalt-60	Ci	0	142,000	142,000	246,000	0
Gamma Irradiation Facility	Test activities	Tests	hours	1,000	0	0	8,000	0
	Hazardous waste		ft^3	7	0	0	14	7
	Low-level waste		ft^3	56	0	0	126	56
	Nuclear inventory	Depleted uranium	kg	13,600	13,600	13,600	13,600	13,600
	Personnel		FTEs	2	0	0	3	2
	Process water		gal	17,000	0	0	17,000	17,000
Sandia Pulsed Reactor	Test activities	Irradiation tests	tests	100	100	100	200	30
	Expenditures		dollars	0	5 M	0	6 M	0
	Hazardous waste		ft^3	7	14	14	30	7
	Low-level waste		kg	440	440	440	900	440

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Sandia Pulsed Reactor (continued)	Low-level mixed waste		ft^3	4	4	4	14	4
	Nuclear inventory	Plutonium-239	g	53	10,000	10,000	10,000	53
		Enriched uranium	kg	550	900	550	1,000	550
	Radioactive air emissions	Argon-41	Ci	9.5	9.5	9.5	30.0	2.85
	Personnel		FTEs	10	12	10	17	8
Annular Core Research Reactor (DP for No Action and Reduced Operations Alternatives, ACPR-II for Expanded Operations Alternative)	Test activities	Irradiation tests	test series	0	1	0	2 to 3	0
	Expenditures		dollars	200,000	5 M	200,000	12 M	200,000
	Explosives inventory	Bare UNO 1.2[d]	g	0	500	500	500	0
	Hazardous waste		ft^3	0	2	0	14	0
	Low-level mixed waste		ft^3	0	35	0	170	0
	Low-level waste		ft^3	0	0	0	5	0
	Nuclear consumption	Enriched uranium	g	0	0	0	2	0
	Nuclear material inventory	Cobalt-60	Ci	33.6	19	10	33.6	33.6
		Enriched uranium	kg	12	37	37	85	12
		Plutonium-239	g	148	148	148	8,800	148
	Personnel		FTEs	1	1	1	8	1
	Process wastewater		gal	0	10,000	0	50,000	0
	Process water		gal	0	10,000	0	100,000	0
	Radioactive air emissions	Argon-41	Ci	2.6	2.6	2.6	7.8	0

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Annular Core Research Reactor DP (continued)	Transuranic mixed waste		ft^3	0	0	0	5	0
	Transuranic waste		ft^3	0	0	0	5	0
Annular Core Research Reactor (medical isotopes production configuration)	Test activities	Irradiation of production targets	targets	8[e]	375	375	1,300	40
	Expenditures		dollars	200,000	4.5 M	4 M	0	0
	Explosives inventory	Bare UNO 1.2[d]	g	0	500	500	500	0
	Hazardous waste		ft^3	7	14	14	30	7
	Low-level waste		ft^3	56	370	370	1,090	56
	Nuclear consumption	Enriched uranium	kg	0	0.38	10.6	16	0
	Nuclear inventory	Enriched uranium	kg	25.8	56.7	56.7	56.7	18.3
	Radioactive air emissions	Tritium	Ci	0	1.1	1.1	2.2	0.24
		Argon-41	Ci	35.4	1.1	1.1	2.2	0.24
	Personnel		FTEs	9	14	14	22	7
	Process water		gal	600,000	5 M	5 M	11 M	1.2 M
	Process wastewater		gal	125,000	1M	1 M	2.2 M	240,000
	Spent fuel	Spent fuel from fuel elements	kg	0	0	189	399	42

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Hot Cell Facility	Development or production of devices, processes, and systems	Processing of production targets	targets	8	375	375	1,300	40
	Expenditures		dollars	0	4 M	0	0	0
	Hazardous waste		ft^3	7	14	14	22	7
	Low-level waste		ft^3	100	2,200	2,200	5,000	270
	Low-level mixed waste		ft^3	7	17	17	40	5
	Nuclear consumption	Enriched uranium	kg	0.2	9.4	9.4	32.5	1.0
	Nuclear inventory	Enriched uranium	g	25	25	25	125	25
	Radioactive air emissions	Iodine-131	Ci	0.00196	1.17	1.17	3.9	0.117
		Iodine-132	Ci	0.000129	3.0	3.0	10.0	0.3
		Iodine-133	Ci	0.00951	5.4	5.4	18.0	0.54
		Iodine-135	Ci	0.00132	3.3	3.3	11	0.33
		Krypton-83m	Ci	0.0000957	198.0	198.0	660.0	19.8
		Krypton-85	Ci	0.00153	0.19	0.19	0.63	0.019
		Krypton-87	Ci	0.0294	57.0	57.0	190	5.7
		Krypton-88	Ci	0.527	480.0	480.0	1,600	48.0
		Xenon-133	Ci	17.5	2,160.0	2,160.0	7,200.0	216.0
		Xenon-133m	Ci	0.768	102.0	102.0	340.0	10.2
		Xenon-135	Ci	14.7	2,070.0	2,070.0	6,900.0	207.0
		Iodine-134	Ci	0	0.22	0.22	0.72	0.022
		Xenon-135m	Ci	0.976	360	360	1,200	36
		Krypton-85m	Ci	0.587	290.0	290.0	970.0	29.0
		Xenon-131m	Ci	0.000345	1.8	1.8	5.9	0.18
	Personnel		FTEs	12	32	32	55	12

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
OUTDOOR TEST FACILITIES								
Aerial Cable Facility	Test activities	Drop/pull-down	Tests	21	32	38	100	2
	Test activities (continued)	Aerial target	tests	6	6	6	30	0
		Scoring system tests	series	0	1	1	2	0
	Expenditures		dollars	250,000	350,000	380,000	725,000	150,000
	Explosives consumption	Bare UNO 1.4[d]	g	410	625	741	2,314	71
		Bare UNO 1.1[d]	kg	18.9	28.4	34.6	78.8	0
		Bare UNO 1.3[d]	kg	1,514	3,268	3,814	22,930	480
	Hazardous waste		kg	5	5	5	9	5
	Personnel		FTEs	8	8	10	24	6
Lurance Canyon Burn Site	Test activities	Certification testing	tests	12	12	12	55	1
		Model validation	tests	56	56	56	100	0
		User testing	tests	37	37	37	50	0
	Expenditures		dollars	250,000	275,000	300,000	625,000	150,000
	Hazardous waste		kg	900	900	900	900	900
	Personnel		FTEs	4.5	4.5	4.5	11	3.5
	Process wastewater		gal	25,000	25,000	25,000	25,000	25,000
Containment Technology Test Facility - West	Test activities	Survivability testing	tests	1	1	0	2	1
	Expenditures		dollars	2 M	2 M	0	2 M	2 M
	Hazardous waste		g	100	100	0	100	100
	Personnel		FTEs	12	12	0	12	12

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Explosives Applications Laboratory	Test activities	Explosive testing	tests	240	240	240	275 to 360	50
	Expenditures		dollars	650,000	747,500	859,625	975,000	435,500
	Hazardous waste		kg	1	1	1	1.5 to 2	0.5
	Personnel		FTEs	3	3	3	6	2
Thunder Range Complex	Other	Equipment disassembly and evaluation	days	60	82	82	144	42
	Test activities	Ground truthing tests	test series	1	5	8	10	1
	Nuclear inventory	Plutonium-239	Ci	≤ 0.52	≤ 0.52	≤ 0.52	0.52	0
		Plutonium-238	Ci	≤ 0.62	≤ 0.62	≤ 0.62	0.62	0
		Americium-241	Ci	≤ 0.52	≤ 0.52	≤ 0.52	0.52	0
		Americium-243	Ci	≤ 0.52	≤ 0.52	≤ 0.52	0.52	0
		Normal uranium	Ci	≤ 4.2	≤ 4.2	≤ 4.2	4.2	0
	Personnel		FTEs	1.1	1.5	1.5	2.6	0.8
INFRASTRUCTURE FACILITIES								
Steam Plant	Infrastructure	Generate and distribute steam to DOE, TA-I, KAFB East, Coronado Club	lbs	544 M	544 M	544 M	544 M	362 M
	Boiler energy consumption	Natural gas[f]	ft^3	779 M	779 M	779 M	779 M	519 M
	Expenditures		dollars	2.8 M	2.83 M	2.83 M	2.87 M	2.4 M

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Steam Plant (continued)	Personnel		FTEs	17	17	17	17	12
	Process electricity		kWh	1.2 M	1.2 M	1.2 M	1.2 M	0.8 M
	Process water		gal	14.3 M	17 M	17 M	20 M	9.5 M
Hazardous Waste Management Facility[g]	Infrastructure	Collection, packaging, handling, and short-term storage of hazardous and other toxic waste	kg	203,000	192,000	196,000	214,000	175,000
	Expenditures		dollars	950,000	890,000	890,000	1.0 M	820,000
	Waste managed	RCRA hazardous waste	kg	55,852	70,469	74,358	92,314	53,123
	Personnel		FTEs	13	12	13	14	11
Radioactive and Mixed Waste Management Facility	Infrastructure	Receipt, packaging, and shipping of radioactive waste	lb	1.6 M	2.1 M	2.1 M	2.7 M	0.8 M
	Expenditures		dollars	320,000	416,000	416,000	528,000	160,000
	Waste managed	Low-level waste	ft^3 (m^3)	11,874 (337)	15,436 (438)	15,436 (438)	19,592 (556)	5,937 (168)
		Low-level mixed waste	ft^3 (m^3)	5,353 (152)	6,959 (197)	6,959 (197)	8,833 (251)	2,677 (76)
		Transuranic	ft^3 (m^3)	214 (6.1)	278 (7.9)	278 (7.9)	353 (10)	107 (3.0)

Table 3.6–1. Comparison of Activity Levels at 10 Selected Facilities/Facility Groups Under the No Action, Expanded Operations, and Reduced Operations Alternatives (concluded)

FACILITY	CATEGORY	ACTIVITY TYPE OR MATERIAL	UNITS (PER YEAR)	NO ACTION ALTERNATIVE			EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
				BASE YEAR[a]	FIVE-YEAR	TEN-YEAR		
Radioactive and Mixed Waste Management Facility (continued)	Waste managed	Mixed transuranic	ft^3 (m^3)	16 (0.45)	21 (0.60)	23 (0.65)	37 (1.05)	8 (0.23)
	Radioactive air emissions	Tritium	Ci	2.203	2.203	2.203	2.203	2.203
	Personnel		FTEs	30	39	39	49	15
Thermal Treatment Facility	Infrastructure	Treatment of waste	lb	minimal	336	336	1,200	minimal
	Expenditures		dollars	10,000	20,000	20,000	100,000	10,000
	Hazardous waste		kg	minimal	76	76	272	minimal
	Personnel		FTEs	0.1	0.2	0.2	1	0.1

Source: SNL/NM 1998a
Ci: curie
DP: Defense Programs
ft^3: cubic foot
FTE: full-time equivalent
FY: fiscal year
g: gram
gal: gallon
HWMF: Hazardous Waste Management Facility
kg: kilogram
kWh: kilowatt-hour
L: liter
lb: pound
M: million
mCi: millicurie
mg: milligram
RCRA: *Resource Conservation and Recovery Act*
RMWMF: Radioactive and Mixed Waste Management Facility
TA: technical area
TSCA: *Toxic Substances Control Act*
yr: year
μg: microgram
≤: less than or equal to
[a] Base year is the year selected as most representative of normal operations (SNL/NM 1998ee).
[b] Deuterium is not a radionuclide; however, it is considered as accountable nuclear material.
[c] Facility not completed as of publication of this SWEIS
[d] The United Nations Organization (UNO) Classification System is used to identify hazard class for explosives.
[e] Eight tests are planned for the base year to test and evaluate Molybdenum-99 separation process
[f] At 14.7 pounds per square inch
[g] Infrastructure and waste management quantities differ from waste generation quantities in Table 3.6–2, because the HWMF does not manage explosive (RCRA hazardous) waste, does not manage all TSCA wastes generated at SNL/NM, and does not manage all other types of wastes (nonRCRA hazardous) generated at SNL/NM.
[h] Infrastructure and waste management quantities differ from waste generation quantities in Table 3.6–2 because the RMWMF manages legacy waste inventories that were previously generated by SNL/NM facilities and activities.

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives

RESOURCE AREA	UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
LAND USE					
SNL/NM Land Use Within KAFB	ac	8,824	8,824	8,824	8,824
DOE Buffer Zones	ac	9,093	9,093	9,093	9,093
INFRASTRUCTURE					
Utilities (Annual Basis)	Note: Expanded Operations Alternative quantities do not include 10% margin.				
Water Use/ Water Capacity	gal/yr	440 M 2.0 B	463 M 2.0 B	495 M 2.0 B	416 M 2.0 B
Sanitary Sewer Discharge/ Sanitary Sewer Capacity	gal/yr	280 M 850 M	304 M 850 M	322 M 850 M	268 M 850 M
Natural Gas Use/ Natural Gas Capacity	ft^3/yr[a]	475 M 2.3 B ft^3	450 M 2.3 B ft^3	475 M 2.3 B ft^3	385 M 2.3 B ft^3
Electrical Use/ Electrical Capacity	MWh/yr	197,000 1.1 M	186,000 1.1 M	198,000 1.1 M	185,000 1.1 M
GEOLOGY AND SOILS					
Potential Soil/Subsurface Contamination Sites Identified	sites	182	182	182	182
Active Sites[b]	sites	20	20	20	20
SNL/NM Usage Areas Near 10% Or Greater Slopes	areas	4	4	4	4
WATER RESOURCES AND HYDROLOGY					
Total SNL/NM Projected Groundwater Use, through 2008[c]	ft^3/10 yr	575 M	605 M	628 M	571 M
Developed Area	mi^2	0.72	0.72	0.72	0.72

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

RESOURCE AREA	UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
BIOLOGICAL/ECOLOGICAL RESOURCES					
Change in Habitat Area		NA	No change	No change	No change
CULTURAL RESOURCES					
Cultural Resources Located in all Areas of Potential Effect	number	192	192	192	192
AIR QUALITY					
Nonradioactive Emissions					
Nitrogen Oxides	tons/yr	153.92	162.36	162.36	162.36
Carbon Monoxide					
Stationary Sources	tons/yr	15.21	18.36	18.36	18.36
Mobile Sources	tons/yr	4,087	3,489	3,837	3,385
Construction Activities	tons/yr	132	132	132	132
Lurance Canyon Burn Site	tons/yr	0.78	0.78	4.5	0.78
Particulate Matter	tons/yr	3.65	7.46	7.46	7.46
Sulfur Dioxide	tons/yr	0.32	1.10	1.10	1.10
Radioactive Emissions					
Argon-41	Ci/yr	44.9	13.2	40.0	3.1
Tritium	Ci/yr	4.52	159.6	161	158.7
Nitrogen-13	Ci/yr	$4.2x10^{-2}$	0.12	0.16	0.02
Oxygen-15	Ci/yr	$2.6x10^{-2}$	$1.25x10^{-4}$	$3.60.10^{-4}$	$1.0x10^{-5}$
Iodine-131	Ci/yr	$1.96x10^{-3}$	1.17	3.90	0.117
Iodine-132	Ci/yr	$1.29x10^{-4}$	3.0	10.0	0.3
Iodine-133	Ci/yr	$9.51x10^{-3}$	5.4	18.0	0.54

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

RESOURCE AREA	UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Iodine-134	Ci/yr		0.22	0.72	0.022
Iodine-135	Ci/yr	1.32×10^{-3}	3.3	11.0	0.33
Krypton-83m	Ci/yr	9.57×10^{-5}	198.0	660.0	19.8
Krypton-85	Ci/yr	1.53×10^{-3}	0.19	0.63	0.019
Krypton-85m	Ci/yr	0.587	290	970	29.0
Krypton-87	Ci/yr	0.029	57	190	5.7
Krypton-88	Ci/yr	0.527	480	1,600	48.0
Xenon-131m	Ci/yr	3.45×10^{-4}	1.8	5.9	0.18
Xenon-133	Ci/yr	17.5	2,160	7,200	216
Xenon-133m	Ci/yr	0.768	102	340	10.2
Xenon-135	Ci/yr	14.7	2,070	6,900	207
Xenon-135m	Ci/yr	0.976	360	1,200	36.0
***TRANSPORTATION** (Normal Operations)*					
Material (Annual Shipments/Receipts Radioactive, Chemical, and Explosives)	trips	3,358	5,096	7,498	4,170
Radioactive Waste (LLW & LLMW)	shipments	5	16	24	11
Chemical Waste	shipments	102	122	150	95
Solid Waste (Includes Construction/Demolition)	shipments	51	650	650	650
Recyclable Waste (Excludes D&D)	shipments	86	231	233	8
Site Related Traffic - Total KAFB Daily traffic	vehicles	37,727	38,406	39,085	37,319
SNL/NM Daily Hazardous Materials Transports	shipments	14.5	24.6	34.4	20.7

Table 3.6–2. Comparison of Parameters Used to Analyze Selected Facilities Under the No Action, Expanded Operations, and Reduced Operations Alternatives (continued)

RESOURCE AREA		UNITS	BASELINE	NO ACTION ALTERNATIVE (2008)	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
WASTE GENERATION [d] ***(Selected Facilities plus Balance of Operations)***						
Radioactive Waste	Low-Level	ft^3 (m^3)	3,322 (94)	5,993 (170)	9,897 (280)	3,616 (102)
	Low-level Mixed	ft^3 (m^3)	153 (4.33)	189 (5.34)	258 (7.31)	134 (3.79)
	Transuranic Waste	ft^3 (m^3)	0 (0)	10 (0.28)	26 (0.74)	0 (0)
	Mixed Transuranic Waste	ft^3 (m^3)	16 (0.45)	23 (0.65)	37 (1.05)	8 (0.23)
	Total Radioactive Waste	ft^3 (m^3)	3,493 (98.9)	6,215 (176.0)	10,220 (289.4)	3,758 (106.4)
Chemical Waste	RCRA Hazardous Waste[e]	kg	55,852	74,358	92,314	53,123
	TSCA (PCBs and Asbestos)[f]	kg	147,055[c]	122,000	122,000	122,000
	Non-RCRA Chemicals[g]	kg	69,321[c]	92,290	114,576	65,934
	Biohazardous[g]	kg	2,463[c]	3,279	4,071	2,343
	Recyclable Materials[g]	kg	60,768[c]	80,903	100,439	57,799
	Total Chemical Waste	kg	340,317	379,298	441,429	305,819
Solid Waste		kg	0.6 M	0.6 M	0.6 M	0.6 M
		m^3	2,022	1,955	2,022	1,955
NOISE/VIBRATION						
SNL/NM Estimated Number of Noise/Vibration-Producing Tests		tests/day	4.1	5.5	15.6	1.5
SOCIOECONOMICS[h]						
Employment[i]		FTEs	7,652 SNL/NM 18,826 (indirect)	8,035 SNL/NM 19,765 (indirect)	8,417 SNL/NM 20,706 (indirect)	7,422 SNL/NM 18,259 (indirect)
Payroll		dollars	480 M SNL/NM 580 M (indirect)	500 M SNL/NM 610 M (indirect)	530 M SNL/NM 640 M (indirect)	470 M SNL/NM 560 M (indirect)
Expenditures		dollars	1.43 B SNL/NM 2.50 B (indirect)	1.50 B SNL/NM 2.63 B (indirect)	1.57 B SNL/NM 2.75 B (indirect)	1.39 B SNL/NM 2.43 B (indirect)

Source: SNL/NM 1998a
ac: acre
B: billion
Ci: curies
D&D: decontamination and decommissioning
FTE: full-time equivalent
ft^3: cubic feet
g: gram
gal: gallon
HSWA: *Hazardous Solid Waste Amendment*
HWMF: Hazardous Waste Management Facility
KAFB: Kirtland Air Force Base
kg: kilogram
M: million
m^3: cubic meter
mi: mile
mi^2: square mile
MWh: megawatt-hour
PCB: polychlorinated biphenyls
RCRA: *Resource Conservation and Recovery Act*
yr: year
[a] 60 psi
[b] Sites that cannot be removed from HSWA permit because of ongoing activities
[c] Ten-year quantities are sums of annual interpolated quantities.
[d] Quantities do not include special operations or legacy waste and differ from those in Table 3.6–1.
[e] HWMF managed.
[f] 1997 was used as the base year as 1996 was abnormal for PCBs and asbestos wastes.
[g] Multipliers, based on the proportional increase/decrease of hazardous waste, were used for projection of other wastes and materials recycled.
[h] Bounding analysis based on parameters presented in DOE 1997j.
[i] Section 4.12, Affected Environment, differs slightly, using 6,824 full-time employees.
Note: Waste totals bound SNL/NM, DOE, and other small DOE-funded activities.

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Land Use		No changes projected in classification or ownership	Same as No Action Alternative	Same as No Action Alternative
Visual Resources		Changes would be minor and transitory. Projected new construction in already developed areas	Same as No Action Alternative	Same as No Action Alternative
Infrastructure		All projected activities within capacities of existing road, waste management, and utility systems	Same as No Action Alternative	Same as No Action Alternative
Water Use		440-463 M gal/yr	495 M gal/yr	416 M gal/yr
Geology and Soils	Slope Stability	SNL/NM activities are not anticipated to destabilize slopes.	Same as No Action Alternative	Same as No Action Alternative
	Soil Contamination	Minimal deposition of contaminants to soils and continued removal of existing contaminants under the ER Project	Same as No Action Alternative	Same as No Action Alternative
Water Resources and Hydrology	Groundwater Quality	TCE above MCL from SNL/NM disposal activities is present in groundwater near the Chemical Waste Landfill (TA-III). No future activities are anticipated to cause further groundwater contamination.	Same as No Action Alternative	Same as No Action Alternative
	Groundwater Quantity	SNL/NM groundwater use is projected to account for 11% of local aquifer drawdown and 1% of basin-wide use. The potential consequence is considered adverse.	SNL/NM groundwater use is projected to account for 12% of local aquifer drawdown and 1% of basin-wide use.	Same as No Action Alternative
	Surface Water Quality	No contaminants attributable to SNL/NM activities have been detected in water samples collected onsite. No future activities are anticipated to cause surface water contamination.	Same as No Action Alternative	Same as No Action Alternative
	Surface Water Quantity	SNL/NM s projected portion of Rio Grande flow is 0.07%.	Same as No Action Alternative	Projected portion of Rio Grande flow is 0.06%

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Biological and Ecological Resources		Impacts projected for biological or ecological resources are low to negligible.		Same as No Action Alternative	Same as No Action Alternative
Cultural Resources[a]		Potential for impacts to cultural resources is low to negligible. Explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires present a low to negligible potential for impacts. SNL/NM security would likely result in continued protection of archaeological sites.		Same as No Action Alternative	Same as No Action Alternative
Air Quality Nonradiological Air Quality	Stationary Source Criteria Pollutants	Concentrations would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment.		Same as No Action Alternative	Same as No Action Alternative
		Modeling results (summary)			
		Carbon Monoxide (8 hours)	57% of standard		
		Lead (quarterly)	0.07% of standard		
		Nitrogen dioxide (annually)	30% of standard		
		Total suspended particulates (annually)	69% of standard		
		Sulfer dioxide (annually)	4% of standard		
	Chemical Pollutants	Concentrations are below regulatory standards and human health guidelines.		Same as No Action Alternative	Same as No Action Alternative
	Mobile sources (percent of Bernalillo county mobile-source carbon monoxide emissions)	4.6		5.1	4.5
	Fire testing facilities	Chemical concentrations are below OEL/100 guideline.		Same as No Action Alternative	Same as No Action Alternative

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA			NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Air Quality (continued)					
	Radiological Air Quality	MEI dose	0.15 mrem/yr	0.51 mrem/yr	0.02 mrem/yr
		Collective ROI dose	5.0 person-rem/yr	15.8 person-rem/yr	0.80 person-rem/yr
		Average individual dose within ROI	6.8×10^{-3} mrem/yr	2.16×10^{-2} mrem/yr	1.1×10^{-3} mrem/yr
Human Health and Worker Safety		MEI public risk (from radiation)	7.5×10^{-8} LCF/yr	2.6×10^{-7} LCF/yr	8.0×10^{-9} LCF/yr
		ROI population risk to public (from radiation)	2.5×10^{-3} LCF/yr	7.9×10^{-3} LCF/yr	4.0×10^{-4} LCF/yr
		Fatal SNL/NM worker occupational injuries	none	Same as No Action Alternative	Same as No Action Alternative
		Average radiation-badged SNL/NM worker dose (risk)	47 mrem/yr (1.9×10^{-5} LCF/yr)	Same as No Action Alternative	Same as No Action Alternative
		Nonfatal SNL/NM worker occupational injuries/illnesses	311/yr	326/yr	287/yr
		Occupational SNL/NM worker chemical exposures	1-2/yr	Same as No Action Alternative	Same as No Action Alternative
		Environmental risk to public (from chemical exposures)	$<1\times10^{-6}$ ELCR	Same as No Action Alternative	Same as No Action Alternative

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (continued)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Transportation	Transportation population risk within ROI (from radiation)	8.3×10^{-4} LCF/yr (1.7 person-rem)	2.5×10^{-3} LCF/yr (4.9 person-rem)	2.0×10^{-4} LCF/yr (0.4 person-rem)
	Total transportation population risk (from radiation)	0.1 LCF/yr	0.33 LCF/yr	4.5×10^{-2} LCF/yr
	Traffic accident fatalities	0.49/yr	1.3/yr	0.18/yr
	Total transportation population risk (from truck emissions)	0.03 LCF/yr	0.06 LCF/yr	0.01 LCF/yr
Waste Generation (Annual)	Management capability (infrastructure)	All projected activities are within capacities of existing facilities and systems.	Same as No Action Alternative	Same as No Action Alternative
	Total radioactive waste	Up to 176 m^3	Up to 289 m^3	Up to 106 m^3
	Total chemical waste	Up to approximately 379,000 kg	Up to approximately 441,000 kg	Up to approximately 306,000 kg

Table 3.6–3. Comparison of Potential Consequences of Continued Operations at SNL/NM (concluded)

RESOURCE AREA		NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Noise and Vibration		Impulse noise-producing test activities projected to increase 35% over 1996 level to 1,435 tests by 2008. Effects would be limited to windows rattling or startle reaction. Background noise levels would continue at current levels from generators, air conditioners, and ventilation systems, but increase due to additional vehicular traffic, aircraft noise, and temporary construction projects (range from 50 to 70 dB).	There would be a 250% increase in test activities over 1996 levels, to 2,638 per year, approximately one impulse noise event per hr for an 8-hr work day and a 261-day work year. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed in neighborhoods bounding the site.	Test activities would be 65% less than the 1996 level, 371 tests per year, an average of approximately 1.5 impulse noise tests per day. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore be unnoticed in neighborhoods bounding the site.
Socioeconomics[b]	SNL/NM employment[c]	8,035	8,417	7,422
	SNL/NM total economic activity within the ROI	$4.13 B/yr	$4.33 B/yr	$3.81 B/yr
	Percent of ROI total economic activity	9.7	10.1	9.0
Environmental Justice[a]		No disproportionately high and adverse impacts to minority or low-income communities are anticipated.	Same as No Action Alternative	Same as No Action Alternative

Source: TtNUS 1998l
B: billion
dB: decibel
ELCR: excess lifetime cancer risk
ER: environmental restoration
gal: gallon
hr: hour
kg: kilogram
LCF: latent cancer fatality
M: million
m^3: cubic meter
MCL: maximum contaminant level
MEI: maximally exposed individual
mrem: millirem
OEL: occupational exposure limit
ROI: region of influence
TA: technical area
TCE: trichloroethene
TCP: traditional cultural property
yr: year

[a] No TCPs have been identified at SNL/NM. If specificTCPs are identified, Native American tribes will be consulted.
[b] Bounding analysis is based on parameters presented in DOE 1997j.
[c] Section 4.12, Affected Environment, differs slightly, using 6,824 full-time employees. Base year in Section 5.3.12, Environmental Consequences (also see Table 3.6–2), used 7,652 full-time employees.

Table 3.6–4. Comparison of Potential High Consequences (condensed version) for Accident Scenarios at SNL/NM

RESOURCE AREA	NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
SITE-WIDE EARTHQUAKE			
RADIOLOGICAL IMPACTS			
50-Mile Population (Additional Latent Cancer Fatalities)	8.1×10^{-2}	7.5×10^{-2}	7.5×10^{-2}
Maximally Exposed Individual (Increased Probability of Latent Cancer Fatality)	8.6×10^{-6}	7.7×10^{-6}	7.7×10^{-6}
Noninvolved Worker (Increased Probability of Latent Cancer Fatality)	3.1×10^{-2}	3.0×10^{-2}	3.0×10^{-2}
CHEMICAL IMPACTS			
Distance (feet) to reach ERPG-2 Levels	3,800	3,800	3,800
CATASTROPHIC ACCIDENT SINGLE FACILITY			
RADIOLOGICAL IMPACTS			
ACRR Medical Isotopes Production			
50-mile population (additional latent cancer fatalities)	1.6×10^{-6} to 4.9×10^{-3}	1.6×10^{-6} to 4.9×10^{-3}	1.6×10^{-6} to 4.9×10^{-3}
Maximally Exposed Individual (increased probability of latent cancer fatality)	1.0×10^{-10} to 6.1×10^{-7}	1.0×10^{-10} to 6.1×10^{-7}	1.0×10^{-10} to 6.1×10^{-7}
Noninvolved Worker (increased probability of latent cancer fatality)	4.9×10^{-8} to 7.6×10^{-5}	4.9×10^{-8} to 7.6×10^{-5}	4.9×10^{-8} to 7.6×10^{-5}
Hot Cell Facility			
50-mile population (additional latent cancer fatalities)	1.6×10^{-6} to 7.9×10^{-2}	1.6×10^{-6} to 7.9×10^{-2}	1.6×10^{-6} to 7.9×10^{-2}
Maximally Exposed Individual (increased probability of latent cancer fatality)	1.0×10^{-10} to 6.6×10^{-6}	1.0×10^{-10} to 6.6×10^{-6}	1.0×10^{-10} to 6.6×10^{-6}
Noninvolved Worker (increased probability of latent cancer fatality)	4.2×10^{-9} to 7.4×10^{-6}	4.2×10^{-9} to 7.4×10^{-6}	4.2×10^{-9} to 7.4×10^{-6}
Sandia Pulsed Reactor			
50-mile population (additional latent cancer fatalities)	1.2×10^{-3} to 9.2×10^{-3}	1.2×10^{-3} to 9.2×10^{-3}	1.2×10^{-3} to 9.2×10^{-3}
Maximally Exposed Individual (increased probability of latent cancer fatality)	1.5×10^{-7} to 8.4×10^{-7}	1.5×10^{-7} to 8.4×10^{-7}	1.5×10^{-7} to 8.4×10^{-7}
Noninvolved Worker (increased probability of latent cancer fatality)	2.5×10^{-4} to 3.8×10^{-3}	2.5×10^{-4} to 3.8×10^{-3}	2.5×10^{-4} to 3.8×10^{-3}

Table 3.6–4. Comparison of Potential Consequences for Accident Scenarios at SNL/NM (concluded)

RESOURCE AREA	NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
ACRR-Defense Programs Configuration			
50-mile population (additional latent cancer fatalities)	1.3×10^{-3} to 9.0×10^{-3}	1.3×10^{-3} to 9.0×10^{-3}	Not operational
Maximally Exposed Individual (increased probability of latent cancer fatality)	1.7×10^{-7} to 1.0×10^{-6}	1.7×10^{-7} to 1.0×10^{-6}	Not operational
Noninvolved Worker (increased probability of latent cancer fatality)	1.2×10^{-5} to 2.2×10^{-4}	1.2×10^{-5} to 2.2×10^{-4}	Not operational
CHEMICAL IMPACTS			
Technical Area-I			
Distance (feet) to reach ERPG-2 Levels[a]	1,440 - 4,884	1,440 - 4,884	1,440 - 4,884
EXPLOSIVE IMPACTS			
Technical Area-I			
Distance (feet) to reach 2 psi (Damage to cinder block walls)	370	370	370
Distance (feet) to reach 10 psi (rupture of 50% of eardrums)	126	126	126
Distance (feet) to reach 50 psi (50% fatalities)	61	61	61

Source:
ERPG: emergency response planning guideline
ACRR: Annular Core Research Reactor
psi: pounds per square inch
[a] For the three largest worker (people) densities within ERPG-2 levels related to Buildings 858, 883, and 893

CHAPTER 4

Affected Environment

4.1 INTRODUCTION

Understanding the affected environment is necessary for understanding potential impacts from operations at Sandia National Laboratories/New Mexico (SNL/NM). This chapter describes the existing conditions that comprise the physical and natural environment within SNL/NM, the Regions of Influence (ROI), and the relationship of people with that environment. Descriptions of the affected environment provide a framework for understanding the direct, indirect, and cumulative effects of each of the three alternatives. The discussion is categorized by resource area to ensure that all relevant issues are included. This chapter is divided into the following 13 resource areas, and also includes other topic areas that support the impact assessment discussed in Chapter 5:

- Land Use and Visual Resources
- Infrastructure
- Geology and Soils
- Water Resources and Hydrology
- Biological and Ecological Resources
- Cultural Resources
- Air Quality
- Human Health and Worker Safety
- Transportation
- Waste Generation
- Noise and Vibration
- Socioeconomics
- Environmental Justice

The information in this chapter comes primarily from the SNL/NM *Environmental Information Document* (SNL/NM 1997a) and from the comprehensive environmental monitoring and surveillance programs that the United States (U.S.) Department of Energy (DOE) maintains at SNL/NM. Data for 1996 are presented where available; data for 1992, 1993, 1994, and 1995 are also included where necessary to present trends. Other relevant information is summarized and incorporated by reference.

Regions of Influence

Each ROI—the area that SNL/NM operations may reasonably affect—is delineated by its resource. The ROIs are determined based on characteristics of SNL/NM and the surrounding area. The ROI limits may be natural features (such as the extent of the Albuquerque-Belen Basin aquifer for groundwater) or political boundaries (such as the immediate four-county area for socioeconomics).

Other ROIs are delineated using industry-accepted norms for the resources (such as the 50-mi radius used in radiological air quality).

Each resource and topic area includes a discussion of the ROI—the area that may be affected by SNL/NM operations. The ROI establishes the scope of analysis and focuses the discussion on relevant information. Because resource and topic areas are often interrelated, one section may refer to another.

Materials (including chemicals and radioisotopes) released from SNL/NM can reach the environment and people in a number of ways. The routes that materials follow from SNL/NM to reach the environment and subsequently people are called transport and exposure pathways. SNL/NM conducts environmental monitoring to measure both radioactive and nonradioactive materials released into the environment.

Transport and Exposure Pathways

The routes that released materials follow to reach the environment and subsequently people involve both transport and exposure pathways. A transport pathway is the environmental media, such as groundwater, soil, or air, by which a contaminant is moved (for example, chemicals carried in the air or dissolved in groundwater and moved along by wind or groundwater). An exposure pathway is how a person or other organism comes in contact with the contaminant (for example, breathing, drinking water, or skin contact).

Environmental monitoring assesses the potential for people to come in contact with these materials by any route of exposure. Sampled media include groundwater, storm water runoff, wastewater discharge, vegetation, soil, and air. SNL/NM publishes an annual site environmental report that contains details on these sampling programs (SNL 1994b, 1995c).

4.2 GENERAL LOCATION

SNL/NM is located within Kirtland Air Force Base (KAFB), approximately 7 mi southeast of downtown Albuquerque, New Mexico (Figure 4.2–1). SNL/NM uses approximately 8,800 ac of Federal land on KAFB (SNL/NM 1997a). Albuquerque is located in Bernalillo county, in north-central New Mexico, and is the state's largest city, with a population of approximately 420,000 (Census 1997a). The Sandia Mountains rise steeply immediately north and east of the city, with the Manzanita Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales to the northwest, the Pueblo of Sandia and town of Bernalillo to the north, and the Pueblo of Isleta and towns of Los Lunas and Belen to the south.

4.3 LAND USE AND VISUAL RESOURCES

4.3.1 Land Use

4.3.1.1 Definition of Resource

Land use describes the activities that take place in a particular area. It is a critical element in site operations decision-making. It is especially important as a means to determine if there is sufficient area for site activities and required buffers and to identify conflicts between existing or projected onsite and offsite programs and operations. DOE P 430.1 governs DOE's management of its land and facilities as valuable natural resources, based on the principles of ecosystem management and sustainable development.

4.3.1.2 Region of Influence

The ROI consists of the land SNL/NM uses in and adjacent to KAFB. It represents probable impact areas differentiated by onsite or offsite land resources. Onsite resources are lands used for SNL/NM activities within KAFB. Offsite resources consist of land immediately adjacent to KAFB and include areas belonging to the Pueblo of Isleta, city of Albuquerque, state of New Mexico, and the U.S. Forest Service (USFS).

4.3.1.3 Affected Environment

KAFB is an Air Force Materiel Command Base southeast of Albuquerque, New Mexico. KAFB shares facilities and infrastructure with several associates, including the DOE and its affiliates (for example, SNL/NM). It is comprised of approximately 51,560 ac of land, including portions of Cibola National Forest withdrawn in cooperation with the USFS. It is geographically bounded by the Pueblo of Isleta to the south, the Albuquerque International Sunport and lands held in trust by the state of New Mexico to the west, and the city of Albuquerque to the north. The eastern boundary lies within the Manzanita Mountains (Figure 4.3–1) (SNL/NM 1997a).

Historical Land Use Within KAFB

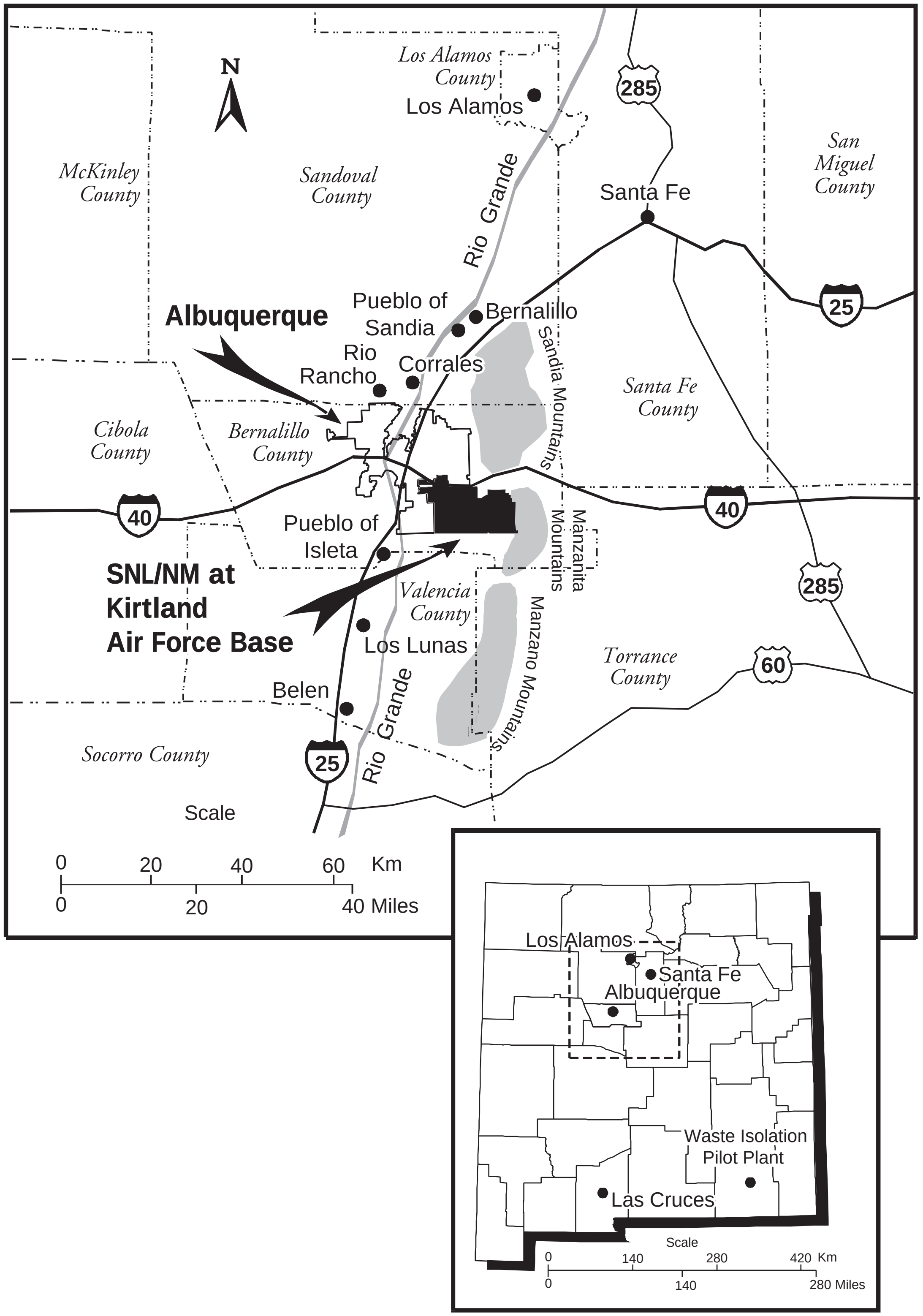
The earliest land use in the KAFB area is attributed to Native Americans and appears to have encompassed hunting, plant gathering, woodcutting, grazing, and possibly ritual activities (Holmes 1996a). No known Spanish land grants have been identified within KAFB. Farming and ranching were the principal activities during the eighteenth and nineteenth centuries. Upon the arrival of the railroad in 1880, mining activity increased and new residents established homesteads. New Mexico became a territory in December 1850 and a state in January 1912.

KAFB's military and civilian history began with the establishment of the city's first airfield in 1928. Beginning in 1942 and throughout World War II, Los Alamos operations, associated with the Manhattan Engineering District, used the area to assist in transportation requirements for the nation's first atomic weapons program (SNL/NM 1997a).

In 1945, jurisdiction over the site that eventually became SNL/NM was transferred to the Manhattan Engineering District, which established the forerunner of SNL/NM. SNL/NM developed and expanded its facilities throughout the Cold War era and to the present. KAFB itself has also continued as a military base and multi-user industrial research and development complex (SNL/NM 1997a).

Land Ownership Within KAFB

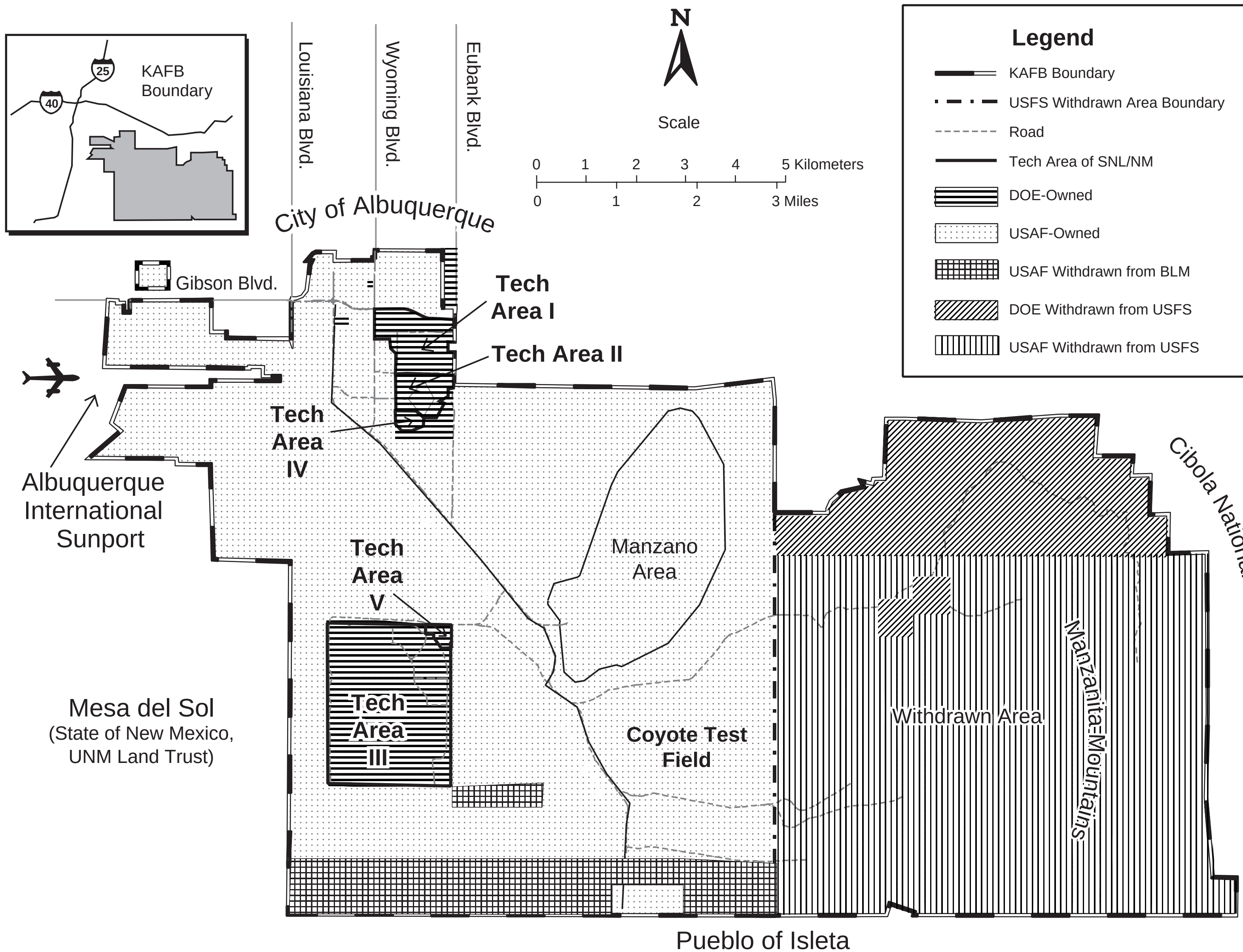
Land ownership on KAFB is divided primarily among the U.S. Air Force (USAF), the DOE, the Bureau of Land Management (BLM), and the USFS (Figure 4.3–1;



Source: SNL/NM 1997j

Figure 4.2–1. General Location of KAFB

KAFB is located southeast of the city of Albuquerque in Bernalillo county.



Source: SNL/NM 1997j

Figure 4.3–1. KAFB Land Ownership

KAFB, occupying approximately 51,560 acres, is primarily owned by the U.S. Air Force, the DOE, the Bureau of Land Management, and the U.S. Forest Service.

Table 4.3–1). The majority of acreage comprising the western half of KAFB is owned by the USAF. The DOE also owns land in this area, which is occupied almost entirely by SNL/NM facilities. Some land in the southwestern half is owned by the BLM and has been withdrawn by the USAF. The eastern portion of KAFB, commonly referred to as the Withdrawn Area, consists of more than 20,480 ac of USFS land within the Cibola National Forest that has been withdrawn by the USAF and the DOE in separate actions.

Table 4.3–1. KAFB Land Ownership

OWNER	ACREAGE	PERCENT OF KAFB
USAF	25,586	49
USFS (Withdrawn by USAF)	15,891	31
USFS (Withdrawn by DOE)	4,595	9
DOE	2,938	6
BLM (Withdrawn by USAF)	2,549	5
TOTAL	**51,559**	**100**

Sources: SNL/NM 1997a, j
BLM: Bureau of Land Management
DOE: U.S. Department of Energy
KAFB: Kirtland Air Force Base
USAF: U.S. Air Force
USFS: U.S. Forest Service

Land Use Within the KAFB

The USAF and the DOE are the principal land users within the KAFB (SNL/NM 1997a) (Table 4.3–2). Land use is established through coordination and planning agreements between these agencies. On matters involving the Withdrawn Area, the USFS is also involved. The USAF operates on much of its own land, as well as on property within its portion of the Withdrawn Area. The DOE owns only a small portion of the land it needs, and is required to conduct many of its activities under permit on land owned or withdrawn by the USAF or within its section of the Withdrawn Area. The DOE also leases land adjacent to KAFB to support SNL/NM activities (see Land Use Adjacent to KAFB). SNL/NM facilities and operations encompass the majority of the DOE's land use requirements on KAFB. Other DOE-funded facilities make up the remainder. Figure 4.3–2 provides a general overview of land use on KAFB.

There is no single comprehensive land use plan for KAFB; however, existing land use designations and future planning scenarios are addressed in documents produced by the USAF, USFS, and SNL/NM. These documents include, for example, the *KAFB Comprehensive Plan* (USAF 1998a), *Cibola National Forest Land and Resource Management Plan* (USFS 1985), *SNL Sites Comprehensive Plan* (SNL 1997a), and *SNL Sites Integrated Master Plan* (SNL 1997c).

Table 4.3–2. KAFB Land Use

USER		ACREAGE	PERCENT OF KAFB
USAF		33,338	65
DOE	***SNL/NM***	8,824	17
	Other	6,447	12
Joint USAF/DOE		2,950	6
TOTAL		**51,559**	**100**

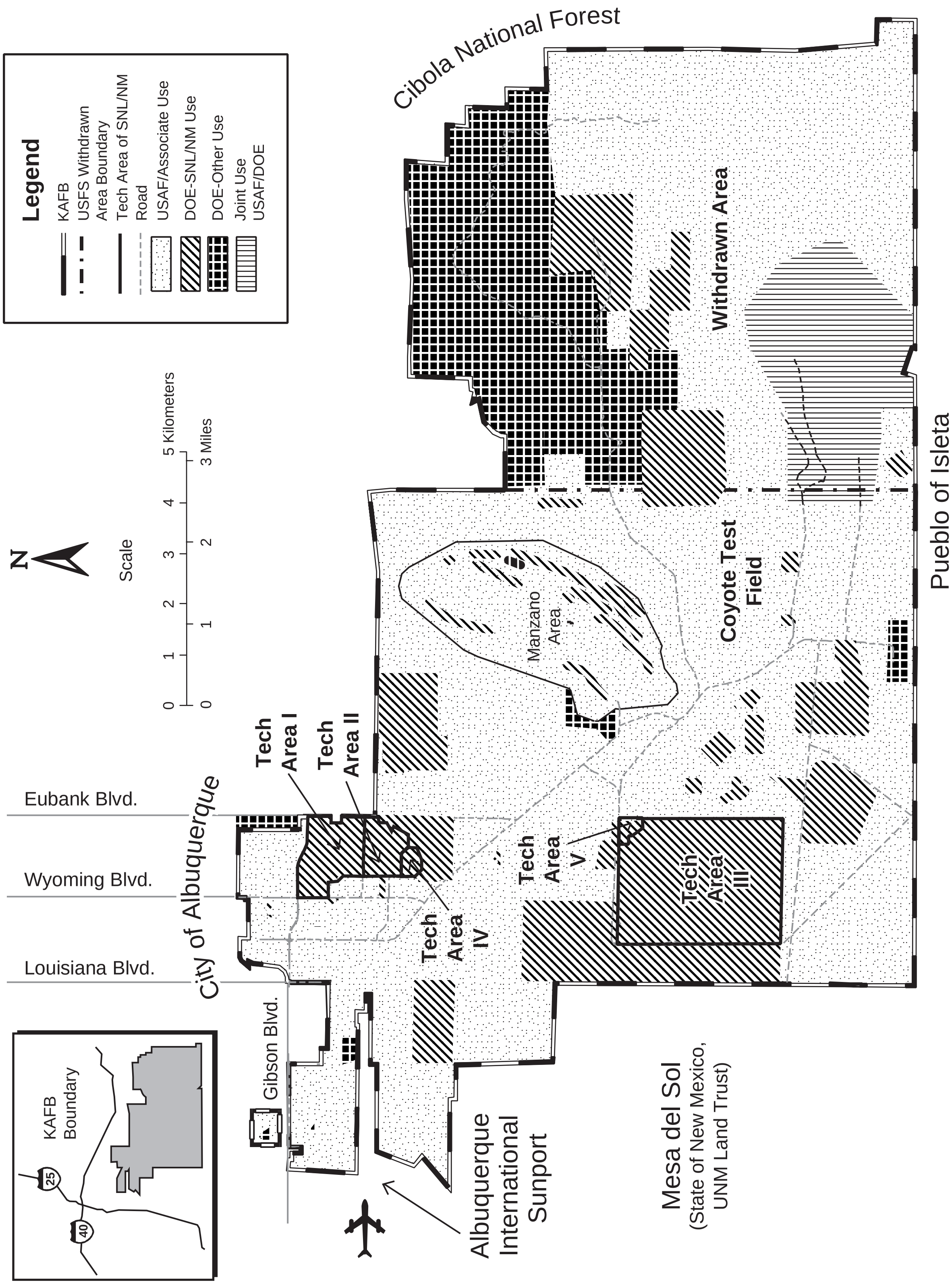
Sources: SNL/NM 1997a, j
DOE: U.S. Department of Energy
KAFB: Kirtland Air Force Base
SNL/NM: Sandia National Laboratories/New Mexico
USAF: U.S. Air Force

SNL/NM primary land use fits into a category of industrial/research park uses. This category coincides with the preliminary future use scenarios presented to the Citizens Advisory Board of the Future Use, Logistics, and Support Working Group (SNL 1997a, Keystone 1995) (see Future DOE Land Use on KAFB). Although not all facilities are industrial in nature (for example, administrative and office buildings), factors that contribute to the industrial designation include the following (SNL/NM 1997a):

- activities occurring in locations with limited area for development,
- testing activities occurring in areas near research and development facilities, and
- environmental restoration (ER) sites with associated remediation efforts resulting from research and testing activities.

In addition to SNL/NM, other DOE-funded facilities are located on land owned by the USAF and permitted to the DOE. These facilities include the Lovelace Respiratory Research Institute, Nonproliferation and National Security Institute (NNSI), Transportation Safeguards Division (TSD), Federal Manufacturing & Technology/New Mexico (FM&T/NM) (AlliedSignal), Ross Aviation, Inc., the Energy Training Center (ETC), and the DOE/Albuquerque Operations Office (AL).

KAFB land used by the USAF is also designated for industrial use, but includes a broader range of other uses such as residential, recreational, and medical activities that are associated with day-to-day base operations. Additionally, large areas of land within KAFB, particularly in the Withdrawn Area, do not support



Sources: SNL/NM 1997a, 1997j

Figure 4.3–2. KAFB Land Use

The U.S. Air Force and the DOE are the principal land users within KAFB.

specific facilities or programs, but are used as safety zones in association with USAF and DOE testing and training activities (SNL/NM 1997a).

SNL/NM Activities on KAFB

The five SNL/NM technical areas (TAs) cover approximately 2,560 ac (87 percent) of DOE-owned land. Table 4.3–3 lists DOE-owned land on and adjacent to KAFB, lists the total acreage of each SNL/NM Technical Area (TA), and provides a brief description of associated land use. TAs-I, -II, and -IV encompass approximately 645 ac. TAs-III and -V encompass approximately 1,915 ac. The DOE also owns approximately 10 ac that house the DOE/AL and 85 ac on the west side of Eubank Boulevard north of TA-I.

Technical Area I

TA-I comprises approximately 350 ac and is located in the northwest part of KAFB. TA-I is bordered by Wyoming Boulevard to the west and Eubank Boulevard to the east, while F and G Avenues form the northern border and Hardin Boulevard defines the southern boundary (Figure 4.3–3). Approximately 110 ac of TA-I are enclosed behind a security fence. TA-I is the most densely developed and populated of the TAs, with over 6,600 employees and 370 structures (SNL/NM 1997a). The structures within TA-I consist of laboratories, shops, offices, warehouses, and other storage buildings used for administration, site support, technical support, basic research, Defense Programs (DP), component development, microelectronics, energy programs, exploratory systems, technology transfer, and business outreach (SNL/NM 1997b). Large parking lots are also prominent features. Future SNL/NM planning efforts are directed at developing the east side of TA-I along Eubank Boulevard, with additional expansion by private entities into the area outside of the KAFB Eubank Gate (SNL/NM 1996f).

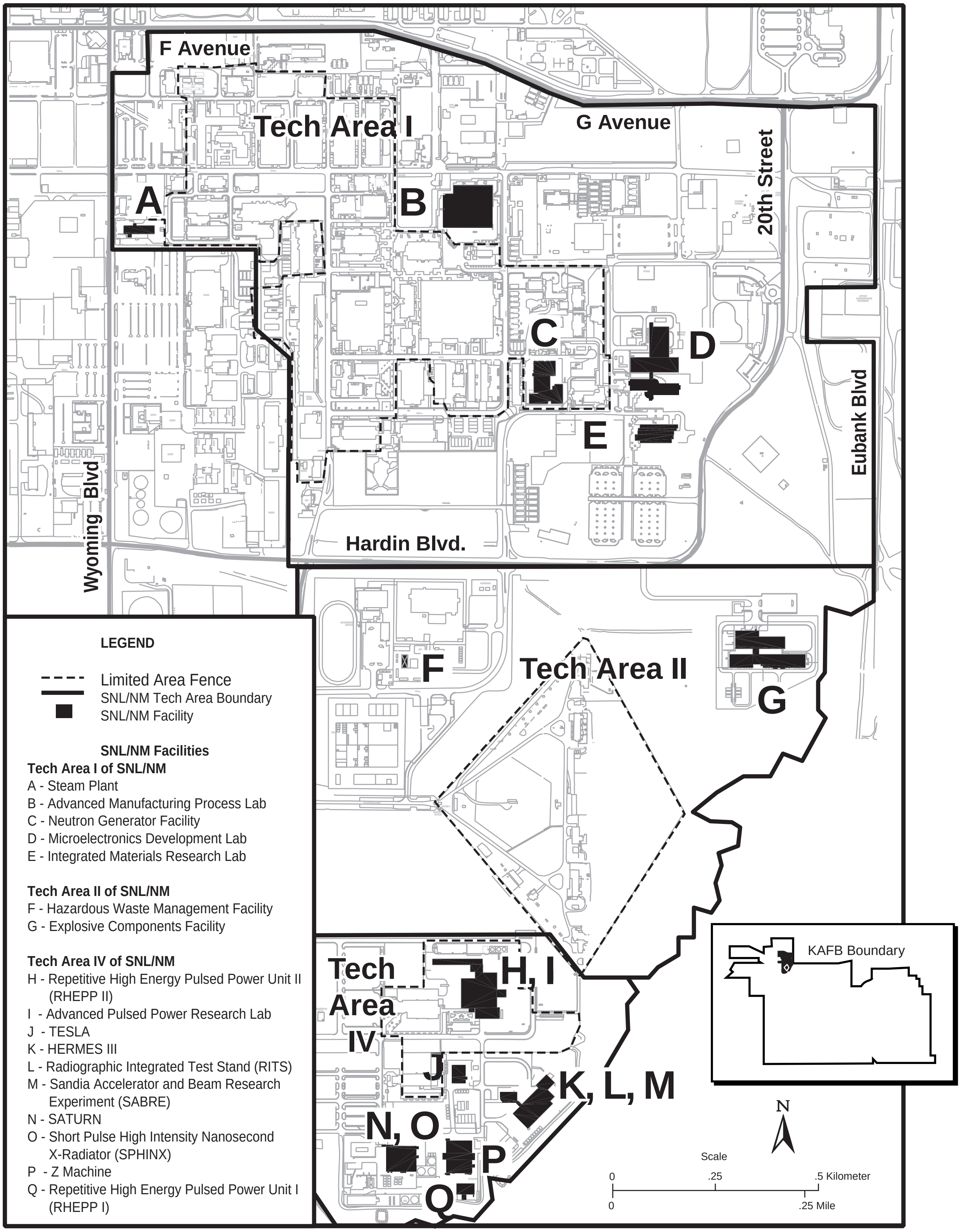
Technical Area II

TA-II is located immediately south of TA-I (Figure 4.3–3). Approximately 440 people work in the 210-ac area. TA-II includes a diamond-shaped fenced area of approximately

Table 4.3–3. DOE-Owned Land on KAFB

AREA	APPROXIMATE ACREAGE	MAJOR LAND USES
TA-I	350	Administrative buildings, laboratories, and offices associated with commercial and light industrial activities
TA-II	210	Storage and warehouse areas, light testing facilities, and maintenance yards
TA-III	1,890	20 test facilities, widely separated by large tracts of open space; a limited number of buildings and mobile office trailers for administrative, office, and light laboratory uses
TA-IV	85	Several major laboratory/research facilities with accompanying office and administrative space
TA-V	25	A small, highly secured area of several primary research facilities, light laboratories, and office space
TOTAL TA ACREAGE	**2,560**	
Tijeras Arroyo Drainage Area (Adjacent to TA-IV)	280	Undeveloped open space
DOE/AL and Coronado Club	10	Administrative buildings and office space
Eubank Boulevard Development Area	85	Undeveloped open space
TOTAL DOE LAND	**2,935**	

Source: SNL/NM 1997a
DOE/AL: Department of Energy/Albuquerque Operations Office
TA: technical area



Source: SNL/NM 1997a

Figure 4.3–3. Technical Areas-I, -II, and –IV

Technical Areas-I, -II, and -IV are located in the northwest section of KAFB.

45 ac distinguished by a 10-ft-high chain link fence and security gate (SNL/NM 1997a, SNL 1997a). Like TA-I, the area is urbanized but less densely developed. Over 30 structures are within the area, consisting of several laboratories, limited office space, and numerous storage buildings (SNL/NM 1997b). The Explosive Components Facility (ECF), completed in 1995, is used by SNL/NM to perform low-hazard testing on small samples of explosive material. Additional facilities include the safeguards and security building, shipping and receiving, the waste transfer station, and maintenance yards. Other portions of the area have been vacated and are awaiting decommissioning and remediation activities (SNL 1997a). TA-II is fully developed; however, suitable facilities may be reassigned for use as warehouses or for other limited-occupancy uses (SNL/NM 1996f).

Technical Area III

TA-III consists of an area of about 1,890 ac located approximately 5 mi south of TA-I (Figure 4.3–4). Approximately 224 people work in the area, which is composed of 20 test facilities devoted to violent physical testing and simulating a variety of natural and induced environments (SNL/NM 1997a). Over 150 structures are located within TA-III. Most of these structures are grouped together in small units separated by extensive open spaces. These units are organized by testing facility (SNL/NM 1997b). An administrative building and mobile office trailers provide space for administrative, office, and light laboratory functions (SNL/NM 1997a). Although much of the area remains as open space characterized by flat to undulating grassland terrain, TA-III is considered fully developed due to the area required for hazard safety zones (SNL/NM 1997a). For example, testing activities associated with the 10,000-ft Sled Track Facility in the NW corner of TA-III require the leasing of a buffer zone west of the boundaries of KAFB (SNL/NM 1997a, SNL/NM 1997x). Buffer zones are discussed in more detail in the Land Use Adjacent to KAFB subsection.

Technical Area IV

TA-IV is located south of TA-II on approximately 85 ac, 19 of which are behind security fencing (Figure 4.3–3). Like TA-II, TA-IV is urbanized but less densely developed than TA-I. The area is primarily a research site for pulsed-power sciences and particle-beam fusion accelerators, as well as a research and development area. The working population of TA-IV is approximately 546, occupying about 70 structures consisting of main laboratories, mobile offices, and storage (SNL/NM 1997a, 1997b). With the exception of the adjacent 280-ac Tijeras Arroyo drainage area, TA-IV has land available for construction of additional facilities.

Technical Area V

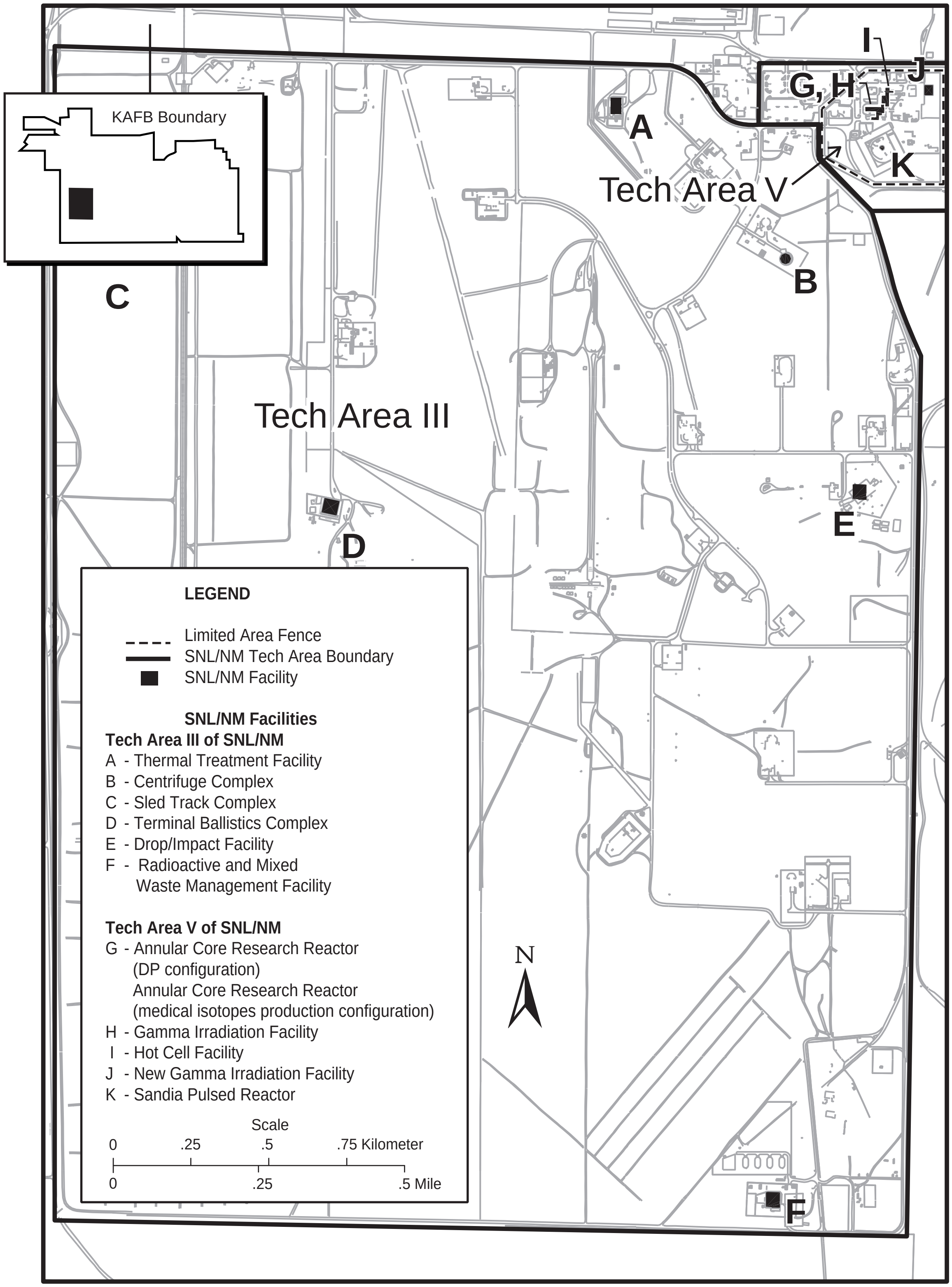
TA-V is located on approximately 25 ac adjacent to the northeast corner of TA-III (Figure 4.3–4). In addition to DOE-owned lands within the boundaries of TA-V, approximately six ac are permitted to the DOE by the USAF to provide additional security (SNL/NM 1997a). TA-V is a relatively small research area consisting of about 35 closely grouped structures where experimental and engineering nuclear reactors are located. Approximately 159 personnel work in the area.

Coyote Test Field

The Coyote Test Field (Figure 4.3–5) is a large area within KAFB that contains a variety of remote testing sites and facilities. The area is comprised of mostly open, flat to undulating, grassland terrain in the west, to more mountainous topography in the east. Approximately 173 structures consisting of laboratory buildings, mobile offices, and numerous storage areas are found widely dispersed throughout the area (SNL/NM 1997b). A number of SNL/NM facilities, such as the Explosives Applications Laboratory (EAL), Containment Technology Test Facility-West, and Thunder Range Complex, operate in this area on land permitted to the DOE by the USAF.

Withdrawn Area

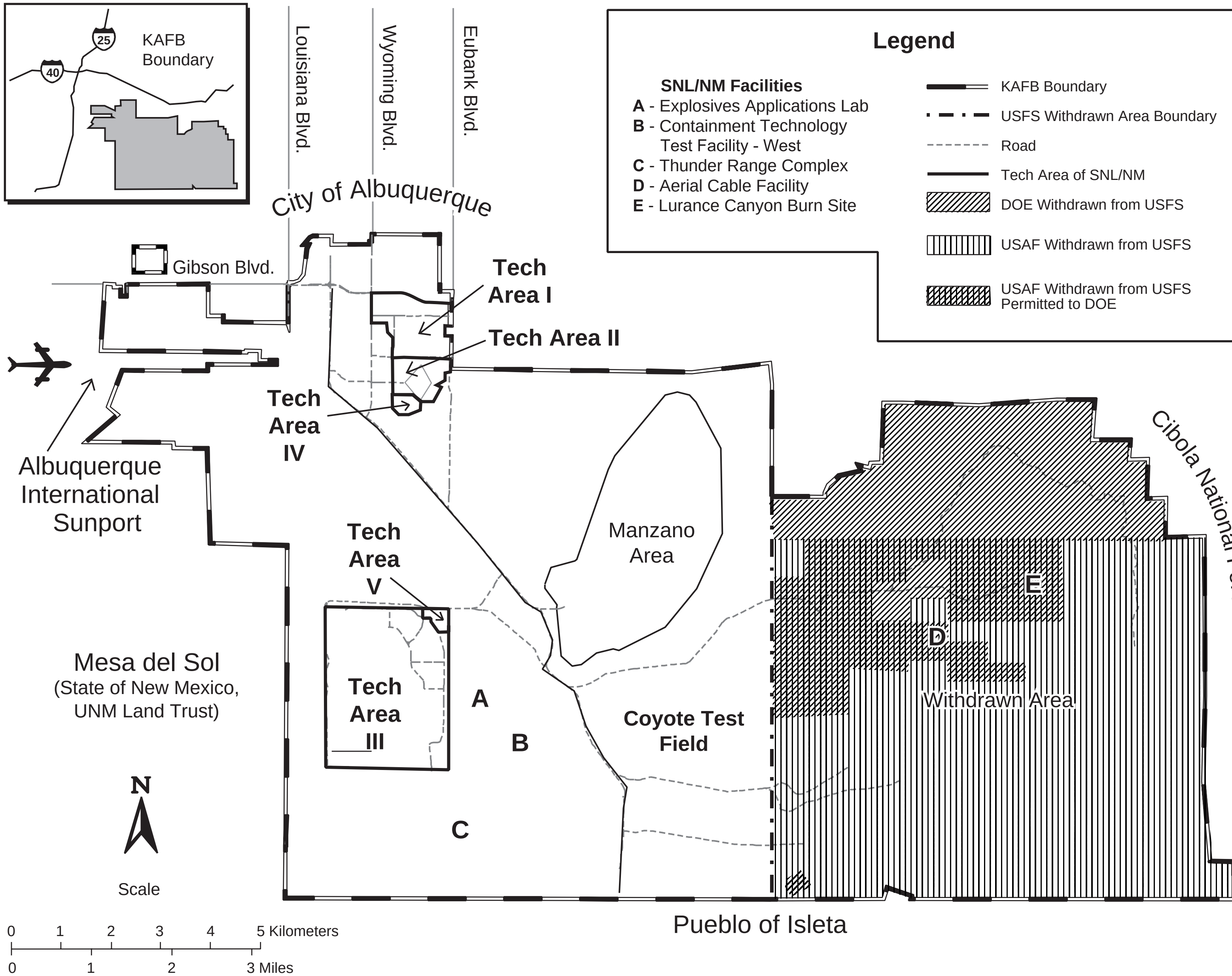
The Withdrawn Area consists of approximately 20,485 ac in the eastern portion of KAFB, including land within the Cibola National Forest that has been withdrawn from public use by the USAF (15,890 ac) and the DOE (4,595 ac) (Figure 4.3–5). SNL/NM operations at the Lurance Canyon Burn Site and the Aerial Cable Facility are conducted on land that has been withdrawn by the USAF and subsequently permitted to the DOE. There are additional SNL/NM activities on USAF-permitted land in the Withdrawn Area as well. Other DOE activities not associated with SNL/NM, such as those associated with the NNSI and the TSD, are also conducted on USAF-permitted land, as well as on that portion withdrawn specifically by the DOE (Figure 4.3–5). The terrain is predominantly mountainous with increasing elevation to the east. Development is limited and characterized by small structures and mobile offices. Large portions of land within the Withdrawn Area do not support specific



Source: SNL/NM 1997a

Figure 4.3–4. Technical Areas-III and -V

Technical Areas-III and -V are located in the southwest section of KAFB.



Source: SNL/NM 1997j

Figure 4.3–5. Coyote Test Field and the Withdrawn Area

The Coyote Test Field and the Withdrawn Area occupy over 20,000 acres in the eastern portion of KAFB.

facilities or programs, but are used as buffer areas for USAF and SNL/NM testing activities (SNL/NM 1997a).

Land Use Adjacent to KAFB

Generalized land use adjacent to KAFB is shown in Figure 4.3–6. The city of Albuquerque has the most influence on land use adjacent to the north-northwestern boundary of KAFB. The city has experienced steady growth in these areas characterized by single-family and multi-family residential dwellings, mixed/minor commercial establishments, and light industrial/wholesale operations. Trending east along the northern border of KAFB, limited residential use, as well as some vacant land, is found within the city and surrounding Bernalillo county. The northeast boundary of KAFB is surrounded almost entirely by Cibola National Forest, although some private land, scattered residential dwellings, and industrial operations are present north of the Withdrawn Area. Much residential development, consisting of single-family homes, has occurred just beyond the national forest approximately 1 mi east of the KAFB Withdrawn Area boundary. The southern portion of KAFB borders a wide expanse of open rangeland owned by the Pueblo of Isleta. To the west, adjacent land consists of the Albuquerque International Sunport, some city and county open space, and a large parcel of open space planned for a significant future development known as Mesa del Sol. Mesa del Sol and a number of other planned development projects affecting adjacent land use are discussed in Chapter 6, Cumulative Effects Analysis.

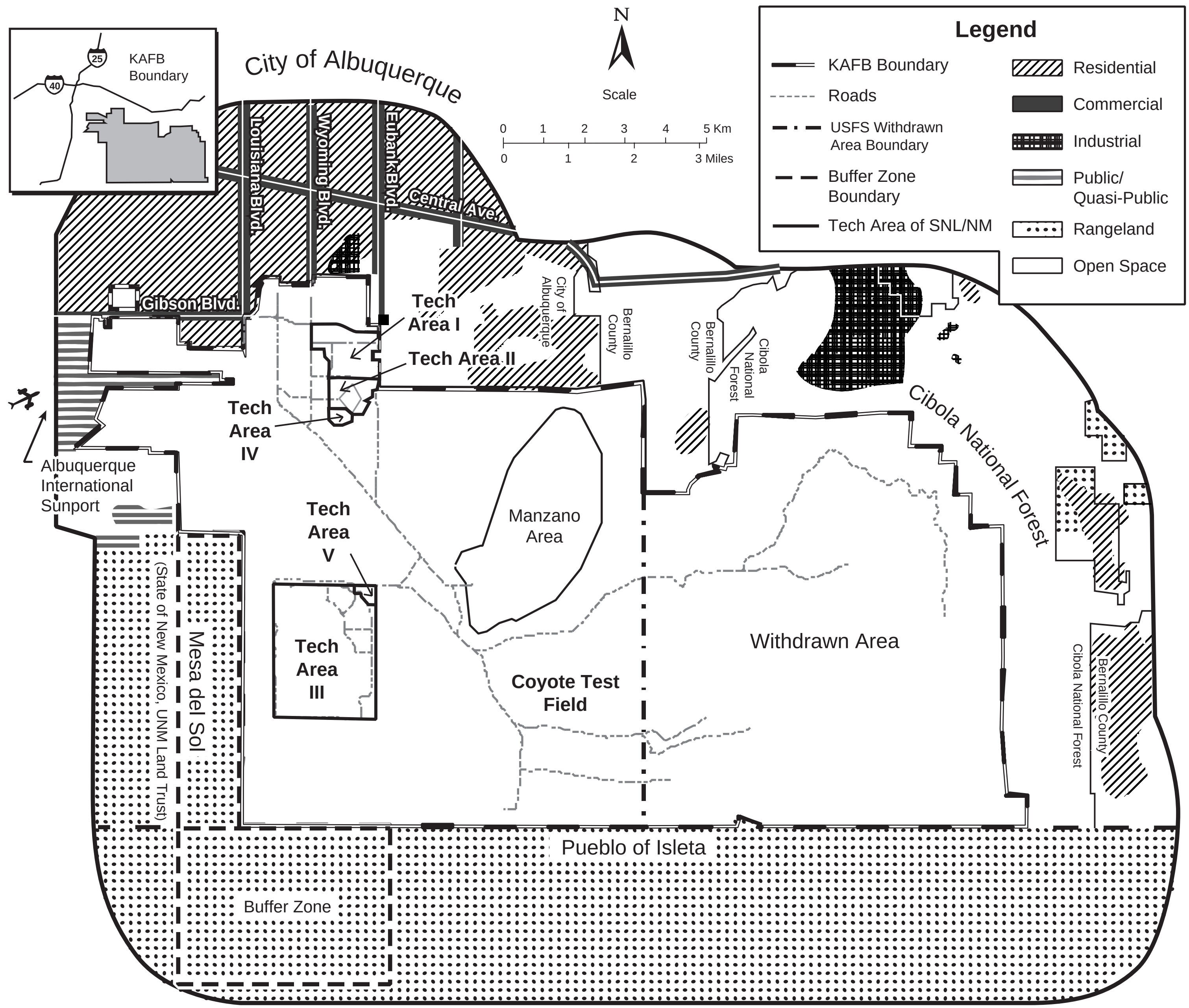
DOE Buffer Zones

The DOE leases approximately 9,100 ac of land adjacent to the western and southwestern boundaries of KAFB as a buffer zone for the operations at the 10,000-ft Sled Track Complex in TA-III (Figure 4.3–7). The Sled Track Complex is an SNL/NM test facility used for simulating high-speed impacts of weapon shapes, substructures, and components to verify design integrity, performance, and fuzing (mechanical or electrical means used to detonate an explosive charge) functions. The facility also subjects weapon parachute systems to aerodynamic loads to verify parachute design integrity and performance (SNL/NM 1998a). The buffer zone ensures that an adequate safety area exists for the physical protection of the public from impact of all sled and payload components. This includes explosive debris and/or shrapnel as well as the maximum range of fly-away rocket motors (SNL/NM 1997x).

> **The Mesa del Sol Area**
>
> The Mesa del Sol area is a 13,000-acre parcel of vacant land, virtually all of which is held in trust by the NMSLO for the benefit of the University of New Mexico and New Mexico Public Schools. The area was annexed by the city of Albuquerque in 1993 and represents a 20 percent increase in the city's incorporated area. It is anticipated that the area will be home to as many as 40,000 households and be a major impetus for economic development for the city and the region.
>
> Plans for Mesa del Sol call for a mixed-use pedestrian-oriented planned community with a number of districts and activity centers surrounded by large areas of open space. The community will be linked by a regional transportation, open space, and trail network, providing access to the entire metropolitan area.
>
> For additional information, consult the 1997 Mesa del Sol Level A Community Master Plan produced by the NMSLO, Santa Fe, New Mexico (NMSLO 1997).

The buffer zone is comprised of two distinct areas due to land ownership and the nature of the individual arrangements between the landowners and the DOE (SNL/NM 1997a). The first part of the buffer zone consists of approximately 2,750 ac west of KAFB boundary that the DOE leases from the state of New Mexico. This area is 1 mi wide and encompasses the eastern edge of the proposed Mesa del Sol (state of New Mexico, University of New Mexico [UNM] land trust) development. The lease expired in 1995 and the New Mexico State Land Office (NMSLO) and the DOE are currently discussing its continuation. The second part of the buffer zone consists of approximately 6,345 ac, extending south and west of the southern KAFB boundary. This land is currently used under agreement with the Pueblo of Isleta through the Bureau of Indian Affairs (BIA) (SNL/NM 1997a, 1997j).

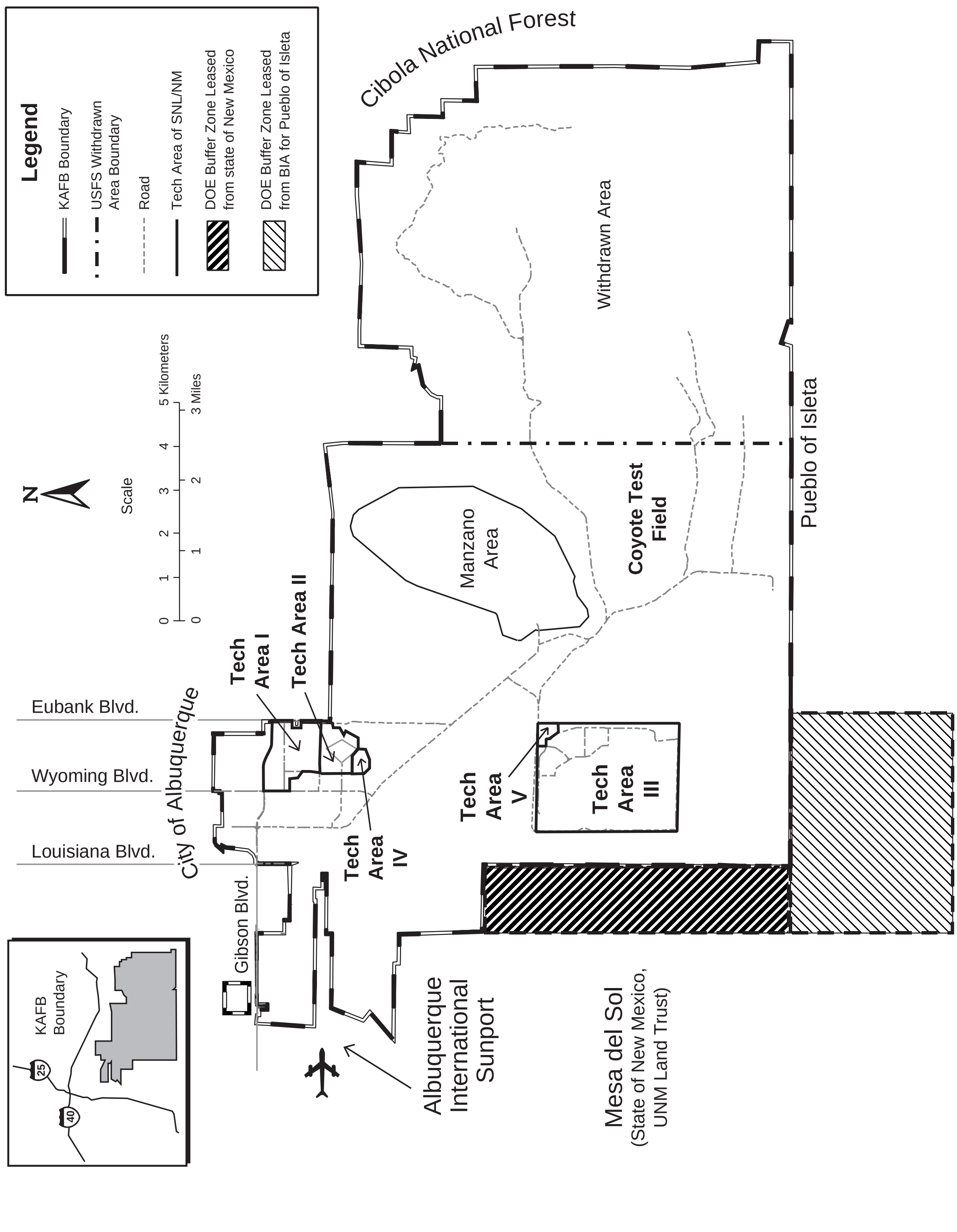
For 20 days in 1990, an agreement with the Pueblo of Isleta temporarily established an additional buffer zone of approximately 3,840 ac south of the KAFB boundary. This action was taken during special testing at the Aerial Cable Facility (DOE 1990).



Sources: DOE 1993c, 1996b; SNL/NM 1997a

Figure 4.3–6. Generalized Land Use Adjacent to KAFB

Land adjacent to KAFB has a wide variety of uses.



Sources: DOE 1993c, 1996b; SNL/NM 1997a

Figure 4.3–7. DOE Leased Buffer Zones

The DOE has leased buffer zones adjacent to the western and southern boundaries of KAFB.

Future DOE Land Use on KAFB

Land use on KAFB is controlled by a complicated series of agreements, permits, and leases among the DOE, the USAF, and the USFS. Since June 1994, a Future Use, Logistics, and Support Working Group has been instrumental in developing future land use recommendations. The working group comprises representatives from the DOE, the U.S. Environmental Protection Agency (EPA), the New Mexico Environment Department (NMED), SNL/NM, the Lovelace Respiratory Research Institute, FM&T/NM, Ross Aviation, Inc., the TSD, the NNSI, the USAF, and the USFS.

The DOE and SNL/NM Citizens Advisory Board (CAB) was identified by the working group as the appropriate vehicle for public participation. The CAB receives information from the DOE and SNL/NM relevant to future land use issues. The CAB held its first future land use meeting in June 1995 and is currently in the process of reviewing site baseline data and preliminary future land use information. The Pueblo of Isleta and the Bernalillo County Commission have been apprised of future land use planning activities at SNL/NM and are provided with all pertinent communications and publications (SNL 1997a).

The Future Use, Logistics, and Support Working Group developed preliminary recommendations for KAFB and recognized the high probability of continued Federal use of the complex. Under these recommendations, the Federal government will maintain institutional control of the site and restrict access to it. Interim future land use recommendations by the working group include industrial/commercial and recreational uses as they relate to general cleanup levels. Refer to Section 4.5.3.3, for a discussion of the cleanup level designations. SNL/NM's primary land uses fit into a category of industrial/research park uses. These uses are consistent with the preliminary future land use scenarios presented to the CAB for DOE-owned properties (SNL 1997a, Keystone 1995).

Although SNL/NM land use will not change significantly in the foreseeable future, the DOE is negotiating two real estate transactions on behalf of SNL/NM. The first involves acquiring from the city of Albuquerque approximately 4 ac along Eubank Boulevard south of H Street in exchange for a right-of-way for the city to improve Eubank Boulevard south of Central Avenue (SNL 1997a). The other possible transaction involves renewing the lease arrangement with the NMSLO for the buffer zone west of TA-III and the KAFB boundary. The DOE and the NMSLO are establishing an arrangement that supports their mutual concerns for public safety while maintaining current testing capabilities (SNL 1997a, NMSLO 1997).

For a discussion of general future land use projects and developments in and adjacent to KAFB, see Chapter 6, Cumulative Effects Analysis.

4.3.2 Visual Resources

4.3.2.1 Definition of Resource

Visual resources encompass those aspects of an area that pertain to its appearance and to the manner in which it is viewed by people. This resource area provides a means to review the aesthetic qualities of natural landscapes and their modifications, associated perceptions and concerns of people, and the physical or visual relationships that influence the visibility of any proposed landscape modifications.

4.3.2.2 Region of Influence

The ROI is similar to that for land use (4.3.1.2). It consists of the geographic areas in and adjacent to KAFB where SNL/NM operations may influence the surrounding landscape and associated visual characteristics.

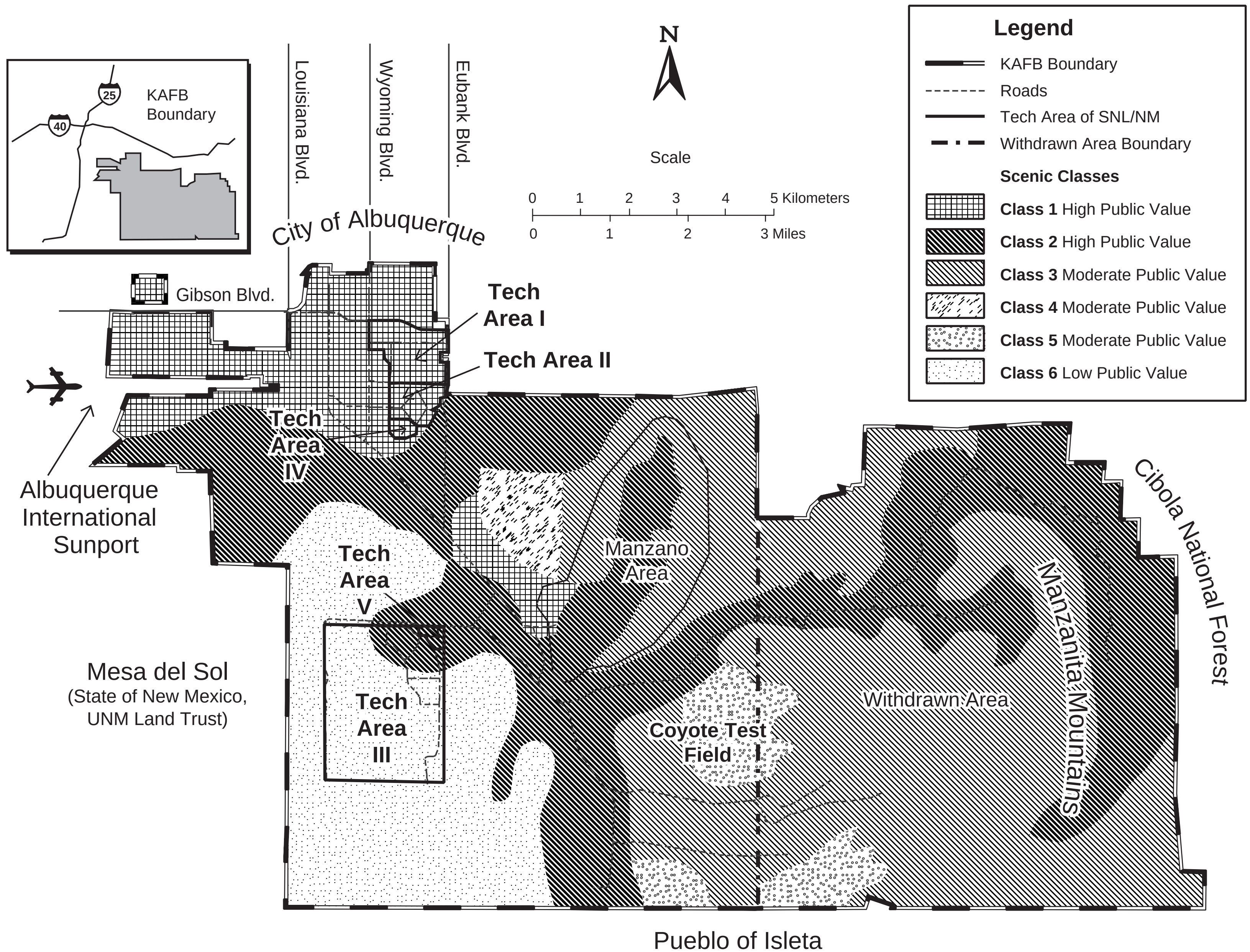
4.3.2.3 Affected Environment

The surrounding visual characteristics of SNL/NM consist of mostly flat, gently sloping grassland to the west and mountainous terrain to the east. Key landforms that dominate views in the general area include the Four Hills formation, the Manzanita Mountains, and the Manzano Mountains further south. From areas of Albuquerque nearest KAFB, views to the east and southeast are limited by the Four Hills formation and surrounding foothills of the Manzano Area. Views to the south partially consist of KAFB facilities, the Albuquerque International Sunport, and open rangeland. In general, the terrain features associated with the western portion of KAFB are not particularly distinctive. The eastern half, however, exhibits greater visual variety due to its mountain and canyon topography (SNL/NM 1997a). Most SNL/NM facilities are well within the KAFB boundary and away from public view. Because of their location and the surrounding terrain characteristics, most facilities are not visible from roads and areas with public access. Distant views of TA-I are possible from eastbound Interstate 40, but they are brief and show limited detail. Views from Interstate 25 consist of background landscapes only (SNL/NM 1997a).

Development is the most apparent modern alteration of the natural environment on KAFB affecting visual resources. Much of this activity is striking in nature and characterized by an urban setting with large buildings, extensive roadways, utility structures, parking lots, and other developed areas. The northwestern portion of KAFB, which includes SNL/NM TAs-I, -II and -IV, is the most populated and densely developed area that exemplifies these conditions. TAs-III and -V have a more limited and scattered development pattern, but similarly exhibit a variety of man-made modifications that affect the visual environment. The Coyote Test Field and particularly the Withdrawn Area are more sparsely developed. While early construction efforts throughout KAFB may not have specifically considered surrounding visual aesthetics, resulting in discordant assemblies of buildings and associated structures, recent development by both the USAF and the DOE includes facilities with designs and materials that are more visually compatible with the natural environment. In support of goals established to improve visual resources, SNL/NM has initiated Campus Design Guidelines, which contain a set of principles and detailed design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. They include guidance for building massing, facades, color palettes, building orientation and entries, circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. All new and modified facilities will be brought into compliance with these guidelines over time. These efforts have been endorsed by SNL/NM senior management and are administered through the Corporate Projects Department, the Sites Planning Department, and the Campus Development Committee (SNL 1997a).

Visual resource value ratings for aesthetics, called “scenic classes,” have been developed for KAFB using the USFS Scenery Management System (Figure 4.3–8) (USFS 1995, SNL/NM 1997a). These scenic classes are based on evaluating landscape character and scenic attractiveness, as well as on the number of observers/users in the area. The latter generate concern levels that measure the degree of public importance on landscapes viewed from travelways and use areas. For the KAFB visual resource analysis, viewer input was obtained from SNL/NM personnel working throughout the area, as well as from public comments solicited during preparation of the Cibola National Forest environmental analysis (USFS 1996). The scenic classes are rated from 1 to 6, corresponding to a gradual range from highest public value (1) to lowest public value (6). The higher the public value, the more important it is to maintain the highest scenic value. This evaluation provides baseline information for assessing potential effects on scenery from proposed projects or other proposed landscape changes.

As shown in Figure 4.3–8, the majority of SNL/NM TAs and other facilities are in areas where the scenic class indicates high public value (scenic class 1 or 2). Although these locations represent areas where the landscape is not particularly distinctive and has been extensively modified by development, the scenic class is elevated by the large number of observers and users present who generate high levels of concern for scenery. On a practical level, this means that future development at SNL/NM should continue to include efforts, such as the Campus Design Guidelines described above, to improve visual resources. Remote facility locations, particularly in the southwestern corner of KAFB and most of TA-III, are in areas of lower scenic value due to a combination of reduced observer/user sensitivity levels, indistinct landscape features, and extensive development. Other areas of SNL/NM activity, such as the Coyote Test Field and the Withdrawn Area, are generally within scenic classes representing high-to-moderate public value due to the inherently distinctive, less developed, and attractive nature of the area.



Source: SNL/NM 1997a

Figure 4.3–8. KAFB Scenic Classes

The scenic classes on KAFB range from the highest public value (scenic class 1) to low public value (scenic class 6).

4.4 INFRASTRUCTURE

4.4.1 Definition of Resource

Infrastructure consists of buildings, services, maintenance, utilities, material storage, and transportation systems and corridors that support the operations of a facility. Specifically, SNL/NM's infrastructure consists of water, sanitary sewer, storm drain, steam, fossil fuels, chilled water, electrical transmission, electrical distribution, communications, roads, and parking that support TAs-I, -II, -III, -IV, and -V and other DOE facilities at KAFB (SNL 1997a). For a discussion of land use, see Section 4.3.

4.4.2 Region of Influence

The ROI for infrastructure mainly consists of assets used by SNL/NM within KAFB. KAFB includes the physical area that encompasses KAFB, lands owned by the DOE, lands owned by the USAF, and portions of the Cibola National Forest withdrawn from public entry by the USAF and the DOE.

SNL/NM relies primarily on KAFB for infrastructure support, including base security, roads, electrical distribution, water supply, and sewage. Table 4.4–1 presents information on the type of utilities and amounts used by SNL/NM and KAFB. Table 4.4–1 also identifies utility capacities.

4.4.3 Affected Environment

4.4.3.1 SNL/NM Buildings

Buildings within SNL/NM are listed by type and square footage in Table 4.4–2. Physical attributes such as construction type, gross square feet, and usage distinguish primary buildings.

4.4.3.2 SNL/NM Services and Maintenance

SNL/NM's management and operations (M&O) contractor is Lockheed Martin Corporation. Under the office of SNL/NM's President and Laboratory Director, the complex is organized into 11 divisions: Physical Sciences and Components; Weapon Systems; Human Resources; Laboratory Development; National Security Programs; Energy, Environment, and Information Technology; Laboratory Services; California Laboratory; Systems, Science, and Technology; Business, Management, and Chief Financial Officer; and Defense Programs Products and Services. Extensive descriptions of key programs and services are provided in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a).

SNL/NM has a maintenance program supported by appropriate *National Environmental Policy Act* (NEPA) review. Routine maintenance and upgrades currently underway or planned include the following:

Table 4.4–1. Utility Capacities and Quantities Used by SNL/NM and KAFB

UTILITY	USAGE				KAFB CAPACITY
	SNL/NM (1996)	% OF CAPACITY	OTHER KAFB (1996)	% OF CAPACITY	
Water	440 M gal	22.0	710 M gal	35.5	2 B gal
Wastewater	280 M gal	32.9	256 M gal	30.1	850 M gal
Electricity	197,000 MWh	18.0	307,000 MWh	28.0	1.1 M MWh[a]
Natural Gas[b]	580 M ft^3[c]	26.5	680 M ft^3	31.1	2.3 B ft^3
Fuel Oil	15,000 gal[c]	NA	Not reported	NA	Not limited by infrastructure
Propane	370,000 gal[c]	NA	Not reported	NA	Not limited by infrastructure

Sources: DOE 1997k, SNL 1997a, SNL/NM 1997b
B: billion
ft^3: cubic foot
gal: gallon
KAFB: Kirtland Air Force Base
M: million
MWh: megawatt-hour
NA: not applicable
SNL/NM: Sandia National Laboratories/New Mexico
[a] Based on 125-megawatt (MW) rating
[b] Estimate based on 60 pounds per square inch (psi)
[c] Quantities were not typical due to several factors including weather and boiler tests at the steam plant, and were not used as baseline quantities in Chapter 3 on Table 3.6–2 and Chapter 5 on Table 5.3.2–1.

Table 4.4–2. Summary of SNL/NM Buildings and Their Square Footage

SNL/NM BUILDING TYPES	NUMBER OF BUILDINGS	GROSS SQUARE FT (GSF)	% OF GSF	PARAMETERS
Primary Buildings	125	4,441,636	88	Buildings > 3,000 GSF Permanent, semi-permanent, or wood/steel construction; not leased space
Other Buildings	304	268,319	6	Nonprimary buildings < 3,000 GSF
Mobile Offices	180	200,530	4	Mobile offices < 3,000 GSF
Transportable Buildings	65	109,529	2	Transportable buildings < 3,000 GSF
TOTAL	**674**	**5,020,014**	**100**	

Source: SNL 1997a
<: less than
>: greater than
SNL/NM: Sandia National Laboratories/New Mexico

- cleaning, painting, repairing, renovating, and servicing buildings, equipment, vehicles, and utility infrastructure;
- maintaining and extending onsite roads, parking areas, and access control structures;
- replacing, upgrading, and maintaining equipment, tools, and components, such as computers, valves, pumps, filters, monitors, and equipment controls to preserve, improve, and extend the life of the infrastructure; and
- maintaining, replacing, and upgrading environment, safety, and health equipment, controls, and monitoring capabilities.

4.4.3.1 Roadways and Transportation Access

The general road network in KAFB is shown in Figure 4.4–1. Key roads include Interstates 25 and 40. Interstate 25 runs north-south and is approximately 1.5 mi west of the KAFB boundary at its nearest approach. Interstate 40 runs east-west through Albuquerque and is approximately 1 mi north of the KAFB boundary at its nearest approach.

Access to KAFB and SNL/NM consists of an urban road network maintained by the city of Albuquerque, the gates and roadways of KAFB, and SNL/NM-maintained roads. Traffic enters SNL/NM through three principal gates: Wyoming, Gibson, and Eubank. Most commercial traffic enters through the Eubank gate because it provides direct access to the SNL/NM shipping and receiving facilities located in TA-II. An additional entrance to KAFB, the Truman gate, serves KAFB's western areas.

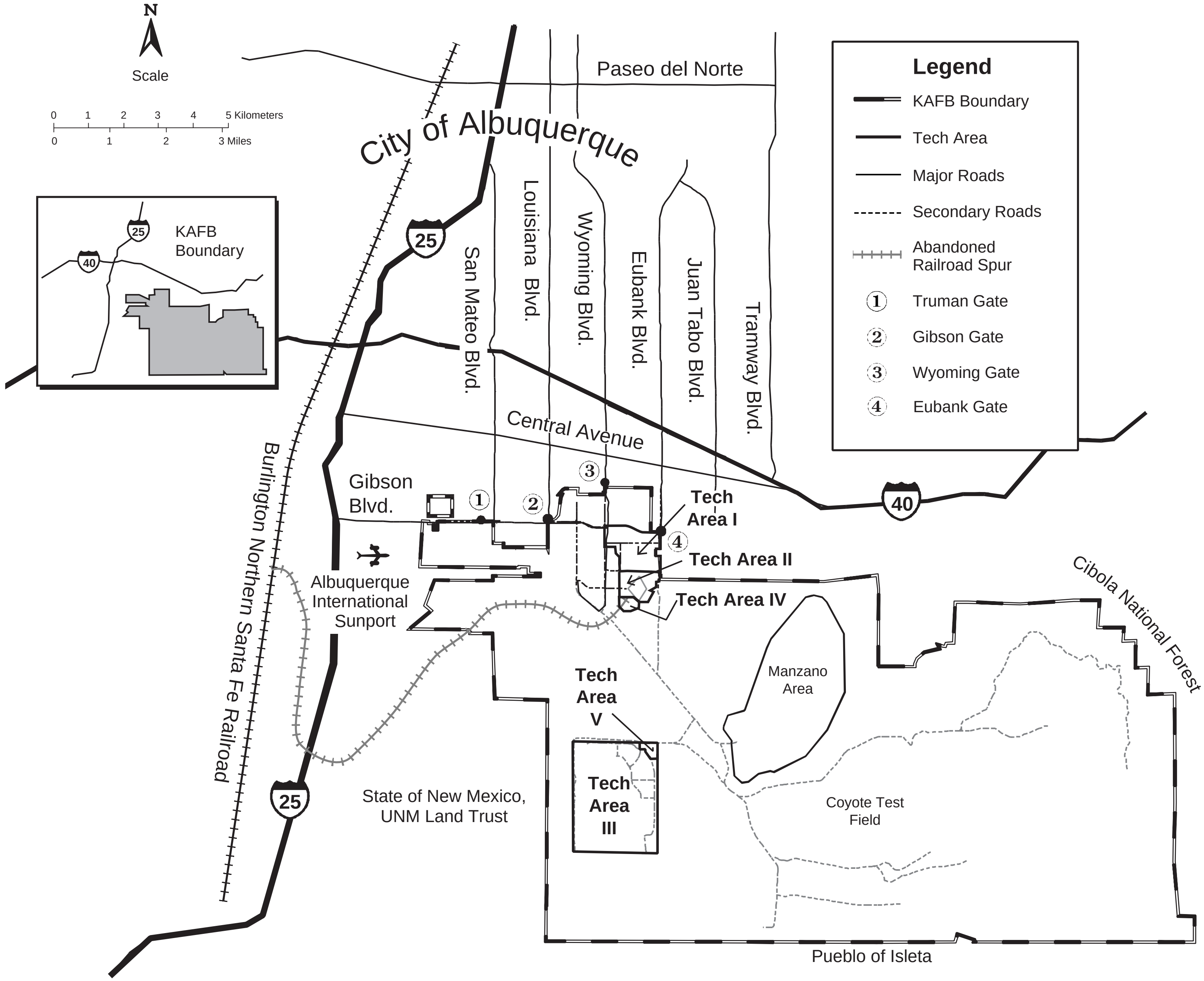
SNL/NM maintains approximately 20 mi of paved roads, 25 mi of unpaved roads, approximately 80 ac of paved service areas, and approximately 80 ac of paved parking (SNL 1997a). The roads near SNL/NM experience heavy traffic in the early morning and late afternoon. The principal contributors are SNL/NM staff and other civilian and military personnel commuting to and from KAFB. Survey estimates of employee-related traffic entering KAFB are between 10,000 to 13,500 SNL/NM and DOE commuters per day (SNL/NM 1997a). SNL/NM and DOE commuters represent approximately 36 percent of commuter traffic on KAFB (SNL 1997a). For a discussion of transportation-related issues such as traffic, see Section 4.11.

Rail facilities are not available on KAFB. The Burlington Northern & Santa Fe railroad discontinued its spur into KAFB in 1994. Land within KAFB, permitted to the DOE for the railroad right-of-way, has been returned to the USAF and demolition of the spur has begun.

Primary air service is provided for the entire region by the Albuquerque International Sunport, located immediately northwest of KAFB. Runways and other flight facilities are shared with KAFB.

4.4.3.2 Water

The water supply system consists of 85 mi of piping that, in 1996, provided 440 M gal of water (22 percent of KAFB capacity) for fire protection, industrial support of SNL/NM's research programs, and sanitary use



Source: SNL/NM 1997j

Figure 4.4–1. General Area Road Network in KAFB

Access to SNL/NM consists of key roads, Interstates 25 and 40, and an urban road network maintained by the city of Albuquerque.

(Table 4.4–1). The highest volume user is the Microelectronics Development Laboratory (MDL), which uses approximately 44 M gal of water per year for its activities. The second largest individual user (14.3 M gal per year) is the steam plant, supplying steam to SNL/NM and KAFB for space heating and laboratory processes (SNL 1998a).

KAFB owns and operates the water supply and distribution system, which includes the main booster pump station, storage reservoirs, and wells. Neither the existing water service from KAFB to SNL/NM, nor most major SNL/NM facilities are metered. The minimum pipeline size is dictated by the need for fire protection; sanitary and industrial use determine the size of service lines to specific facilities. For a discussion of water resources, see Section 4.6.

4.4.3.3 Sanitary Sewer

In 1996, the sewer system consisted of a 40-mi underground pipe network that discharged approximately 280 M gal per year (32.9 percent of KAFB capacity) of industrial and domestic wastewater (Table 4.4–1). Wastewater has leaked from underground sewer lines. Possible soil contamination associated with these leaks is being investigated and cleaned up as part of the SNL/NM Environmental Restoration (ER) Project. Sections 4.5 and 4.6 discuss ER Project activities.

4.4.3.4 Storm Drain

As part of its storm drain system, SNL/NM maintains approximately 15 mi of pipe and 2 mi of channel. KAFB experiences periodic thunderstorms accompanied by brief periods of intense rainfall. Approximately one-half of the system is designed to provide a means of storm water control to protect buildings, roads, and equipment from a 100-year storm event. The remaining half, which does not meet the current standard, has been assessed and upgrades, modifications, and repairs are currently underway in order to effectively control storm water throughout the facility and meet the 100-year storm event criteria. Existing drainage channels require continuous maintenance to correct erosion problems and remove weeds, sediment, and debris that inhibit proper flow (SNL 1997a).

4.4.3.5 Electrical Transmission and Distribution

SNL/NM maintains approximately 115 mi of electrical transmission/distribution lines. The electrical transmission system is a high-voltage (46-kV) overhead transmission system from the Public Service Company of New Mexico (PNM) to the various substations within SNL/NM. SNL/NM maintains the 26 master unit substations that distribute all its electrical power. The estimated monthly electric bill for the DOE, KAFB, and SNL/NM is $1.6 M. PNM provides power to SNL/NM through the Eubank substation, located east of SNL/NM. A second source of power from PNM is currently under construction south of TA-IV (SNL 1997a).

South of Tijeras Arroyo, KAFB owns and maintains the transmission lines that support SNL/NM facilities. The system has experienced outages to facilities in TAs-III, -IV, and -V and the Coyote Test Field. Improvements to the system are anticipated pending completion of an upgrade project (SNL 1997a). In 1996, SNL/NM used 197,000 MWh (18 percent of KAFB capacity) (Table 4.4–1).

4.4.3.6 Natural Gas

SNL/NM maintains 4.5 mi of gas line. Natural gas supplied by PNM is the primary heating fuel used at the steam plant. It is also supplied to self-contained boilers at facilities in TAs -I, -II, and -IV, which are not on the steam distribution system. Laboratories also use natural gas in many of the buildings for heating and experiments. SNL/NM uses approximately 580 M ft^3 per year (26.5 percent of system capacity). Diesel fuel is used as an emergency backup during natural gas pressure interruptions. SNL/NM uses 370,000 gal of propane per year in TAs-III and -V and in other remote locations (SNL 1997a). Natural gas and propane use in 1996 was not considered typical due to several factors, including weather and tests associated with the steam plant. However, the recent completion of a natural gas line into the area is expected to significantly reduce the demand for propane, while increasing use of natural gas.

The source of natural gas to KAFB and the SNL/NM central steam plant is a high-pressure line that enters KAFB near the intersection of Pennsylvania Avenue and Gibson Boulevard. The reliability of the line may be questionable, since it has been damaged in the past. Two low-pressure gas isolation valves allow restoration of service if the primary distribution line becomes damaged. The internal low-pressure gas system is a dual loop throughout the TAs that provides a backup source if a portion of the line becomes temporarily disabled. This distribution system is made of steel pipe and requires protection to prevent corrosion. Recent projects have upgraded the steel pipelines, replaced building gas valves, and replaced many of the steel lines with polyethylene pipe, thus eliminating the need for previously required protection measures (SNL 1997a).

4.4.3.7 Steam/Chilled Water

The purpose of the steam system is to provide heat for buildings and hot water for sanitary use. It is also used to provide humidity in a limited number of buildings and chilled water through absorption chillers. The steam plant supplies an average of 1.5 M lbs per day of saturated steam for space heating in TA-I and the eastern portion of KAFB (SNL/NM 1997b). SNL/NM maintains 14 mi of piping for steam and 1 mi of piping for chilled water.

4.4.3.8 Communications

SNL/NM maintains 2,900 mi of communication lines. Surveys indicate that the system may be nearing capacity; however, system upgrades are meeting the current demand for data links (SNL 1997a).

4.4.3.9 Selected Infrastructure Facilities

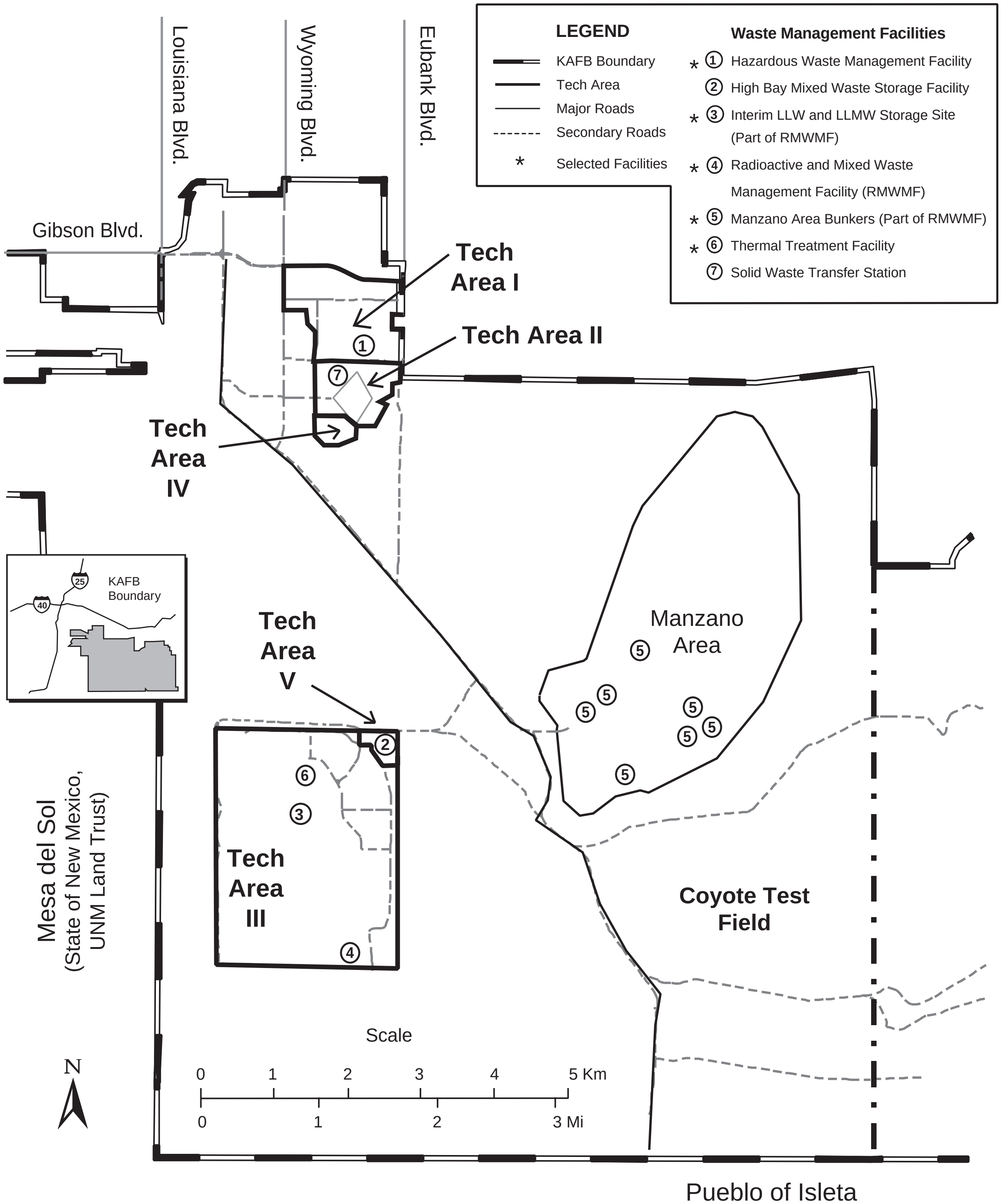
The steam plant, Radioactive and Mixed Waste Management Facility (RMWMF), Thermal Treatment Facility (TTF), and Hazardous Waste Management Facility (HWMF) were identified as representative facilities that provide infrastructure support services. For a discussion of the facility screening process, see Section 2.3. Steam plant functions are discussed in the Facility Descriptions that follow Chapter 2.

The three remaining facilities are waste management facilities. The facilities vary in size, capacity, and scope of operation, depending on the waste type for which they are designed. SNL/NM manages low-level waste (LLW,) low-level mixed waste (LLMW), transuranic (TRU) waste, mixed transuranic (MTRU) waste, and hazardous waste. Descriptions of these wastes and associated management facilities are provided in Section 4.12. Figure 4.4–2 shows the locations of the three selected waste management facilities and four additional waste management facilities on SNL/NM.

4.4.3.10 Material Storage and Inventory

SNL/NM stores and manages a wide variety of hazardous and nonhazardous materials. Hazardous materials include radioactive materials; chemicals including solvents, acids, bases, and specialty gases; explosives and explosive containing materials; and fuels. Nonhazardous materials include plastics, metals, certain solvents, certain oils like mineral oil, and simple office materials like paper. For a detailed discussion of SNL/NM material management see *SNL/NM Environmental Information Document* (SNL/NM 1997a).

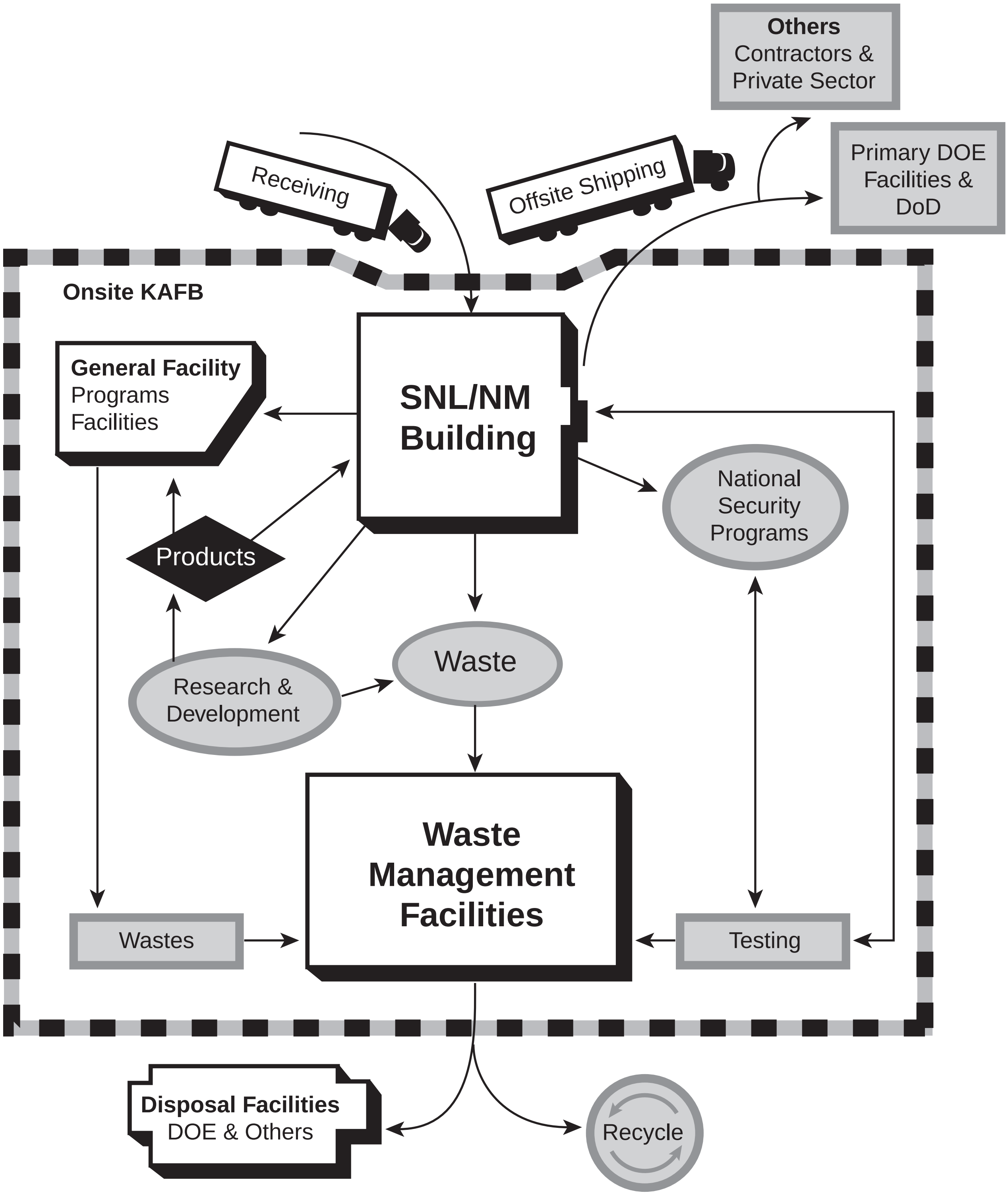
Figure 4.4–3 illustrates conceptually how materials move at SNL/NM. For details regarding material inventories used for analysis in the SWEIS, see Appendix A. The material inventories and SNL/NM databases were used to analyze potential air quality impacts, human health impacts including accidents, and transportation requirements (see Sections 4.9, 4.10, and 4.11, respectively).



Source: SNL/NM 1997j

Figure 4.4–2. Waste Management Facilities

SNL/NM manages a variety of waste through seven facilities located throughout SNL/NM.



Source: SNL/NM 1997j

Figure 4.4-3. Conceptual Illustration of Material Movement at SNL/NM

SNL/NM receives materials that are then distributed to testing, research and development, and other facilities.

4.5 GEOLOGY AND SOILS

4.5.1 Definition of Resource

The discussion of geology and soils includes seismology, slope stability, and soil contamination. Seismology refers to the geology below the soil layer that is relevant to the occurrence, frequency, and magnitude of earthquakes. Slope stability generally focuses on the stability of the soil layer. For the purpose of this SWEIS, soils include natural material at the ground surface extending to a depth that construction activities could reasonably disturb (20 to 30 ft).

4.5.2 Region of Influence

The main concern of seismic activity and slope stability is their effect on onsite facilities, specifically, whether damage from earthquakes or slope failures could result in a contaminant release. The ROI would, therefore, be the extent of environmental or human health effects from such a release. Offsite impacts from these and other accidental releases are addressed in Sections 5.3.8.2, 5.4.8.2, and 5.5.8.2.

Potential soil contamination effects would result from exposure at or near the contaminated area. Thus, the ROI is limited to KAFB. Potential migration of soil contaminants into groundwater or surface water is addressed in Sections 4.6.1.3 and 4.6.2.3.

4.5.3 Affected Environment

4.5.3.1 Seismology

SNL/NM is in the eastern portion of the 30-mi-wide Albuquerque-Belen Basin, about midway along its north-south trending length of about 90 mi (Figure 4.5–1). The city of Albuquerque is in a region expected to experience moderate earthquakes that could result in damage to buildings, depending on the quality of construction (SNL/NM 1997a). Since 1966, New Mexico has experienced four moderate earthquakes, all approximately 5.0 on the Richter scale. Two of these were in Dulce (near the Colorado border in north-central New Mexico), one was in Gallup (near the Arizona border in west-central New Mexico), and one was in Eunice (extreme southeast corner of New Mexico, near the Texas border). The Dulce and Gallup earthquakes were the closest to SNL/NM, all approximately 125 mi away. The largest shock predicted in New Mexico in a 100-year period would have a magnitude of 6.0 on the Richter scale (SNL/NM 1997a). The Richter scale does not measure damage. Damage is dependent upon several factors, including duration of the event, type of movement, facility design, and construction materials and practices.

A number of regional faults (Sandia, West Sandia, Manzano, Hubbell Springs, Tijeras, and Coyote) intersect within KAFB (Figure 4.5–2). There is no evidence of movement along these faults over the last 10,000 years (SNL/NM 1997a).

In the Albuquerque area, the largest magnitude earthquake of the century, a recorded magnitude 4.7 on the Richter scale, occurred on January 4, 1971. SNL/NM buildings did not receive any appreciable damage. A survey after the event noted cracks in some SNL/NM buildings, but the cracks could have predated the earthquake (SNL/NM 1997a).

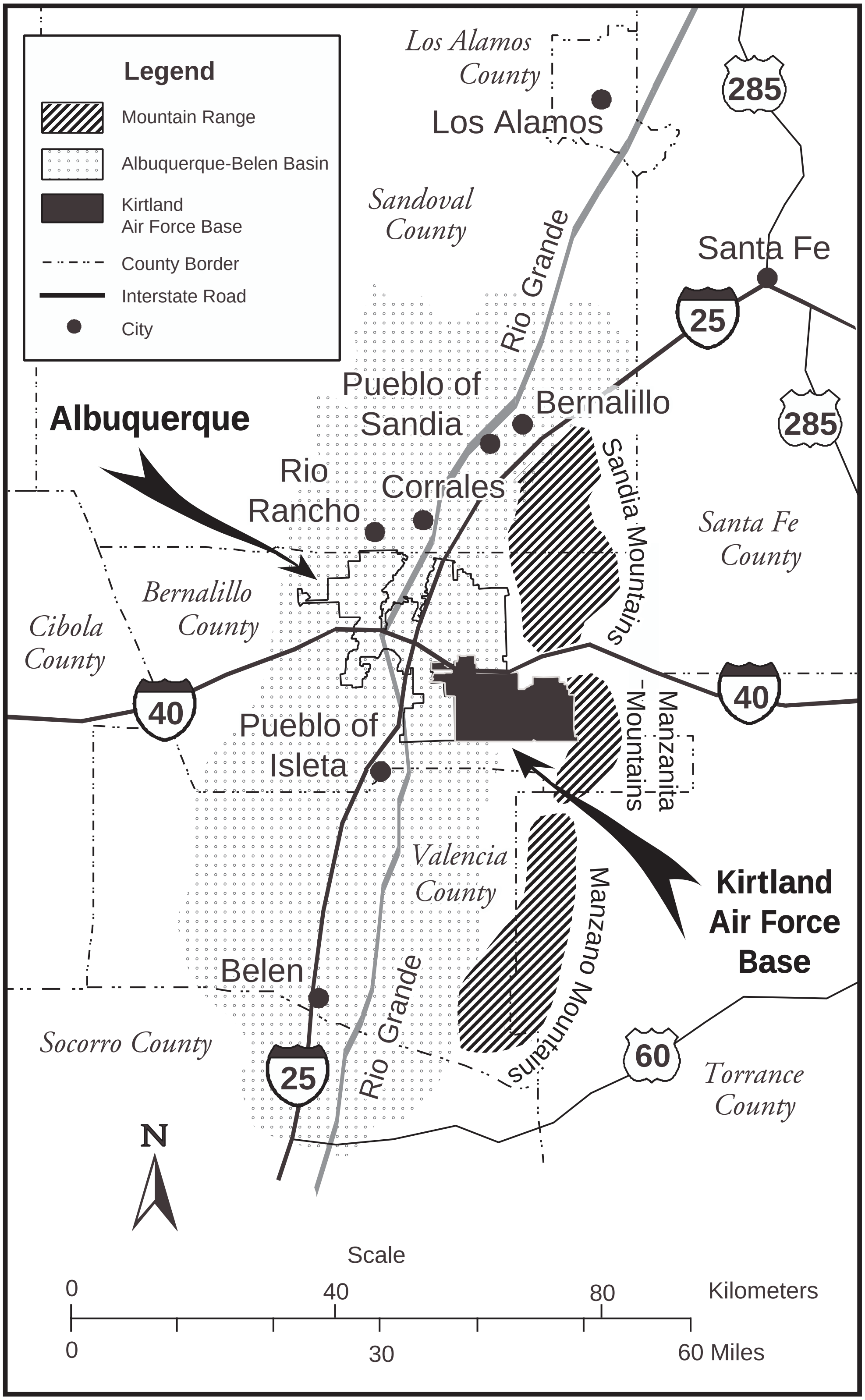
4.5.3.2 Slope Stability

Most SNL/NM facilities are constructed on level ground or gentle slopes. These areas are composed of alluvial fan sediments that slope westward toward the Rio Grande. Steeper slopes occur along the arroyos (particularly where channel erosion occurs during periods of storm runoff) and in the Manzanita Mountains. Facilities near slopes are those that border the Tijeras Arroyo at the southern edge of TA-IV, including Building 970 and parking areas, and the ECF, Building 905, in TA-II. Similarly, there are only two SNL/NM facilities in the Manzanita Mountains—the Lurance Canyon Burn Site and the Aerial Cable Facility. The Manzanita Mountains are predominantly Precambrian crystalline and Paleozoic marine carbonate bedrock and are not prone to landslides. To date, no SNL/NM facility has been affected by slope instability.

4.5.3.3 Soil Contamination

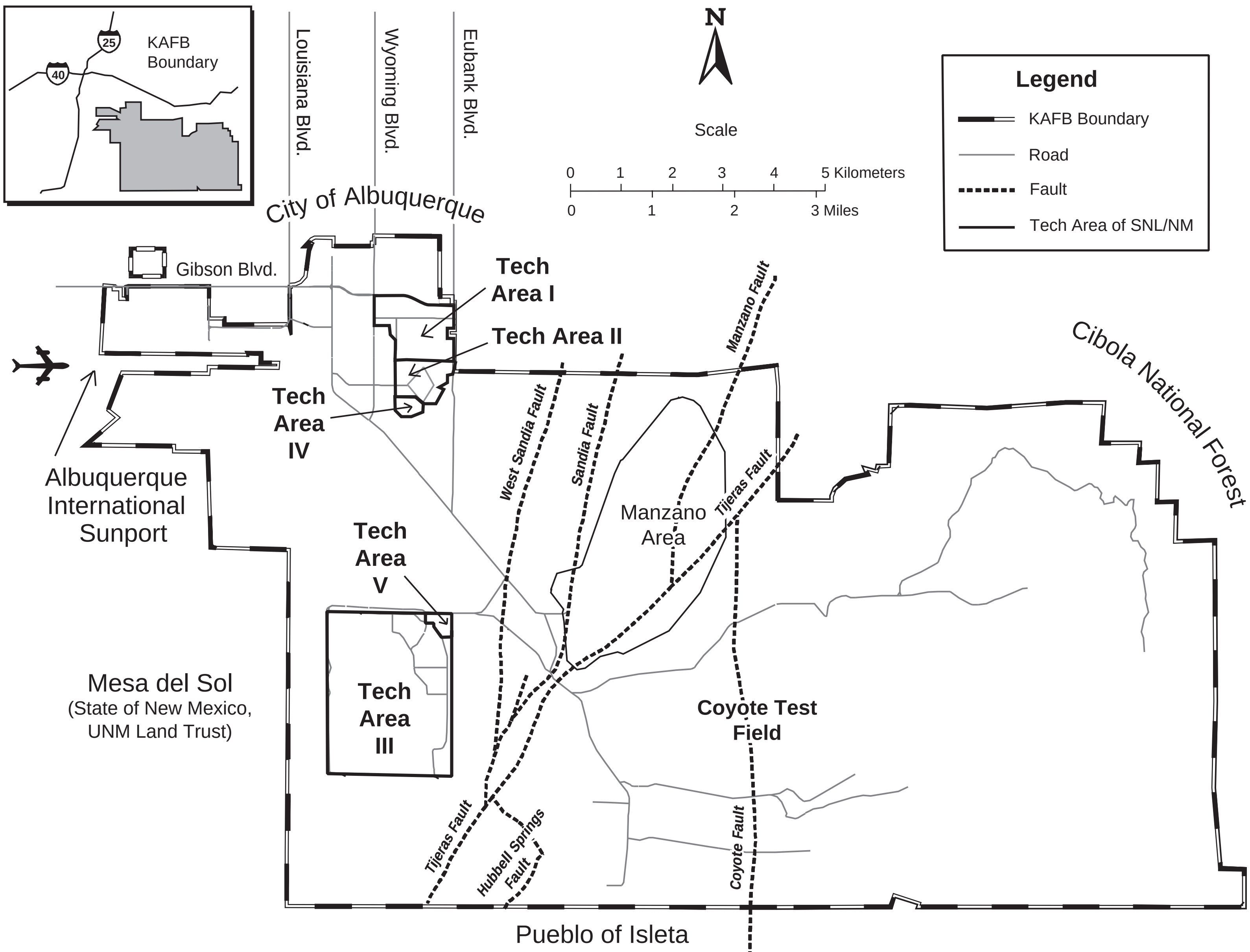
Soils at SNL/NM are derived primarily from eroded bedrock in the Manzanita Mountains that was transported downslope by water. Soil layers formed by these sediments tend to be discontinuous. The chemical composition of these soils reflect the composition of the source bedrock, and soils at SNL/NM frequently have high naturally occurring (background) concentrations of the metals arsenic, beryllium, and manganese (SNL/NM 1996e).

As a result of past SNL/NM activities, soil contamination exists or may exist at a number of locations at KAFB, although most sites are less than 1 ac in size (Figure 4.5–3). Cleanup of these contaminated sites is regulated under RCRA. SNL/NM investigates and



Sources: SNL/NM 1997j, USGS 1995

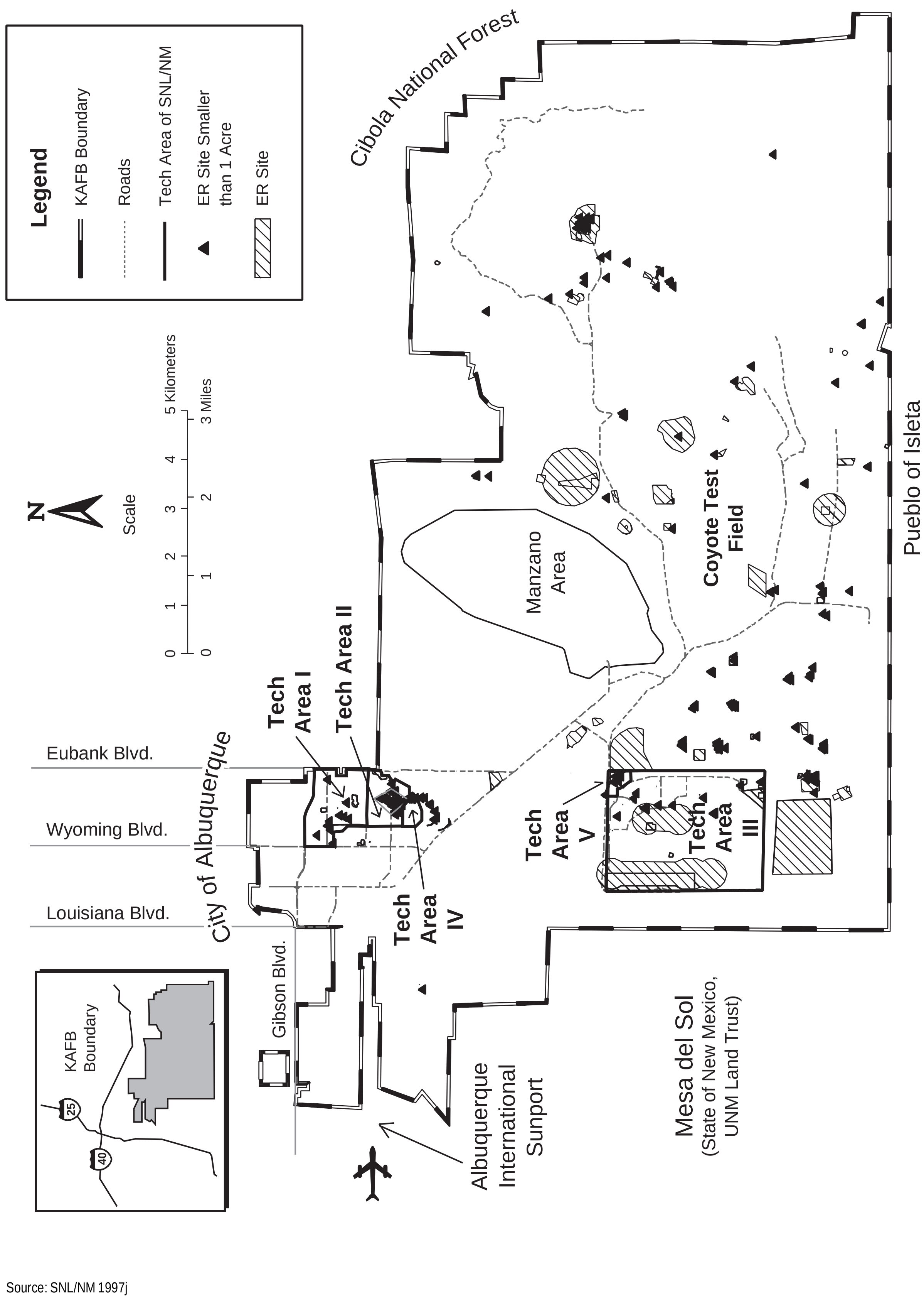
Figure 4.5–1. Location and Extent of the Albuquerque-Belen Basin
SNL/NM is located along the eastern edge of the Albuquerque-Belen Basin.



Sources: SNL/NM 1997a, 1997j

Figure 4.5–2. Regional Faults at KAFB

Six regional faults intersect KAFB.



Source: SNL/NM 1997j

Figure 4.5–3. Locations of SNL/NM Environmental Restoration Sites

One hundred eighty-two sites have been identified for investigation and potential remediation under the SNL/NM Environmental Restoration Project.

remediates these sites through the ER Project. Under the ER Project, potentially contaminated sites go through an investigative process that includes identification, sampling, and, if necessary, remediation. SNL/NM proposes no further action at sites that do not have contamination or that have concentrations of contaminants that pose no appreciable risk to human health or the environment. The state of New Mexico has the authority to approve or reject "no further action" proposals. As of August 1998, 182 sites had been identified, with 122 proposed as "no further action" to the NMED

Further, of the 182 sites identified under the ER Project, 47 are within 0.5 mi of a major surface water drainage, either Tijeras Arroyo or Arroyo del Coyote (DOE 1996c). Of these, 39 were proposed by SNL/NM for no further action, either because confirmatory soil sampling failed to show the presence of contamination or contaminants in soil were present in low concentrations.

Sites that pose a potential risk to human health and the environment will undergo some type of remediation, often the removal of contaminated soil. Some residual contamination may remain at these sites, but at concentrations presenting little or no human-health risk. Immediate risks to human health are addressed through short-term measures, such as restricting site access or covering contaminated soil with tarps or commercially available dust suppression products that reduce the chance of airborne soil particles (DOE 1996c). Monitoring near ER sites indicates that exposure to dust particles is not a significant transport pathway for radioisotopes (Section 4.1) (SNL 1996a). The ER Project is scheduled for completion by 2004.

Soil contamination also exists at some active SNL/NM outdoor test facilities. In the past decade, environmental controls on testing have reduced the concentrations or extent of additional soil contamination. The ER Project addresses soil contamination resulting from past testing (DOE 1996c). Most of the soil contamination at these active sites is shallow surface contamination stemming from the explosion, destruction, or burning of tested devices containing hazardous material. The primary contaminants at these active sites are depleted uranium (DU) and lead.

SNL/NM actively performs environmental soil monitoring on and near KAFB to confirm the effectiveness of control systems in place at the various TAs. Soil samples are collected twice annually from 50 locations: 31 onsite, 13 at the site perimeter, and 6 offsite (SNL 1997d). Samples are analyzed for common radionuclides and metals, with analytical results compared to naturally occurring concentrations. For 1996, most soil monitoring results showed no difference from naturally occurring concentrations. However, three onsite locations had higher-than-background soil concentrations of tritium (averaging 20.13 pCi/ml versus 0.24 pCi/ml offsite), which were associated with identified ER Project sites in controlled areas (SNL 1996a, 1997d). Excluding these three locations, onsite tritium concentrations averaged 0.72 pCi/ml (SNL 1997d).

4.6 WATER RESOURCES AND HYDROLOGY

4.6.1 Groundwater

4.6.1.1 Definition of Resource

Groundwater in the KAFB area occurs within saturated unconsolidated geologic material and fractured and porous bedrock. Aquifers are subsurface layers of rock or unconsolidated material that are capable of yielding usable amounts of water to wells or springs.

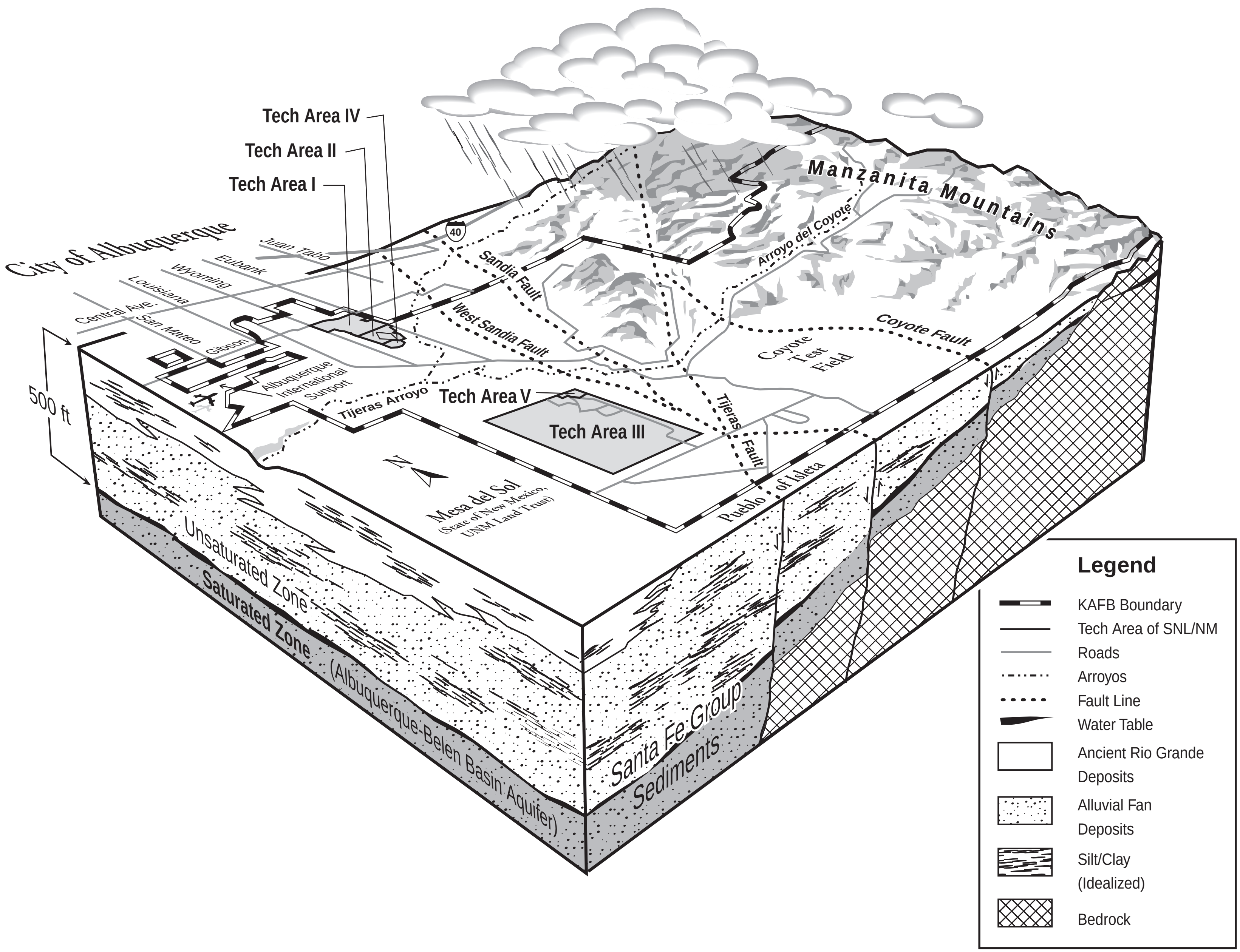
4.6.1.2 Region of Influence

The groundwater beneath KAFB is part of an interconnected series of water-bearing geologic units within the Albuquerque Basin that form the Albuquerque-Belen Basin aquifer (Figure 4.5–1). This aquifer defines the ROI.

4.6.1.3 Affected Environment

The principal sedimentary fill of the Albuquerque-Belen Basin is the Santa Fe Group, consisting of gravels, sands, silts, and clays (Figure 4.6–1). The local (SNL/NM area) groundwater system has three hydrogeologic regions (HRs), which are delineated by their locations in relation to the geologic fault system that bisects KAFB (Figure 4.6–2).

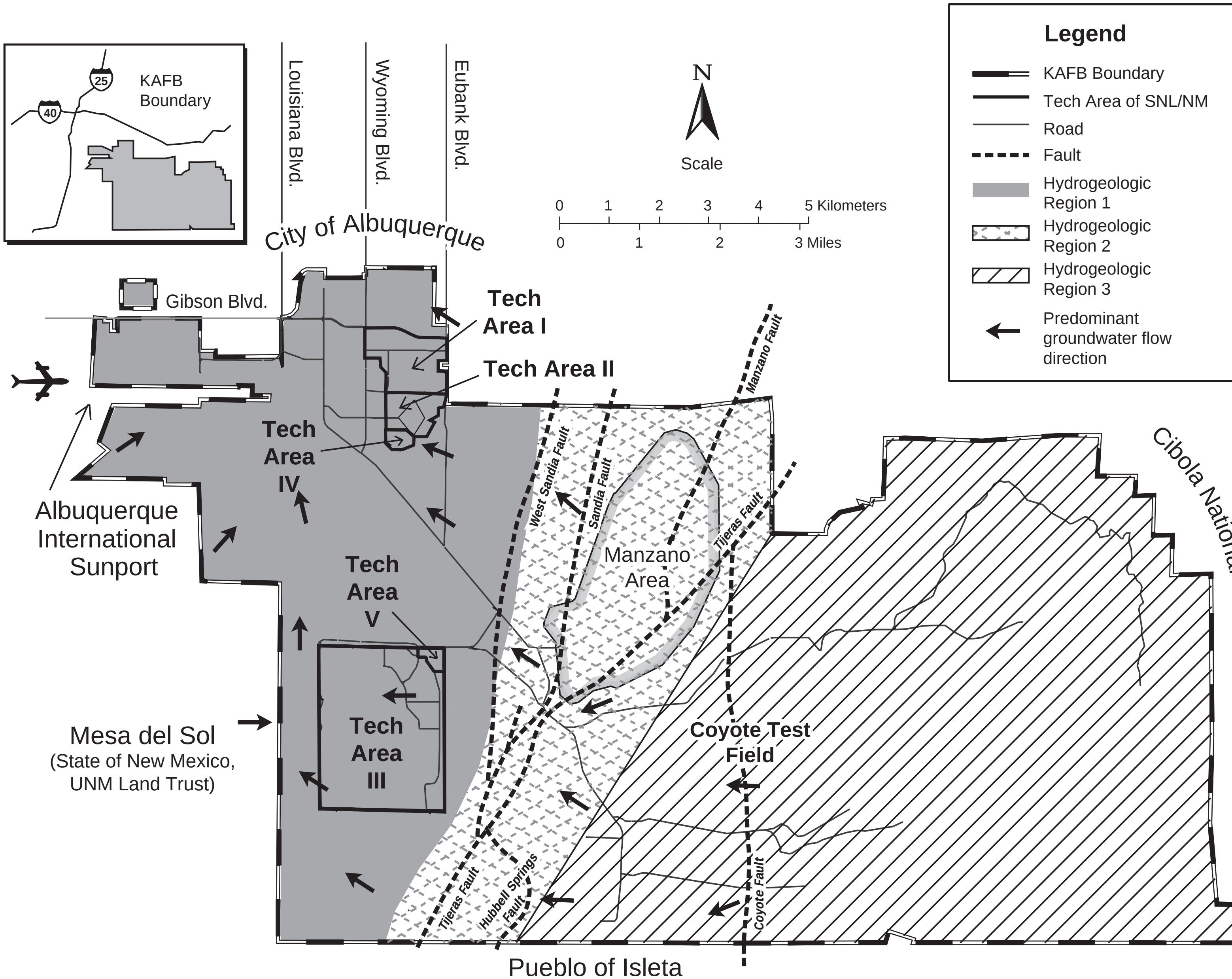
HR-1, within which the SNL/NM TAs are located, is to the west of the fault system. It consists of thick unconsolidated sedimentary deposits overlying bedrock. The Albuquerque-Belen Basin aquifer occurs in this unit of unconsolidated sediments and is the source of Albuquerque's municipal water. Groundwater flow is generally north to northwest in the northwestern portion of KAFB where TAs-I, -II, and -IV are located (Figure 4.6–2). Hydraulic conductivities range from less



Source: Original

Figure 4.6–1. Conceptual Diagram of Groundwater System Underlying KAFB

Santa Fe Group alluvial sediments and groundwater underlie KAFB.



Source: SNL/NM 1997j

Figure 4.6–2. Locations of Hydrogeologic Regions at KAFB

The SNL/NM area groundwater system has three hydrogeologic regions.

than 0.1 ft to more than 100 ft per day. The depth of the unsaturated zone, from ground surface to the aquifer, increases toward the west and is approximately 500 ft at the western edge of KAFB.

HR-2 straddles the Sandia/Tijeras/Hubbell Springs fault system. This region is a transition between the unconsolidated sedimentary character of HR-1 and the bedrock-dominated character of HR-3. Hydraulic conductivities are highly variable, ranging from 0.003 ft per day in bedrock to near 150 ft per day in alluvial material. Depth to groundwater is also highly variable, ranging from 500 ft near the southeast corner of TA-III to near zero ft along the Arroyo del Coyote south of the Manzano Area (Figure 4.6–2). The eastern portion of KAFB, which includes the Coyote Test Field and the Withdrawn Area, is within HR-2 and HR-3.

HR-3 is characterized by its bedrock aquifers, although in some places a thin layer of groundwater-containing alluvial material overlies the bedrock. Depth to groundwater in HR-3 varies from 150 ft near the Hubbell Springs Fault to near zero ft along portions of Arroyo del Coyote (SNL/NM 1997a). The depth to groundwater may exceed 150 ft in mountainous areas, but data are limited.

Groundwater Quality

A network of monitoring wells is used to collect samples for characterizing baseline water chemistry and groundwater contamination (Figure 4.6–3). This network is part of an active environmental monitoring program covering groundwater, surface water, and air (SNL 1995c, 1996a).

The groundwater beneath SNL/NM and adjacent areas is the source of drinking water for SNL/NM, KAFB, and adjacent portions of the city of Albuquerque. The local groundwater is also used for irrigation and industry. Federal and state water quality standards are based on the type of water use (for example, drinking, irrigation, or recreation). Maximum contaminant levels (MCLs) are based on the National Primary Drinking Water Regulations. The New Mexico Water Quality Control Commission (NMWQCC) has established maximum allowable concentrations for some substances for which no Federal MCLs have been established (NMWQCC 1994).

Groundwater quality can be influenced by the presence of contaminants in the soil column above the groundwater, as well as in the groundwater itself. These influences are of major concern to the SNL/NM ER Project, which is investigating the nature and extent of groundwater contamination from past activities at SNL/NM sites. All known groundwater contamination is the result of past waste management activities that occurred before the enactment of such laws as RCRA, the *Toxic Substances Control Act* (TSCA), and the *Clean Water Act* (CWA).

Locations of Potential or Known Groundwater Contamination

Sites with potential or known groundwater contamination at SNL/NM are Sandia North (an ER Project designation for groundwater investigations of sites in TA-I and TA-II), the Mixed Waste Landfill (MWL), locations in TA-V, Lurance Canyon Burn Site, and the CWL (SNL 1997d) (Figure 4.6–4). Measurements indicate that some contaminants at some of these sites exceed MCLs (40 CFR Part 141) (Table 4.6–1). Investigation or remediation of these sites is ongoing as part of the ER Project.

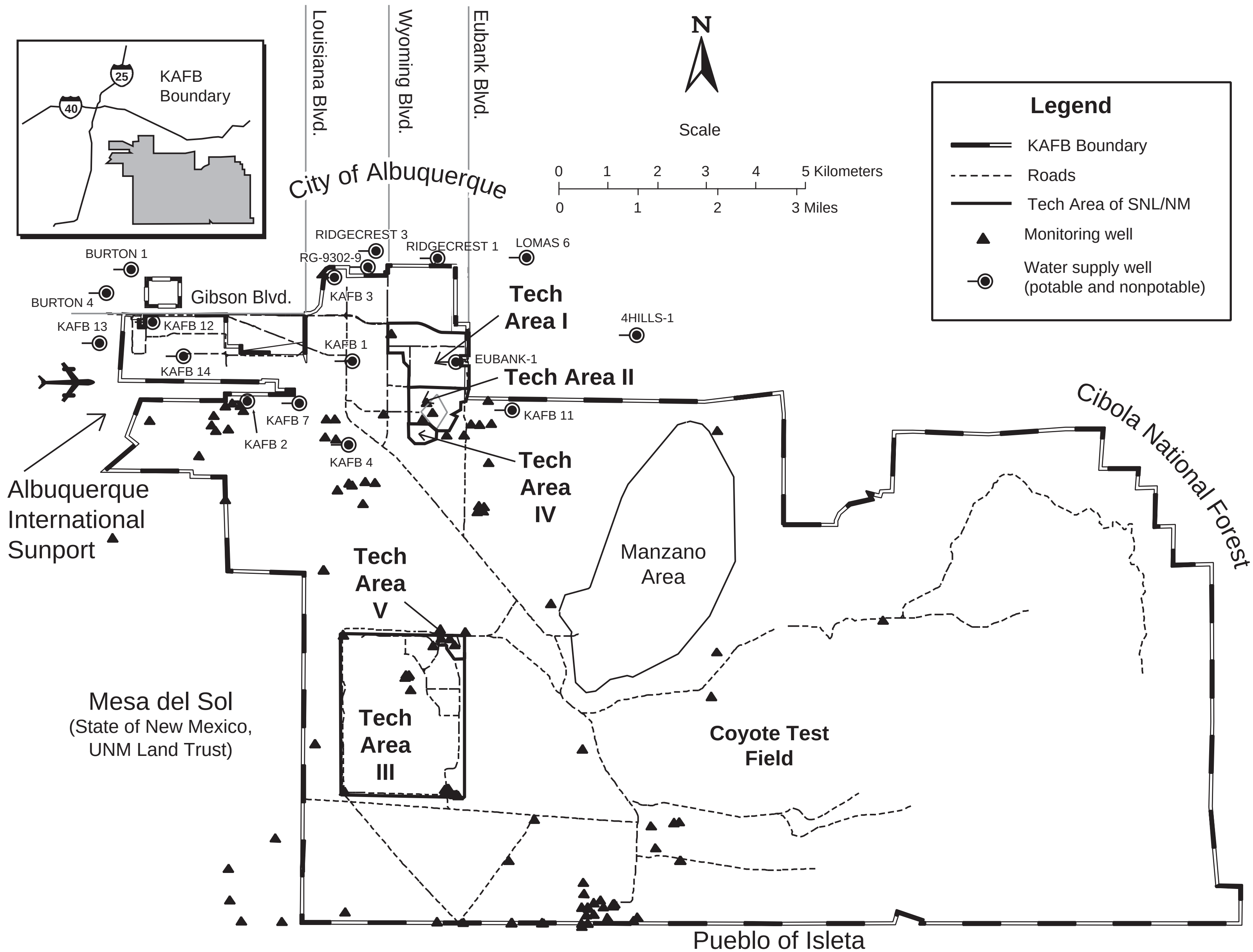
Sandia North

Sandia North is a 1.2-mi^2 area located in the northern part of KAFB. It encompasses TA-I and TA-II and includes approximately 40 ER sites. Underlying the Sandia North area are shallow water-bearing zones, with a gradient towards the southeast, and deep regional groundwater (approximately 500 ft deep) that flows generally to the northwest and north. Some city of Albuquerque and KAFB production wells are located within 1 mi of the Sandia North area. Trichloroethene (TCE) and nitrates have been detected in both the deep and shallow groundwater beneath the Sandia North area. Since 1993, six shallow and three deep wells have been used to monitor groundwater in the Sandia North area. TCE and nitrates have been detected repeatedly in some of these wells. In 1996, TCE was detected at just above the 0.005-mg/L MCL at a deep aquifer monitoring well; nitrate was detected at levels almost three times the MCL of 10 mg/L in another deep aquifer monitoring well (SNL 1997d).

An investigation plan is being implemented to characterize the sources and site hydrogeology (SNL/NM 1998bb). The sources of the TCE and nitrate have not been determined. Possible explanations include multiple sources among the SNL/NM ER sites located in this area or nearby private landfills not associated with SNL/NM.

Mixed Waste Landfill

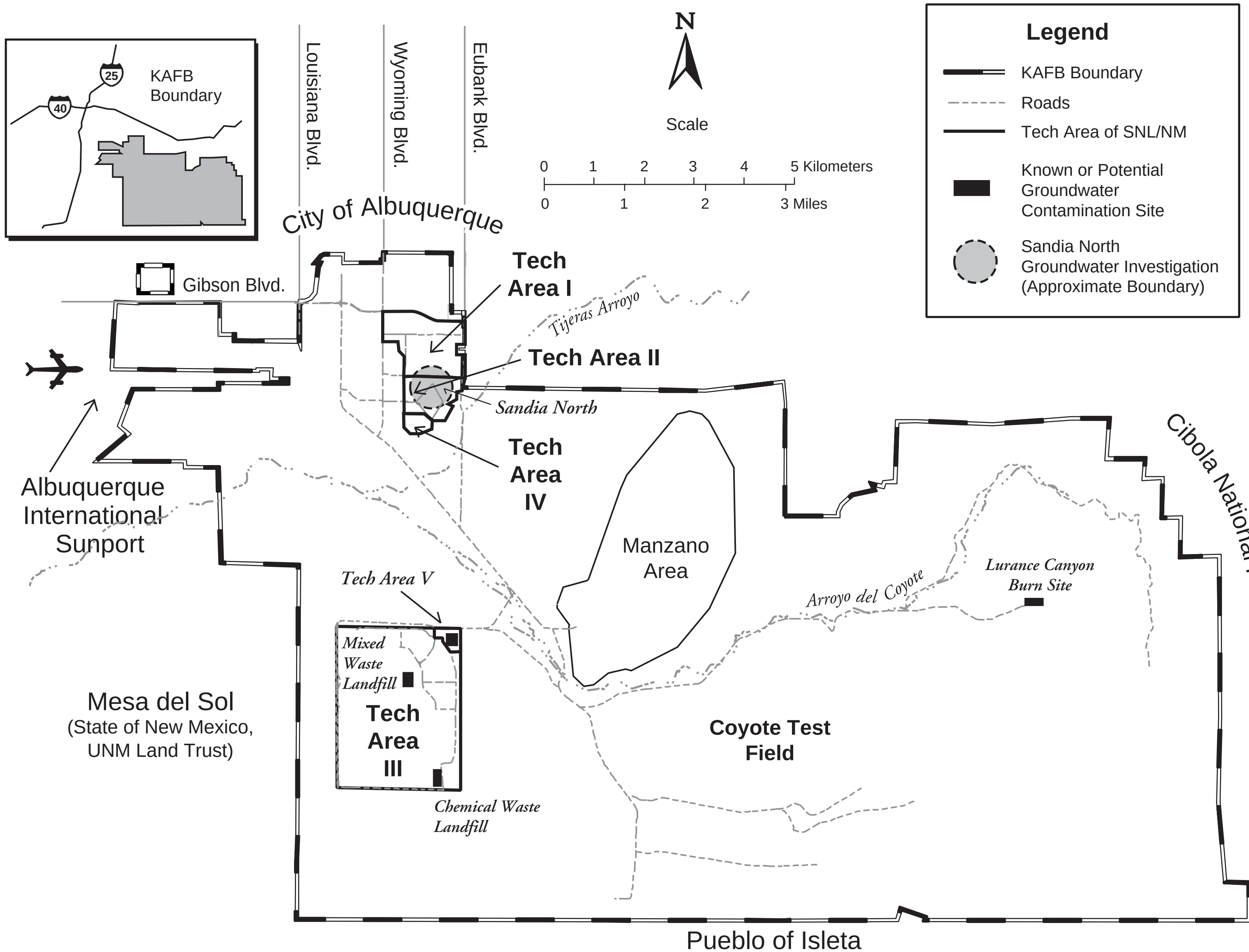
The MWL was established in 1959 for the disposal of radioactive and mixed wastes. The landfill, inactive since



Source: SNL/NM 1997j

Figure 4.6–3. Locations of Groundwater Monitoring and Supply Wells

A network of monitoring wells is used to collect samples for environmental monitoring.



Sources: SNL 1997d,SNL/NM 1997j

Figure 4.6–4. SNL/NM Known or Potential Groundwater Contamination Sites

Sites with potential for or that have known groundwater contamination are located at TAs-I, -II, -III, and -V and the CTF.

Table 4.6–1. Maximum Recorded Levels of Suspected Groundwater Contamination at SNL/NM

SITE	CONTAMINANTS	MAX MEASURED CONCENTRATIONS	MCL
Sandia North (TA-I and TA-II)	TCE	0.0056 mg/L	0.005 mg/L
	Nitrate[a]	29 mg/L	10 mg/L
TA-V	TCE	0.019 mg/L	0.005 mg/L
	Nitrate[a]	12 mg/L	10 mg/L
Chemical Waste Landfill	TCE	0.026 mg/L	0.005 mg/L

Sources: 40 CFR Part 141, DOE 1996c, SNL 1997d
MCL: maximum contaminant level
mg/L: milligram per liter
TA: technical area
TCE: trichloroethene
[a] All nitrate concentrations are as nitrogen.

1988, is located in the north-central part of TA-III and encompasses approximately 2.6 ac. Uranium, thorium, transuranics, fission products, and tritium were disposed of in the landfill. Tritium has been detected in soils below and outside the perimeter of the MWL.

The regional water table at the MWL occurs at a depth of approximately 460 ft. No evidence of groundwater contamination has been detected at the landfill since September 1990 in 18 rounds of sampling. Nickel has been measured in one monitoring well at a concentration (0.145 mg/L) above the 0.1-mg/L MCL. The concentrations of nickel in groundwater samples at this well are attributed to dissolution of the stainless steel well screen (SNL 1997d). Such dissolution is a well-known phenomenon (Hewitt 1992, Oakley and Korte 1996), with these concentrations confined to water within or immediately surrounding the well (not characteristic of concentrations in the aquifer). Monitoring of nickel concentrations continues at this location. SNL/NM has removed broken and subsided concrete caps at the MWL to reduce the possibility of ponding water infiltrating into underlying wastes. The waste pits where the concrete caps were removed were backfilled with soil to ground surface to promote precipitation runoff. Site remediation is projected to be completed in 1999.

TA-V

The TA-V area contains seven monitoring wells, including those that monitor the Liquid Waste Disposal System (LWDS) site. During 1996, TCE was present at levels of about 3 to 4 times the 0.005-mg/L MCL at one LWDS well. TCE has been detected in several wells at concentrations below the MCL. The source of the TCE is unknown; however, it is believed that the TCE is reaching groundwater via aqueous phase transport. From 1963 to 1967, approximately 6.4 M gal of waste water were released to the LWDS drain field. Historical disposal of small amounts of TCE through the LWDS is a possible source. In 1996, nitrate concentrations as high as 12 mg/L (versus an MCL of 10 mg/L) were found in samples at two wells, including the LWDS well (SNL 1997d). The probable sources of the nitrates are septic tanks and leachfields; these systems have been closed and waste and contamination from these sites have been removed. Information about the hydrogeology and contamination at TA-V is presently being developed for a groundwater data report to be released by the SNL/NM ER Project in mid FY99.

Lurance Canyon Burn Site

The Lurance Canyon Burn Site is located in the eastern part of KAFB in a canyon in the Manzanita Mountains. This site was used in the 1970s for testing high explosives. Today it is used to test the effects of fire on weapons components and equipment. Nitrates have been consistently found in a production well used to supply fire-control water to the Burn Site, at concentrations ranging from 8 to 27 mg/L, near or above the 10-mg/L MCL (SNL 1997d). This well is upgradient from Burn Site activities, where it would not be expected to be affected by these activities. A recently completed downgradient well shows the presence of similar concentrations of nitrates. Isotopic analyses performed by SNL/NM indicate that these nitrates are not from septic systems or fertilizers and may be naturally occurring (SNL/NM 1997a). An ongoing investigation is intended to identify the source.

Chemical Waste Landfill

The CWL, located in TA-III, is currently managed in accordance with the *Chemical Waste Landfill Closure Plan*

(DOE 1992d) that was approved in 1993 by the NMED. Although cleanup is underway at the CWL, there is no plan to remove the entire source (DOE 1996c). The primary inorganic and organic contaminants of concern at the CWL are hexavalent chromium (disposed of as chromic acid) and TCE, respectively (DOE 1992d). Both contaminants have been discovered in the groundwater beneath the site at levels above the EPA's drinking water standards of 0.100 and 0.005 mg/L, respectively (SNL 1997d). The released chromium has not reached the water table, although chromium is found in groundwater samples as a result of stainless steel corrosion from the monitoring wells that were installed in 1988 (SNL/NM 1995d). Such dissolution is a well-known phenomenon (Hewitt 1992, Oakley and Korte 1996). Furthermore, if the chromium in the aquifer were a result of vertical transport of the CWL contamination, chromium contamination would be continuously seen in the vadose zone down to the water table. Chromium contamination is not found in the lower 410 ft of the vadose zone.

Groundwater Quantity

Little moisture is available for groundwater recharge from direct precipitation on the site. Recharge estimates range from 0.004 to 0.1 inch per year. Local groundwater recharge is associated primarily with infiltration of arroyo water during short-term storm events. Water supply wells (in the Santa Fe Group) for the city of Albuquerque and KAFB are near the northern boundary of KAFB (Figure 4.6–3). Pumping from these wells and others throughout the Albuquerque-Belen Basin results in groundwater withdrawal exceeding recharge. The 1996 KAFB withdrawal was 1.16 B gal; some of the nearby city well fields pump considerably more than this amount (SNL/NM 1997a).

An excess of withdrawal over recharge results in a continuing decline in groundwater levels beneath the site. In HR-1, groundwater levels have been declining at rates of 0.2 to 3.0 ft per year. During the 12-year period from 1985 through 1996, water levels declined by more than 35 ft in the extreme northwestern portion of KAFB (Figure 4.6–5). At KAFB, the rates of drawdown are greatest westward from the fault zone and northward near the water-supply wells. Water levels in HR-2 and HR-3 have not been affected by water supply production in HR-1 (SNL/NM 1997a).

A shallow groundwater system underlies TA-II and TA-IV at approximately 300 ft below the ground surface. Groundwater within this system perches on a relatively impermeable layer of sediments above the Albuquerque-Belen Basin aquifer. Relatively shallow groundwater also underlies the Tijeras Arroyo Golf Course, about 1.5 mi east of TA-II. Water levels in this area are rising at a rate of 2 ft per year, most likely because of golf course watering. Existing information is insufficient to determine whether this shallow zone is connected to the regional Albuquerque-Belen Basin aquifer (SNL/NM 1997a).

Water level declines in the Albuquerque-Belen Basin as a whole mirror those in HR-1. Estimates of basin-wide declines range from 20 to 160 ft since the 1960s, when significant increases in groundwater withdrawal began (SNL/NM 1997a).

4.6.2 Surface Water

4.6.2.1 Definition of Resource

The surface water system on KAFB is a reflection of the dry high-desert climate of the area. Surface water flows through several major and many small unnamed arroyos, primarily during summer thunderstorms (July through September). With the exception of flow from one spring, there are no perennial streams or other surface water bodies at KAFB. As an example of how infrequently water flows in the arroyos, flow was detected at the lowermost Tijeras Arroyo monitoring station on only 28 days during the 4-year period from 1992 through 1995. Floodplains occur next to the major arroyos; however, their areas are small in comparison to the size of KAFB (Figure 4.6–6). Wetlands are present only in the immediate vicinity of several springs in the Manzanita Mountains.

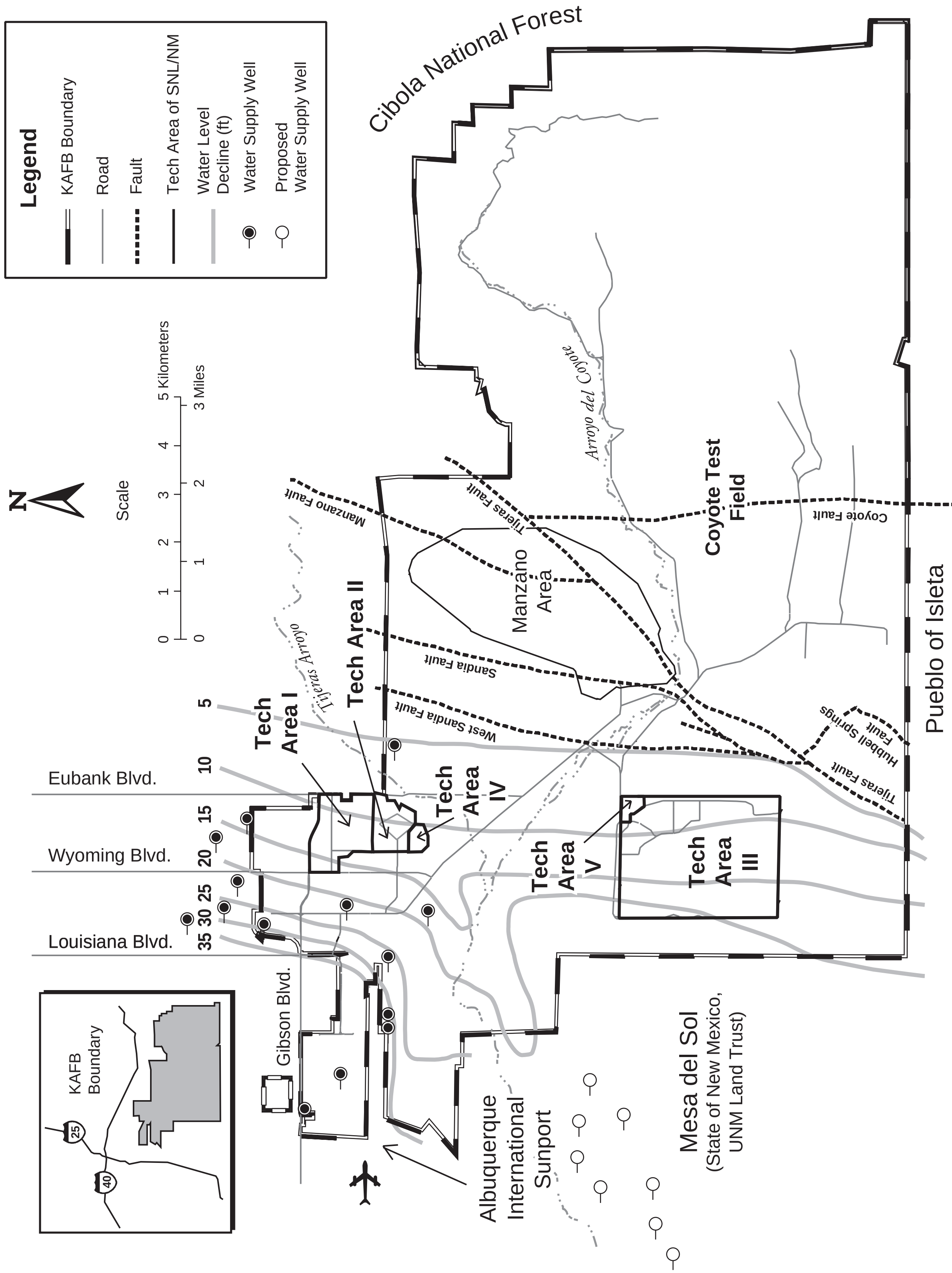
4.6.2.2 Region of Influence

The ROI for surface water is onsite arroyos and the watershed downstream from KAFB, which consists of Tijeras Arroyo, extending from the western KAFB boundary to the Rio Grande, and the Rio Grande downstream from Tijeras Arroyo. Surface water flowing in arroyos and subject to SNL/NM influences can affect KAFB and downstream resources and users. Surface water in Tijeras Arroyo flows through public and private lands west of KAFB before discharging into the Rio Grande.

4.6.2.3 Affected Environment

Major Arroyos

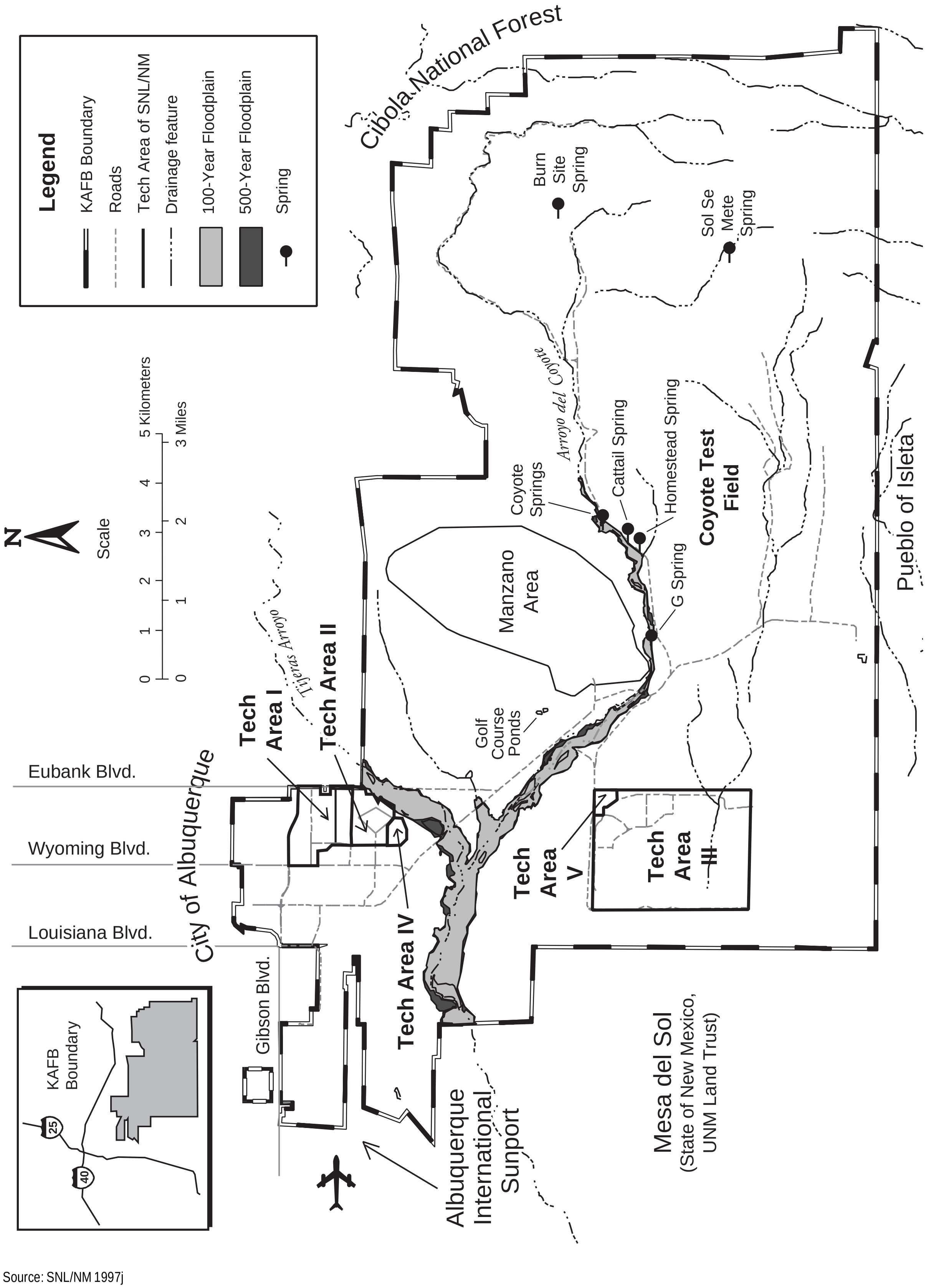
The major surface drainages at SNL/NM are Tijeras Arroyo and Arroyo del Coyote (Figure 4.6–6). With the



Sources: SNL/NM 1997a, 1997j; NMSLO 1997

Figure 4.6–5. Decline in Water Levels from 1985 through 1996

During the period from 1985 through 1996, groundwater levels in parts of KAFB declined by more than 35 ft.



Source: SNL/NM 1997j

Figure 4.6–6. Arroyos, Floodplains, and Springs at KAFB

Surface water flows through several major and many small unnamed arroyos, primarily during summer thunderstorms.

exception of two short sections of channel with intermittent flow (fed by springs), these drainages flow only during storm events.

Tijeras Arroyo is the primary drainage feature on KAFB. Above the point where Tijeras Arroyo enters KAFB, it drains approximately 80 mi^2; at the point where it exits, the drainage area encompasses approximately 122 mi^2. Tijeras Arroyo is the only substantial outlet for surface water exiting KAFB; this arroyo joins the Rio Grande approximately 6 mi downstream of the KAFB boundary.

Arroyo del Coyote joins Tijeras Arroyo approximately 2 mi upstream of where Tijeras Arroyo leaves KAFB, and drains approximately 39 mi^2.

Several unnamed arroyos and drainages to the south of Arroyo del Coyote dissipate as the topographic relief decreases to the west. Storm water in this area either evaporates or infiltrates into the soil; therefore, there is no hydrologic surface connection from these areas to Tijeras Arroyo or the Rio Grande.

Floodplains and Wetlands

Floods and runoff occur most commonly during the summer thunderstorm season (July through September) when approximately 50 percent of the average annual rainfall occurs. Snow in the Manzanita Mountains can produce local runoff that rarely reaches the lower portions of the arroyos or the Rio Grande. Figure 4.6–6 shows the 100- and 500-year floodplains. Note that 100-year floodplains identified in TA-I (DOE 1996c) are not shown on Figure 4.6–6. These are narrow floodplains confined to existing drainage channels and several low-lying streets and vacant areas.

Wetlands on KAFB are associated with several springs, all within the Arroyo del Coyote drainage (Figure 4.6–6). Two of these springs, Coyote Springs and Sol Se Mete Spring, flow year-round. G-Spring, Burn Site Spring, Cattail Spring, and Homestead Spring are intermittent (SNL 1997d). The water originating at springs on KAFB travels only a short distance before infiltrating the soil. Associated wetlands (if any) are smaller than 1 ac (Section 4.7.3.2). Only the Burn Site Spring is under SNL/NM control.

No floodplain/wetlands impacts were identified for the SWEIS for which a floodplain/wetlands assessment is required under 10 CFR Part 1022.

Surface Water Quality – Storm Water Runoff

Water flowing in arroyos is subject to the quality standards listed in 20 New Mexico Administrative Code (NMAC) 6.1, *State of New Mexico Standards for Interstate and Intrastate Streams* (NMWQCC 1994). This regulation includes a set of general standards, applicable to all surface water in the state (including ephemeral streams) and additional or more stringent standards for designated bodies of water. They include criteria within the KAFB boundary for stream bottom deposits; floating solids, oil, and grease; color; odor and taste of fish; plant nutrients; toxic substances; radioactivity; pathogens; temperature; turbidity; salinity; and dissolved gases. For "non-classified" waters, such as the arroyos on KAFB, livestock watering and wildlife habitat standards apply. Livestock watering standards are the most stringent, with numeric standards for 12 metals, radium-226/-228, tritium, and gross alpha.

New Mexico standards also apply to the Rio Grande from the Alameda Bridge (14 mi upstream of the Albuquerque sewage treatment plant) to the headwaters of Elephant Butte Reservoir (120 mi downstream of Tijeras Arroyo). The designated uses of this water are irrigation, limited warm water fishery, livestock watering, wildlife habitat, and secondary contact. Additional water quality criteria cover pH, temperature, fecal coliform bacteria, total dissolved solids, sulfate, and chloride.

The Rio Grande flows through the Pueblo of Isleta, beginning 6 mi downstream from the confluence with Tijeras Arroyo. The Pueblo of Isleta has designated surface water quality standards (Isleta Pueblo 1992) that parallel the New Mexico standards for many quality indicators. However, Pueblo of Isleta standards are generally more specific (quantitative measures rather than qualitative criteria for oil and grease, color, plant nutrients, and turbidity) and stricter (for example, a fecal coliform limit of 100 colonies/100 ml versus 1,000 colonies/100 ml). The stricter criteria stem from additional designated uses of the Rio Grande, which are "primary contact" and "primary contact-ceremonial."

SNL/NM's discharge to arroyos is limited to runoff during storm events. Storm water from TAs-I, -II, and -IV is collected in storm sewer systems that discharge to Tijeras Arroyo. There is no discharge from TAs-III and -V because of evaporation and infiltration of storm water into the air and ground.

Potential Sources of Runoff Contamination

Environmental Restoration Project Sites

A few ER sites are located adjacent to arroyos. In July 1997, a heavy storm washed DU into the soil outside the boundary of an ER site. (This event was documented in the Occurrence Reporting and Processing System [ORPS] Report number ALO-KO-SNL-6000-1997-0006 and reported to the state [SNL 1997a].) However, past sampling activities have not shown clear evidence of contamination in local surface runoff water. Samples taken from SNL/NM operational sites in the upper Arroyo del Coyote showed higher levels of aluminum, magnesium, and copper compared to samples taken upstream of the sites, but none of these constituents has been associated with SNL/NM activities or ER sites in the area (SNL 1995c).

Permitted Storm Water Discharge

SNL/NM monitors storm water runoff from TAs-I, -II, and -IV for compliance with National Pollutant Discharge Elimination System (NPDES) permits. Sampling conducted in 1995 and 1996 show four exceedances of the New Mexico Maximum Allowable Concentrations (MACs). Manganese was detected above the 0.2-mg/L MAC on three occasions (twice at 0.24 mg/L, and once at 0.57 mg/L). Barium was detected above the 1.0-mg/L MAC on one occasion (1.1 mg/L); this concentration may be naturally occurring. No exceedances of radionuclides, organics, or other metals were detected. The concentrations of manganese noted are likely the result of high natural concentrations in KAFB soils (SNL/NM 1996e).

Outdoor Testing Facilities

Radioactive materials could be released to the ground during outdoor testing activities conducted in TA-III and the Coyote Test Field (SNL/NM 1998a). Only facilities in the Coyote Test Field have a defined surface water drainage path to Tijeras Arroyo. SNL/NM sampling in Tijeras Arroyo has shown only trace amounts of the sampled radionuclides, uranium-233/234, -235, and -238; thorium-228, -230, and -232; and strontium-90 (Appendix B). These concentrations are consistent with estimates of background levels for surface water (SNL/NM 1996g).

Surface Water Monitoring Data

During storm events in 1994 and 1995, SNL/NM collected 32 surface water samples from onsite arroyos (Figure 4.6-7, Table 4.6–2). Not all samples were analyzed for all constituents. Most constituents of concern, which include dissolved metals, explosives, and radionuclides, were found only at trace concentrations (SNL/NM 1996g). Only aluminum was detected above applicable standards in any of the samples (5 of 29 samples analyzed). Three of these samples, including the sample with the highest aluminum concentration (41.4 mg/L), were collected from tributaries of the Arroyo del Coyote in the Withdrawn Area. These sampling locations are upstream of SNL/NM facilities, indicating that aluminum at these concentrations is naturally occurring.

Surface Water Quality - Wastewater

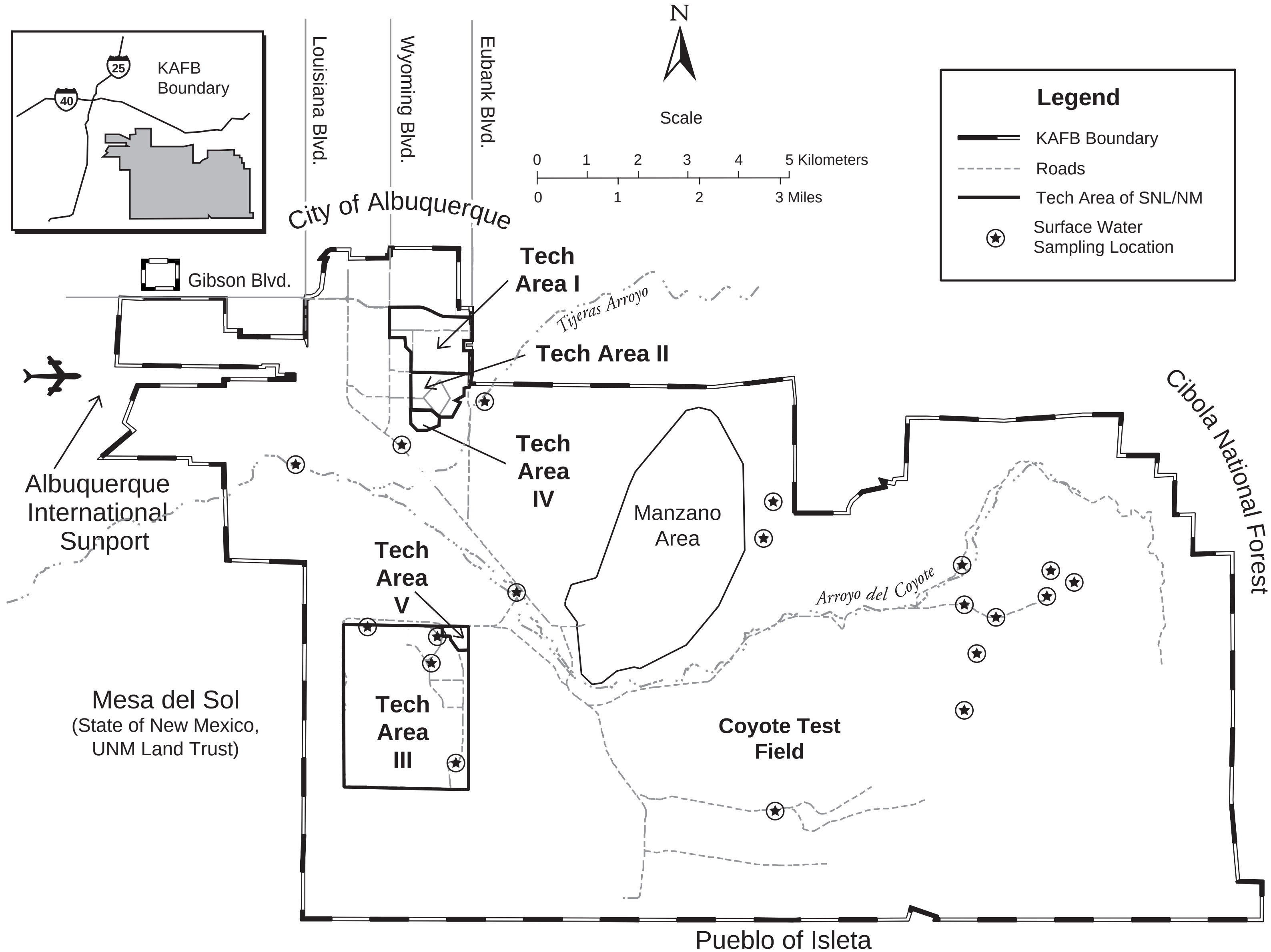
SNL/NM discharges both sanitary and industrial effluents into the Albuquerque sanitary sewer system. Sanitary effluents include wastewater from restrooms and cafeterias and from other domestic activities. Industrial discharges originate from laboratory processes, general manufacturing, and experimental activities. SNL/NM actively monitors compliance with discharge permits (see Section 7.3.4.1) and policies that allow no direct disposal of hazardous chemicals or radioactive materials into the sewer system.

As part of the wastewater management program, SNL/NM also maintains a small number of septic systems (at remote facilities) that are periodically pumped and discharged by certified pumping contractors. Contents are sampled before pumping to ensure that the sewage meets regulatory criteria. SNL/NM submits wastewater permit applications, which detail potential pollutant sources and the raw materials used in industrial processes, to the city of Albuquerque. To ensure compliance with the discharge limits stated on each city permit, SNL/NM conducts monthly sampling at each general outfall monitoring station and continuous monitoring of pH and water flow at all permitted stations.

During 1996, SNL/NM reported two permit violations for all wastewater discharges (both pH exceedances lasted a total of 4.5 hrs). No violations were reported for 1995 (SNL 1996a).

Surface Water Quantity

The quantity of surface water flow depends on the nature of both the drainage area (soil characteristics, slope, and vegetation) and the storm event (intensity and duration). Flow data for the arroyos is limited; only one stream gauge was in place before 1994.



Sources: SNL 1995c; SNL/NM 1997j

Figure 4.6–7. Locations of Surface Water Samples Collected During 1994 and 1995

Thirty-two surface water samples were collected from nineteen locations at KAFB during 1994 and 1995.

Table 4.6–2. Summary of Surface Water Quality Data Collected by the Site-Wide Hydrogeologic Characterization Project (1994 and 1995)

ANALYTE	SAMPLES ANALYZED	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	MEAN DETECT	MEDIAN DETECT	STANDARD[a]
METALS (mg/L)							
Silver	29	2	ND	0.0061	0.00485	0.00485	NA
Aluminum	29	21	ND	41.4	4.93	1.7	5.0
Arsenic	29	1	ND	0.016	0.016	0.016	0.2
Barium	29	20	ND	3.9	0.53	0.22	NA
Beryllium	29	3	ND	0.0091	0.0062	0.0056	NA
Calcium	29	18	ND	1,690	205	51.65	NA
Cadmium	29	1	ND	0.0056	0.0056	0.0056	0.05
Cobalt	29	8	ND	0.021	0.0096	0.0084	1.0
Chromium	29	0	NA	NA	NA	NA	1.0
Copper	29	16	ND	0.096	0.022	0.0135	0.5
Iron	29	19	ND	23.2	2.21	0.82	NA
Mercury	29	3	ND	0.0003	0.00019	0.00016	0.01
Potassium	18	17	ND	14.9	4.94	4.3	NA
Magnesium	29	26	ND	20.4	4.44	3.5	NA
Manganese	29	18	ND	2.6	0.54	0.27	NA
Sodium	19	10	ND	11.3	3.28	2.6	NA
Nickel	29	10	ND	0.054	0.019	0.00965	NA
Lead	29	15	ND	0.04	0.015	0.011	0.1
Antimony	29	0	NA	NA	NA	NA	NA
Selenium	29	3	ND	0.012	0.0076	0.0057	0.05
Tin	10	0	NA	NA	NA	NA	NA
Thallium	29	3	ND	0.011	0.0086	0.011	NA
Vanadium	29	19	ND	0.081	0.024	0.016	0.1
Zinc	28	18	ND	0.24	0.087	0.059	25.0
EXPLOSIVES (µg/L)							
1, 3-DNB	16	0	ND	ND	NA	NA	NA
HMX	16	0	ND	ND	NA	NA	NA
Nitrobenzene	16	0	ND	ND	NA	NA	NA
RDX	16	0	ND	ND	NA	NA	NA

Table 4.6–2. Summary of Surface Water Quality Data Collected by the Site-Wide Hydrogeologic Characterization Project (1994 and 1995) (concluded)

ANALYTE	SAMPLES ANALYZED	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	MEAN DETECT	MEDIAN DETECT	STANDARD[a]
EXPLOSIVES (µg/L)							
Tetryl	16	2	ND	1.9	1.25	1.25	NA
2,6-DNT	16	0	NA	NA	NA	NA	NA
2,4-DNT	15	0	NA	NA	NA	NA	NA
2,4,6-TNT	16	2	ND	0.11	0.087	0.087	NA
2-Amino-4,6-DNT	16	5	ND	0.28	0.091	0.038	NA
4-Amino-2,6-DNT	16	0	NA	NA	NA	NA	NA
1,3,5-TNB	16	0	NA	NA	NA	NA	NA
RADIONUCLIDES (pCi/L)							
Uranium-233/234	26	26	0.17	22	4.38	1.415	NA
Uranium-235	26	19	ND	0.98	0.25	0.13	NA
Uranium-238	26	25	ND	42	4.77	1.1	NA
Thorium-228	10	6	ND	4.81	1.61	1.46	NA
Thorium-230	26	25	ND	27	5.04	1.2	NA
Thorium-232	26	18	ND	24	5.73	2.6	NA
Strontium-90	23	23	0.26	19	3.12	1.7	NA

Sources: SNL 1995c, SNL/NM 1996g
µg/L: micrograms per liter
DNB: Dinitrobenzene
DNT: Dinitrotoluene
HMX: High Melt Explosive
mg/L: milligrams per liter
NA: not applicable
ND: not detected
pCi/L: picocuries per liter
RDX: Research Development Explosive
TNB: Trinitrobenzene
TNT: Trinitrotoluene
[a] Most stringent standard for designated use from 20 NMAC 6.1 (NMWQCC 1994)

SNL/NM activities affect surface water quantity in two ways: storm water runoff from SNL/NM facilities and discharge of process and sanitary water to the Albuquerque sewage treatment plant.

Storm Water Runoff

Parking lots, buildings, and other activities that have altered the natural vegetation or topography have affected the quantity of storm water runoff. Increases in the amount of storm water runoff from SNL/NM activities are due to the replacement of natural surfaces (soil and desert vegetation) with more impervious surfaces (primarily buildings and parking lots). Runoff to arroyos is more likely to occur from impervious surfaces, either directly or through storm sewers. The greatest areal extent of paved surfaces and buildings is in TA-I, which contains the densest population of SNL/NM employees.

Discharge to Sanitary Sewer

SNL/NM discharges approximately 770,000 gal of water per day to the sanitary sewer, the result of manufacturing activities and sanitary water used in SNL/NM facilities (SNL/NM 1997a). This water flows to the Albuquerque sewage treatment plant, where it is treated along with other sewage from the city. The treated water is discharged to the Rio Grande, about 0.7 mi north of Tijeras Arroyo. The discharged water must meet Federal and state quality standards.

4.7 BIOLOGICAL AND ECOLOGICAL RESOURCES

4.7.1 Definition of Resource

Biological resources are the plants and animals that live on or otherwise rely on lands at KAFB and contiguous lands for their continued existence. Biological resources include the habitats where plant and animal species live, as well as the plants, animals, and ecosystems that the Federal and state governments and agencies specifically address as protected or deserving of special consideration in planning and management activities.

4.7.2 Region of Influence

The ROI consists of KAFB, the Withdrawn Area, and the DOE buffer zones adjacent to the southwest corner of KAFB. In addition, it includes the adjacent lands to which animals regularly travel.

4.7.3 Affected Environment

4.7.3.1 Overview

KAFB is located at the juncture of four major North American biological provinces: Great Basin, Rocky Mountains, Great Plains, and Chihuahuan Desert (Brown 1982). Each province influences the existing biological communities. KAFB contains a diversity of biological resources due, in part, to these influences and an elevation change from a low point of approximately 5,200 ft in Tijeras Arroyo to a high point of 7,715 ft at Mt. Washington in the Manzanita Mountains.

Biological data at KAFB have been collected primarily for specific projects (Biggs 1991; IT Corp. 1995; SNL 1994a). Broad-scale studies include sensitive species surveys on KAFB (New Mexico Natural Heritage Program [USAF 1995d]), wetland surveys (USACE 1995), and plant and vertebrate animal inventory of portions of KAFB (SNL/NM 1997a). More extensive information on the biological resources at KAFB is available in the *SNL/NM Environmental Information Document* (SNL/NM 1997a).

4.7.3.2 Biodiversity

At least 267 plant species and 195 animal species occur on KAFB (SNL/NM 1997a). This diversity is due, in part, to the variety of habitats, which include cliff faces, caves, abandoned mines, and drainages, as well as the four major vegetation associations, which are grassland, woodland, riparian, and altered. Restricted access and limited planned development have benefited biological resources at KAFB. The grasslands appear to be of particularly good quality in relation to the region, due to the exclusion of livestock grazing for 50 years (Parmenter & Chavez 1995). The presence of grama grass cactus may be due to this lack of grazing. The state of New Mexico delisted grama grass cactus as endangered in 1995, partially as a result of the populations found during surveys on KAFB (SNL/NM 1997a).

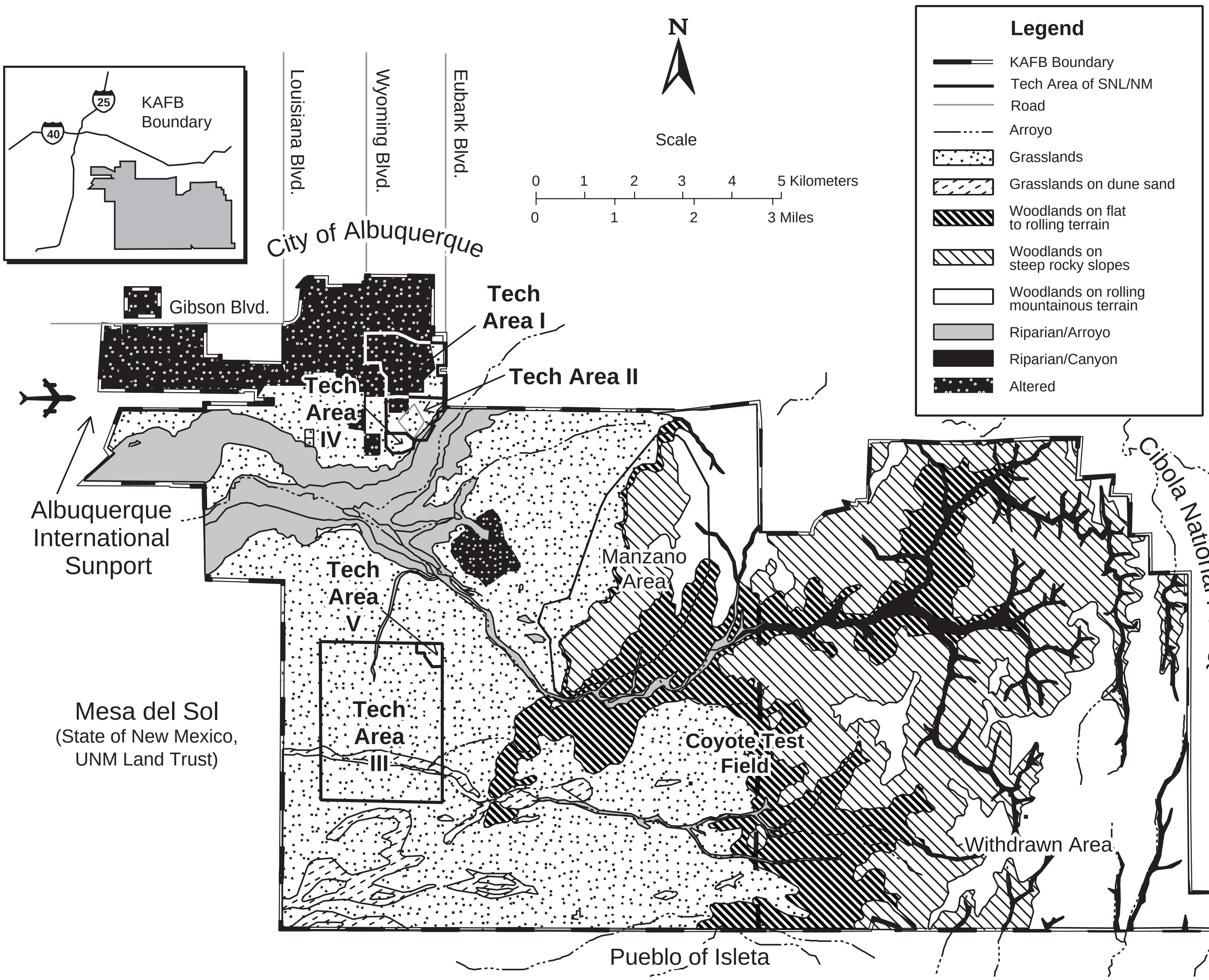
Plants

The four major vegetation associations at KAFB, grassland, woodland, riparian, and altered, are distinct in the form and composition of their vegetation (USAF 1996). Figure 4.7–1 shows the areal extent and location of the major natural vegetation associations on KAFB.

The grassland association occupies the lower alluvial slopes and terrace surfaces of the Rio Grande valley near the city of Albuquerque. It is the dominant vegetation association on KAFB, west of the Withdrawn Area. Coyote Test Field and TAs-I, -II, -III, -IV, and -V are on grasslands. Selected plant species common in the grasslands are listed in Table 4.7–1.

Woodland vegetation occurs primarily on the upper alluvial slopes and mountainous areas of the Withdrawn Area. Species generally found in the 6,000- to 6,200-ft elevation range include one-seed juniper with a groundcover that includes blue grama. Pinyon pine-juniper woodland, at an elevation of 6,200 to 6,500 ft, is characterized by an even mix of pinyon pine and one-seed juniper. The numbers of ponderosa pine have declined since 1850 due to fire suppression practices and climate change (Baisan & Swetnam 1994). Many areas of the woodlands are becoming progressively choked with deadwood and dense thickets of young trees (Baisan & Swetnam 1994).

Isolated, narrow bands of riparian vegetation occur along the surface drainages of KAFB. These drainages are predominantly ephemeral and contain flow only after large rainfall events. Riparian vegetation constitutes less than 5 percent of the area of KAFB. The riparian woodland vegetation is limited primarily to the upper reaches of Arroyo del Coyote and associated drainages. Common riparian plant species are listed in Table 4.7–1. The sites contain dense stands of trees where the water table is close to land surface, such as at G Spring and Coyote Springs. The riparian woodland vegetation is dominated by exotic species, principally salt cedar, which is widespread in the arroyos on KAFB (SNL/NM 1997a). They form dense stands on Arroyo del Coyote at G Spring and near Coyote Springs. Large, mature native



Source: SNL/NM 1997j

Figure 4.7–1. Major Vegetation Associations at KAFB

The diversity of plant and animal species on KAFB is due, in part, to the presence of four major vegetation associations.

Table 4.7–1. Selected Plant Species Common in the Vegetation Associations Occurring on KAFB

COMMON NAME	SCIENTIFIC NAME	VEGETATION ASSOCIATION
Black Grama	*Bouteloua eriopoda*	Grasslands
Blue Grama	*Bouteloua gracilis*	Grasslands
Fourwing Saltbush	*Atriplex canescens*	Grasslands
Galleta	*Hilaria jamesii*	Grasslands
Sand Sagebrush	*Artemisia filifolia*	Grasslands
Apache Plume	*Fallugia paradoxa*	Riparian
Fremont Cottonwood	*Populus fremontii*	Riparian
Salt-Cedar	*Tamarix pentandra*	Riparian
Siberian Elm	*Ulmus pumila*	Riparian
Tree-of-Heaven	*Ailanthus altissima*	Riparian
Gambel Oak	*Quercus gambellii*	Woodlands
Mountain Mahogany	*Cercocarpus montanus*	Woodlands
Pinyon Pine	*Pinus edulis*	Woodlands
Ponderosa Pine	*Pinus ponderosa*	Woodlands
One-Seed Juniper	*Juniperus monosperma*	Woodlands
Wavy-Leaf Oak	*Quercus undulata*	Woodlands
Cattail	*Typha latifolia*	Wetlands
Three-square	*Scirpus americanus*	Wetlands
Torrey Rush	*Juncus torreya*	Wetlands
Wire Rush	*Juncus balticus*	Wetlands
Poplar	*Populus spp.*	Altered
Russian Thistle	*Salsola kali*	Altered
Summer Cypress	*Cupressus arizonica*	Altered

Sources: Parmenter & Chavez 1995; SNL 1997a, 1994a; SNL/NM 1974; USACE 1995

Fremont cottonwood trees occur where there is a sufficient subsurface water supply.

Human development and activities have created altered vegetation associations at KAFB. This vegetation ranges from no vegetative cover to manicured landscapes, such as the golf course. Most of this vegetation consists of nonnative species. Common plant species in altered vegetation are listed in Table 4.7–1.

Aquatic Habitat

Natural spring-fed wetlands form a minor component of the riparian habitat on KAFB and are cumulatively less than 1 acre in size. KAFB has six wetlands, all associated with springs (USACE 1995) (Figure 4.6–6). These wetlands are designated as jurisdictional wetlands under Section 404 of the CWA, because they have the soils, hydrology, and vegetation that meet standard criteria (USACE 1995). The largest wetland is Coyote Springs in Arroyo del Coyote. Two of the wetlands, Sol se Mete and Burn Site Springs, are in the canyons of the Withdrawn Area. Species characteristic of these wetlands include wire rush, three-square, Torrey rush, and cattail (USACE 1995). Only the Burn Site Spring is on land used by SNL/NM. The USFS manages a tank that collects water for wildlife at this spring and Sol se Mete Spring. The USAF administers constructed ponds on KAFB Tijeras Arroyo Golf Course and a constructed lake, Christian Lake, in the southern part of KAFB.

Animals

Each of KAFB's vegetation associations support a distinct assemblage of animal species, which include amphibians, reptiles, birds, and mammals. Each species exhibits specific habitat requirements for food, water, and cover, as well as behaviorally controlled requirements, such as travel corridors (areas through which animals habitually move), breeding site preferences, and sensitivity to human activity. Because of their mobility, bird communities are particularly dynamic. Although some bird species at KAFB are resident throughout the year, many are migratory. They are only present seasonally, breeding, wintering, or traveling between their breeding and wintering grounds.

The most important ecological factor that controls wildlife communities on KAFB is the limited availability of surface water (USAF 1996). Selected common animal species and habitats on KAFB are listed in Table 4.7–2.

Large predators in the woodlands include the mountain lion and the black bear. The mule deer is the only large herbivore known to use KAFB and is also the principal game animal. Grassland-juniper vegetation in the foothills surrounding Lurance Canyon and Sol se Mete Canyon is an important winter range for mule deer (Biggs 1991).

Table 4.7–2. Selected Common Animal Species and Habitats on KAFB

COMMON NAME	SCIENTIFIC NAME	HABITAT TYPE
American Kestrel	*Falco sparvertius*	Grasslands
Coyote	*Canis latrans*	Grasslands
Deer Mouse	*Peromyscus maniculatus*	Grasslands
Desert Cottontail	*Sylvilagus auduboni*	Grasslands
Red-Tailed Hawk	*Buteo jamaicensis*	Grasslands
Whiptail Lizard	*Cnemidophorus spp.*	Grasslands
Ash-Throated Flycatcher	*Myiarchus cinerascens*	Woodlands
Cooper s Hawk	*Accipiter cooperii*	Woodlands
Mule Deer	*Odocoileus hemionus*	Woodlands
Northern Flicker	*Colaptes auratus*	Woodlands
Rock Squirrel	*Spermophilus variegatus*	Woodlands
Scrub Jay	*Aphelocoma coerulescens*	Woodlands
Lark Sparrow	*Chondestes grammacus*	Riparian
Gray Fox	*Urocyon cinereoargenteus*	Riparian
Red-Spotted Toad	*Bufo puntatus*	Riparian
Violet-Green Swallow	*Tachycineta thalassina*	Riparian
Barn Swallow	*Hirundo rustica*	Altered
European Starling	*Sturnus vulgaris*	Altered
House Sparrow	*Passer domesticus*	Altered

Sources: Parmenter & Chavez 1995, SNL 1994a, SNL/NM 1997u, USAF 1995d

Drainages provide a focal point for animals due to greater availability of food, water, and cover generally found along their courses. Diversity is, therefore, generally higher in the riparian habitat, especially where surface water is available. Most large mammal species of the area inhabit the canyons and arroyos. Coyote Springs, for example, attracts mule deer and a large number of bird species.

Drainages and their associated riparian vegetation serve as important wildlife corridors. In the Withdrawn Area, the Madera and Bonita Canyons and ridgelines contain travel corridors. On a regional scale, the Manzanita Mountains are an important migratory bird corridor for neotropical migrants, including several raptor species (SNL/NM 1997a).

Many species favor habitats that are disturbed, altered, or close to human activities. Colonies of Gunnison's prairie dogs (a state sensitive species) occur in the margins of developed areas including roads, housing, runways, and the golf course. On DOE lands, the colonies are limited to TA-I. The burrows in these colonies provide nesting sites for the burrowing owl, a species protected under the *Migratory Bird Treaty Act* (16 U.S.C. §703). The grass, ponds, and variety of trees at KAFB golf course provide a particularly rich haven for animals, including waterfowl and shorebirds.

Exposed cliffs on the west side of the Manzano Mountains provide potential nesting or roosting sites for a wide variety of birds, including raptors such as the golden eagle and peregrine falcon. Both species have been observed in that area; however, no nesting activity for either of these species has been documented. Several abandoned mines in the Manzanita Mountains provide habitat for bats.

4.7.3.3 Threatened, Endangered, and Sensitive Species

There are four agencies that have the authority to designate threatened, endangered, and sensitive species occurring in New Mexico. The agencies are the U.S. Fish and Wildlife Service (USFWS), the New Mexico Game and Fish Department (NMGFD), the New Mexico Forestry and Resource Conservation Division (NMFRCD), and the USFS. The state of New Mexico separates the regulatory authority for plants and animals between the NMFRCD and the NMGFD, respectively. The USFS lists species for special management consideration on USFS lands. The USFWS protects species under the authority of the *Endangered Species Act of 1973* and the *Migratory Bird Treaty Act*, which contains a list of migratory nongame birds for which information exists indicating declining populations. The levels of protection afforded threatened, endangered, and sensitive species on KAFB are defined in Table 4.7–3.

The Pueblo of Isleta recognizes and applies all state and Federal designations of endangered, threatened, and sensitive species to populations that occur on pueblo lands (SNL/NM 1997a). In addition, the Pueblo of Isleta considers all species occurring on pueblo lands to be of cultural importance and, therefore, protected (SNL/NM 1997a).

Plants

Table 4.7–3 lists the threatened, endangered, and sensitive species and habitats on KAFB. One state-listed sensitive plant species, the Santa Fe milkvetch, occurs on the low hills in the southwestern part of KAFB (SNL 1994a). The Strong prickly pear, found near the northern boundary of KAFB, is on the state of New Mexico Rare Plant Review List (Ferguson 1998). One USFS-listed species, the grama grass cactus, is found in areas of the grasslands.

Animals

The peregrine falcon is the only Federally listed threatened or endangered species that may frequent KAFB. A probable sighting near Mt. Washington was likely a migrant (USAF 1995d). No nesting activity of this species has been observed and KAFB contains only marginal nesting habitat (USAF 1995d). No Federally proposed or candidate species occur on KAFB. In 1993, a colony of state-listed threatened gray vireos was discovered in the western foothills of the Withdrawn Area on land controlled by the USAF. This is the largest known concentration of gray vireos in the state of New Mexico (USAF 1995d).

Eight species of concern have been observed on KAFB, in addition to thirteen migratory nongame birds of management concern for the USFWS, Region 2 (Table 4.7–3). These species are protected under the *Migratory Bird Treaty Act* (16 U.S.C. §703).

Four state-listed threatened animal species occur on KAFB (Table 4.7–3). Eleven USFS-listed sensitive animal species have also been observed on KAFB (Table 4.7–3). One of the state-listed sensitive species, Pale Towsend's big-eared bat, has been observed hibernating in two caves (Altenbach 1997).

Table 4.7–3. Threatened, Endangered, and Sensitive Species and their Habitats on KAFB

COMMON NAME	SCIENTIFIC NAME	STATUS	HABITAT
ANIMALS			
Baird s Sparrow	*Ammodramus bairdii*	SC, ST, FSS	Grasslands and moist meadows
Bell s Vireo	*Vireo bellii arizonae*	ST, FSS	Canyons
Black Swift	*Cyseloides niger borealis*	SS	Higher elevations
Desert Massasauga	*Sistrurus catenatus edwardsii*	FSS	Grasslands and arroyos
Ferruginous Hawk	*Buteo regalis*	SC, FSS	Grasslands and open shrublands
Gunnison s Prairie Dog	*Cynomys gunnisoni*	SS	Grasslands
Gray Vireo	*Vireo vicinior*	ST, FSS	Juniper woodlands & shrublands
Loggerhead Shrike	*Lanius ludovicianus*	SC	Shrublands & shrubby grasslands
Pale Townsend s Big-Eared Bat	*Plecotus townsendii pallescens*	SC, SS, FSS	Caves, mines, and rock shelters
Peregrine Falcon	*Falco peregrinus*	FE, ST, FSS	Cliffs, woodlands, and streams
Small-Footed Myotis	*Myotis ciliolabrum*	SC, SS	Caves, rock crevices, and grasslands
Swainson s Hawk	*Buteo swainsonii*	FSS	Grasslands and lower slopes
Texas Horned Lizard	*Phrynosoma cornutum*	SC, FSS	Grasslands and open deserts
Texas Longnose Snake	*Rhinocheilus lecontei*	FSS	Grasslands and arroyos
Western Spotted Skunk	*Spilogale gracilis*	SS	Arroyos, canyons, and rocky slopes
Western Burrowing Owl	*Athene cunicularia hypugea*	SC	Grasslands and open shrublands
White-Faced Ibis	*Plegadis chihi*	SC, FSS	Marshes, ponds, & riparian areas
PLANTS			
Grama Grass Cactus	*Pediocactus papyracanthus*	FSS	Grasslands
Santa Fe Milkvetch	*Astragalus feenis*	NML2 FSS	Limestone hills in grasslands
Strong Prickly Pear	*Opuntia valida*	NML3	Lower elevation hills

Sources: NMDGF 1997; SNL 1994a, b; SNL/NM 1997a; USAF 1995d; USFS 1994; USFWS 1998

FE: Federal Endangered: "… Any species that is in danger of extinction throughout all or a significant portion of its range" (16 U.S.C. Chapter 35).

SC: Federal species of concern: Species for which further biological research and field study are needed to resolve their conservation status (USFS-listed species).

FSS: United States Forest Service Sensitive Species: Species for which population viability is a concern based on current or predicted numbers, density, distribution, or habitat capability.

NML2: New Mexico List 2: Official listing of plant species that are vulnerable to extinction or extirpation within the state due to rarity or restricted distribution, but are not protected under the *New Mexico Endangered Plant Species Act*.

NML3: New Mexico List 3: Official Listing of plant species that are on the New Mexico Rare Plant Review List as species for which more information is needed, but are not protected under the *New Mexico Endangered Plant Species Act*.

ST: State Threatened: New Mexico-listed species protected as threatened under the *Wildlife Conservation Act*.

SS: State Sensitive: New Mexico-listed species: Taxa that, in the opinion of a qualified New Mexico Game and Fish Department biologist, deserve special consideration in management and planning, and are not listed threatened or endangered by the state of New Mexico. These can include taxa that are listed as threatened, endangered, or sensitive by other agencies; taxa with limited protection; and taxa without legal protection. The intent of this category is to alert land managers of the need for management where these taxa could be affected.

4.7.3.4 Biomonitoring

Ecological monitoring of selected biota, including small mammals, birds, reptiles, amphibians, and vegetation, is conducted annually by SNL/NM. Baseline measurements are collected on potential contaminant loads in species as well species density and composition. In 1997, data were collected at two sites: TA-II and a site at the southeastern end of the perimeter fence separating the Pueblo of Isleta and KAFB. Analysis of samples of seven small mammals from these sites did not show any significant radionuclide or metal contamination (SNL/NM 1997u).

4.7.3.5 Ecosystems Management

KAFB is bordered by Cibola National Forest and the Pueblo of Isleta. Sensitive species and other wildlife travel across the management boundaries of the Pueblo of Isleta and the national forest, where biological resources are valued and actively used for recreational, cultural, and aesthetic purposes. Many of the sensitive biological resources on KAFB are on the lands the DOE and the USAF have withdrawn from the USFS (Cibola National Forest). SNL/NM conducts activities on these DOE and USAF lands, but the USFS retains management responsibilities for their natural resources. Management measures are delineated in the *Ecosystem Management Plan for National Forest Lands in and Adjacent to the Military Withdrawal, Sandia Ranger District, Cibola National Forest, Bernalillo County, New Mexico* (USFS 1996) and the 1985 *Cibola National Forest Land and Resource Management Plan,* as amended (USFS 1985). The USFS's emphasis in the Withdrawn Area is to improve wildlife diversity and decrease the threat of an escaped wildfire. USFS fire management practices include thinning vegetation, constructing fuel breaks, and prescribed burning. The USFS has stated that the desired condition for the Withdrawn Area is one in which the public feels that the area is a "special wildlife haven" over which it has stewardship (USFS 1995).

On KAFB, the USAF manages wildlife resources, wetlands, land resources, and outdoor recreation through guidance outlined in the *Integrated Natural Resources Management Plan, Kirtland Air Force Base, New Mexico* (USAF 1995).

4.8 CULTURAL RESOURCES

4.8.1 Definition of Resource

Cultural resources are prehistoric or historic sites, buildings, structures, districts, or other places or objects considered to be important to a culture, subculture, or community for scientific, traditional, or religious purposes, or for any other reason. Cultural resources primarily addressed in the SWEIS are those that have been recommended as or determined to be eligible or potentially eligible for inclusion in the National Register of Historic Places (NRHP) and those that are Traditional Cultural Properties (TCPs). TCPs are places or objects that have religious, sacred, or cultural value for a particular cultural group. In order to be included in the NRHP, a resource must meet one or more of the following criteria (36 Code of Federal Regulations [CFR] Part 60):

- Criterion A—Associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B—Associated with the lives of persons significant in our past.
- Criterion C—Embodies the distinctive characteristics of a type, period, or method of construction.
- Criterion D—Yielded or may be likely to yield information important in prehistory or history.

The resource must also retain most, if not all, of seven aspects of integrity: location, design, setting, workmanship, material, feeling, and association.

Cultural resources considered in the SWEIS are divided into three categories. The first is prehistoric archaeological sites, which in the Albuquerque area date to before A.D. 1540, when Francisco Vasquez de Coronado and his expedition arrived in the middle Rio Grande valley and initiated Spanish exploration of the area. The second category, historic sites, includes archaeological sites as well as buildings and structures dating from A.D. 1540 to 1948. Based on the standards of the National Park Service (NPS), the cutoff date for being categorized as a historic resource is 50 years in age, which provides the historical perspective necessary to evaluate significance. However, this category also includes younger resources (post-1948) that have been recommended as *exceptionally significant* within one of the criteria. The third category consists of TCPs. TCPs can include resources that fall within the previous two categories.

4.8.2 Region of Influence

The ROI includes KAFB and the DOE buffer zones adjacent to the southwest corner of KAFB. The resources include those already identified, as well as those that have not yet been identified, such as buried archeological sites, TCPs, and unassessed resources. The ROI is further refined into areas of potential effect to cultural resources for the various activities performed at SNL/NM use areas.

4.8.3 Affected Environment

4.8.3.1 Overview of Cultural Resource Inventories and Sites

SNL/NM is located along the middle Rio Grande valley. The valley has been consistently inhabited for thousands of years, and contains present-day Puebloan cultural groups who have ancestral ties to the area. Archaeological resources and TCPs hold important roles within the traditional cultures of these groups and of groups that are farther away. These resources are not just contained in the groups' traditions and oral histories, but play an active part in continuing a way of life that has been in existence since the groups' origins. Cultural resources are also important to the scientific community and to the general public as a key to understanding the vast prehistory and history of this region.

Since the first documented survey in 1936, well before the establishment of KAFB, both KAFB and the DOE buffer zones have been the subject of cultural resource studies (Figure 4.8–1). Over 160 cultural resource investigations, reports, and studies have been conducted, most in the last 10 years. While many of these studies are extremely limited in scope, others are broad and apply to the entire KAFB. Approximately 75 percent of the ROI has been studied for cultural resources (Trierweiler 1998, SNL/NM 1997a).

Within the boundaries of KAFB and the DOE buffer zone, 284 prehistoric and historic archaeological sites have been recorded, of which 192 have been recommended as eligible or potentially eligible for the NRHP. The resources range from prehistoric Native American campsites to historic Euro-American placer mining pits. Of the prehistoric archaeological sites, campsites are the most common, followed by sites of limited activity (such as stone tool production), then habitations. Of the historic sites, mining sites are the most common, followed by habitations, then sites related to agriculture and ranching, then small, isolated trash scatters (Trierweiler 1998).

Five hundred seventy-nine architectural properties have been recorded and assessed for NRHP eligibility within KAFB boundaries, of which nine individual properties have been recommended as eligible or potentially eligible for the NRHP (Trierweiler 1998; USAF 1998a; Tuttle 1998). Most of them were recorded by the 377th Air Base Wing of KAFB, under the auspices of the U.S. Department of Defense (DoD) Legacy Program, and are on KAFB lands. Few of these properties predate World War II, and most were constructed during the 1940s and 1950s (Trierweiler 1998). In addition, the architectural properties in TA-II, as a group, are eligible to the NRHP as a district. A more detailed discussion of the cultural resources at KAFB is provided in Appendix C.

Unidentified Sites

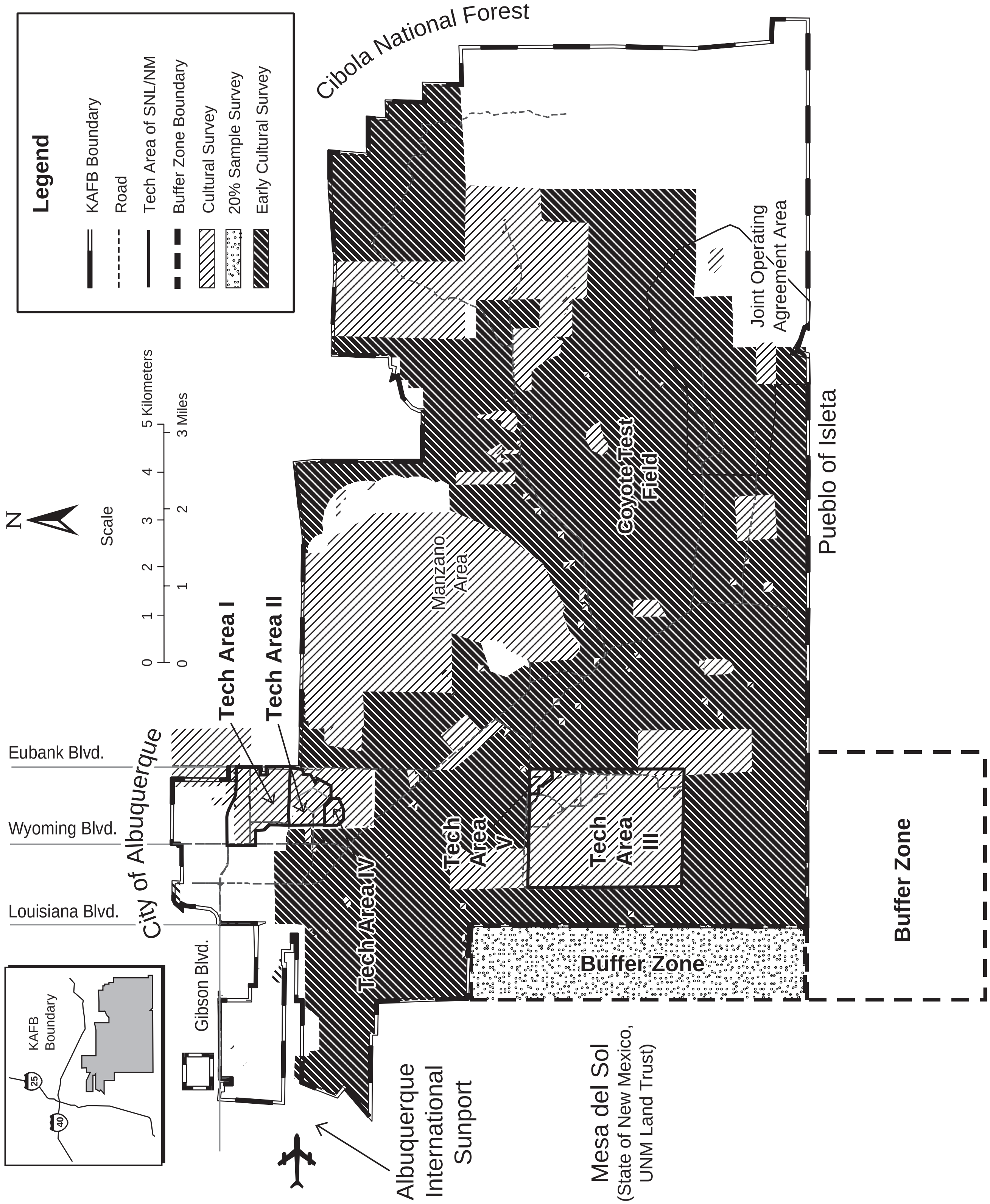
Despite the large number of cultural resource inventories conducted on KAFB, cultural resources probably exist that have not yet been identified or recorded. Even in areas that have been inventoried, data collected on resource locations could be incomplete due to human error or conditions such as heavy vegetation cover, which can seriously affect the ability to see sites on the ground. In addition, archaeological sites may be buried (Frederick 1992, Frederick & Williamson 1997, Larson et al. 1998, Abbott et al. 1997, Doleman 1989).

Settlement Patterns

Previous archaeological research on KAFB indicates definite patterns in the location and densities of cultural resources on KAFB (Figure 4.8–2). These patterns can be used to predict if sites are likely to exist in an area and, if so, their probable density. Known archaeological sites on KAFB are primarily concentrated in four areas. Two areas along Arroyo del Coyote contain the largest concentrations of sites: one in the area southeast of the Manzano Area and the other in the Withdrawn Area near the headwaters of Arroyo del Coyote, where tributaries from the mountains flow into Coyote Canyon. A third concentration of sites is in the southwest corner of the Withdrawn Area in the upper elevations. Finally, a smaller concentration of sites is found along Tijeras Arroyo in the northwest portion of KAFB.

4.8.3.2 Cultural Resource Protection in the ROI

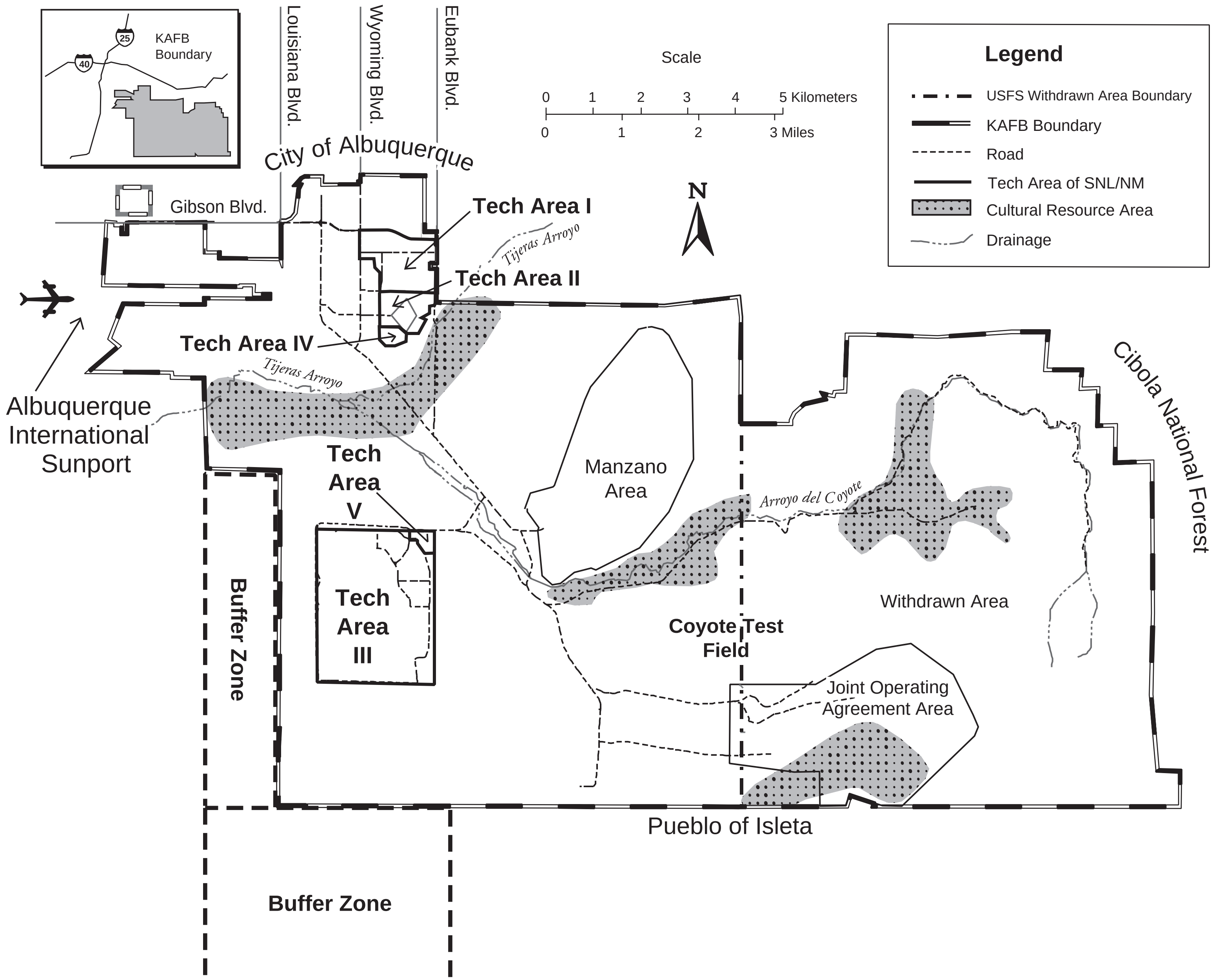
Because activities within KAFB are conducted by Federal agencies, contractors to Federal agencies, and private entities under agreement with Federal agencies, there are a number of laws, regulations, and executive orders applicable to Federal agencies that protect cultural



Source: SNL/NM 1997j

Figure 4.8–1. Areas Inventoried for Cultural Resources in KAFB and the DOE Buffer Zones

Over 160 cultural resource studies have been conducted on KAFB and the DOE Buffer Zones.



Source: SNL/NM 1997j

Figure 4.8–2. Areas With a Concentration of Archaeological Sites on KAFB and the DOE Buffer Zone

Known archaeological sites on KAFB are primarily concentrated in four areas.

resources and access to resources that are sacred or ceremonial sites on KAFB (see Chapter 7). Each of the agencies in the ROI (DOE, USAF, and USFS) has implementing policies and procedures that follow these regulations. In addition, there are personnel assigned within each agency with responsibility for overseeing compliance with the policies and procedures implemented by their respective agencies. Proposed undertakings in the ROI undergo review by the responsible Federal agency to determine if eligible cultural resources could be effected by the undertaking. Consultations between the agencies and the New Mexico State Historic Preservation Officer (SHPO) take place as required. Agencies and the SHPO consult on measures that can be implemented to mitigate or avoid any potential adverse effects.

4.8.3.3 Cultural Resources by Land Use Type

KAFB Lands Owned by the DOE and Used by SNL/NM

TAs-I through -V have been completely inventoried for archaeological sites (both prehistoric and historic) (Hoagland 1990 a,b,c,d,e; Lord 1990). Although TAs-II and -IV are in an area that likely contains sites (adjacent to Tijeras Arroyo), aside from isolated occurrences of artifacts, no prehistoric or historic archaeological sites have been identified there. The vast majority of buildings and structures used by SNL/NM are less than 50 years old, and thus have not been assessed for eligibility for inclusion in the NRHP. Assessments have not been conducted for buildings and structures in TAs-III, -IV, and -V; thus, their eligibility to the NRHP is unknown. Fifty-two buildings in TA-I were assessed and determined to be ineligible (Hoagland 1991, 1993; Sebastian 1993; Merlan 1993). The remaining buildings and structures in that area have not been assessed due to their young age. As the buildings in the four TAs attain the 50-year mark, the DOE will assess them for eligibility for inclusion in the NRHP (Merlan 1991). TA-II has been determined to be eligible to the NRHP as a district, with most of the larger buildings contributing to that status (DOE 1998o).

The DOE is responsible for the cultural resources contained in these TAs and has adopted implementing policies and guidelines that address the management of cultural resources. The DOE does not have a cultural resource management plan for the land it owns on KAFB due to the paucity of sites on these lands.

Other KAFB Lands Used by SNL/NM Through Land Use Agreements

A number of cultural resource inventories on KAFB have included areas used by SNL/NM through various land use agreements with the USAF and the USFS. These areas have been completely surveyed for cultural resources, except for the southeastern one-third of the Joint Operating Agreement Area (Starfire Optical Range) (Figure 4.8–1). In the areas that have been inventoried, archaeological sites are frequent only in the areas coinciding with the settlement patterns discussed previously, such as the Joint Use Agreement Area (uplands), the DOE Withdrawn Area used by SNL/NM as a buffer for the Lurance Canyon Burn Site (near a tributary to Arroyo del Coyote), and the DOE permit area along Arroyo del Coyote. The unsurveyed portion of the Joint Use Agreement Area is likely to contain sites based on the high density of sites located in the adjacent inventoried areas. No building or structure assessments have been conducted in these areas.

Responsibility for managing the cultural resources contained in these areas falls to the agency that owns the specific parcel of land, though the land use agreements usually stipulate that the DOE must conduct the necessary studies to determine if an area scheduled for DOE activities contains cultural resources. For KAFB areas permitted to the DOE, the guidelines and policies of the USAF direct managing cultural resources in concert with the KAFB cultural resource management plan (Trierweiler 1998). For the entire Withdrawn Area, the management of cultural resources follows the policies and procedures of the USFS, along with the guidelines presented in the *Cibola National Forest Land and Resource Management Plan* (USFS 1985). The DOE and the USFS have two separate memorandums of agreement (dated May 15, 1989, and January 22, 1987) that address agency responsibilities on portions of the Withdrawn Area.

The DOE Buffer Zones Used by SNL/NM

SNL/NM uses two areas outside and adjacent to the KAFB boundary. These areas, leased from the state of New Mexico and the Pueblo of Isleta, comprise the DOE buffer zones. The land leased from the state of New Mexico has undergone a 20-percent cultural resource sample inventory (Doleman 1989). This inventory identified three archaeological sites within the leased area, one of which is eligible to the NRHP and the other two are potentially eligible. The land leased from the Pueblo of Isleta has not undergone a cultural resource inventory and no cultural resources are currently known in this area (Geister 1998). Based on the settlement patterns evident on adjacent KAFB areas, a low density of archaeological sites in both these areas is expected. No building or structure assessments have been conducted on either leased area. Responsibility for the cultural resources in these areas is retained by the land-owning agencies (state of New Mexico or Pueblo of Isleta/BIA).

KAFB Lands Not Used by SNL/NM

Cultural resource inventories conducted on KAFB have also included areas not used by SNL/NM. Locations of archaeological sites in these areas follow the settlement patterns discussed previously, such as along Tijeras Arroyo, Arroyo del Coyote, and in the uplands near the Joint Use Agreement Area. Some inventories assessed the eligibility of certain buildings and structures. Of these areas, the DOE is responsible only for those areas owned by the DOE (Table 4.3–1), which may be used by, permitted to, or out-granted to other agencies.

4.8.3.4 Traditional Cultural Properties

A TCP is a place or object that is significant to a particular living community. This significance is "derived from the role the TCP plays in the community's historically rooted beliefs, customs, and practices" (NPS 1990). TCPs are associated with the cultural practices and beliefs that are rooted in a community's history and important in maintaining the cultural identity of the community.

A TCP study is being conducted for the purposes of the SWEIS. Consultations are being held with 15 Native American tribes with a cultural interest in the area to determine the presence of cultural properties significant to them within the ROI (Appendix C). Consultations have been completed with 8 of the 15 tribes, and are ongoing with the remaining 7 tribes. No specific TCPs have yet been identified through these consultations and no TCPs are currently known to exist within the ROI. Although no specific locations have been identified during these consultations, some tribes have stated that they have concerns for cultural sites in the ROI that are important to them. A more detailed discussion of the TCP study methods and results can be found in Appendix C.

4.9 AIR QUALITY

4.9.1 Nonradiological Air Quality

4.9.1.1 Definition of Resource

Ambient air quality is determined by measuring or modeling ambient pollutant concentrations and comparing the concentrations to the corresponding standards. As directed by the *Clean Air Act* (CAA) of 1970 (42 U.S.C.§7401), the EPA has set the National Ambient Air Quality Standards (NAAQS) for several criteria pollutants to protect human health and welfare (40 CFR Part 50). These pollutants include particulate matter less than 10 microns in diameter (PM_{10}), sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, and ozone. As of September 16, 1997, a new NAAQS became effective for particulate matter with a size classification defined as less than or equal to 2.5 microns in diameter ($PM_{2.5}$). This new standard is in addition to the PM_{10} NAAQS. It is estimated that the new $PM_{2.5}$ standard will not require local area controls until about 2005 and that compliance determinations will not be required until around 2008.

On June 5, 1998, SNL became subject to a new 8-hour, 0.08-ppm ozone standard, replacing the previous 1-hour, 0.12-ppm ozone standard (63 FR 31034). In the year 2000, the EPA will designate areas that do not meet the 8-hour standard based on the most recently available 3 years of ozone data available at that time (that is, 1997 through 1999).

A primary NAAQS has been established for carbon monoxide, and both primary and secondary standards have been established for the remaining criteria pollutants. Primary NAAQS define levels of air quality judged necessary, with an adequate margin of safety, to protect public health. Secondary NAAQS define levels of air quality judged necessary to protect public welfare from any known or anticipated adverse effects of a pollutant.

Air quality for SNL/NM is governed by regulations promulgated locally by the Albuquerque/Bernalillo County Air Quality Control Board (A/BC AQCB) and Federally by the EPA. The EPA has delegated authority for regulating sources under the CAA to the state of New Mexico. In turn, the state of New Mexico has delegated authority for regulating sources to the A/BC AQCB, located in Bernalillo county.

The A/BC AQCB promulgates regulations in 20 NMAC 11 for compliance with the CAA, as well as applicable state and local air quality requirements. The Albuquerque Environmental Health Department (AEHD) Air Pollution Control Division (APCD) administers the regulations promulgated by the A/BC AQCB (SNL/NM 1997a). The New Mexico Environmental Improvement Board (NMEIB) has established ambient air quality standards (20 NMAC 2.3) that are generally more stringent than the Federal standards and that incorporate additional standards for hydrogen sulfide and total reduced sulfur. In addition to the criteria pollutants provisions, the EPA established in 40 CFR Part 62, the National Emission Standards for Hazardous Air Pollutants (NESHAP) and Title III of the 1990 CAA Amendments, which define hazardous air pollutants (HAPs). The primary nonradiological pollutants considered in the SWEIS are criteria pollutants and chemical pollutants.

Chemical pollutants include the 188 HAPs defined by the EPA in Title III of the CAA. Also included are other potentially toxic chemical air pollutants for which occupational exposure limits (OELs) have been defined by various organizations, including those chemicals categorized as volatile organic compounds (VOCs) (any organic compound that participates in atmospheric photochemical reactions except those designated by the EPA administrator as having negligible photochemical reactivity). The OEL used for this analysis is a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.

4.9.1.2 Region of Influence

The ROI is defined in the *New Mexico Air Pollution Control Bureau Dispersion Modeling Guidelines* (NMAPCB 1996) as the maximum extent of a source's significant impact. Significant impact is provided for each of the criteria pollutants as a specific concentration for a given averaging period (for example, 5.0 $\mu g/m^3$ for nitrogen oxide for a 24-hour averaging period). The maximum extent of significant ambient concentrations for the primary stationary source at SNL/NM (the steam plant) is approximately 15 mi for nitrogen oxide. The ROI for nonradiological air quality is, therefore, an area approximately 15 mi in radius about the SNL/NM steam plant. The steam plant is the primary stationary source at SNL/NM and determines the maximum extent of significant ambient concentrations (Figure 4.9–1). The area contained within a 15-mi radius around the steam plant falls largely within the Albuquerque air basin and within Bernalillo county, with a small portion extending into northern Valencia county.

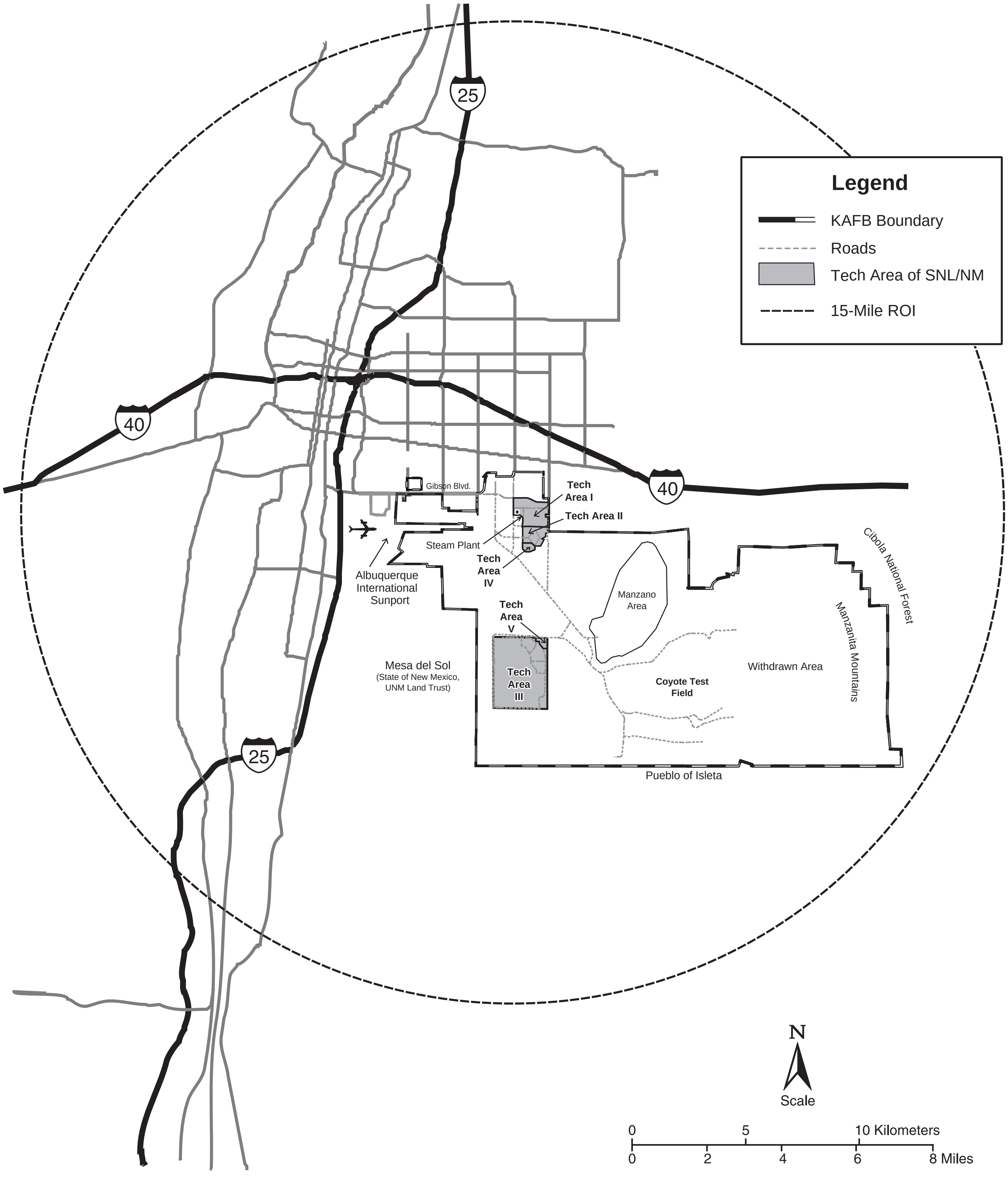
4.9.1.3 Affected Environment

The 1996 baseline air quality at SNL/NM and the ambient air quality within the ROI represent the affected environment. SNL/NM's contribution to the ambient air quality of the affected environment is based on its sources of emissions. The primary stationary sources of criteria pollutants are the steam plant boilers (which represent more than 90 percent of the total emissions of criteria pollutants), Building 862 generators, and the fire testing facilities located at the Lurance Canyon Burn Site (SNL/NM 1997a). Other sources are spatially separated, thereby contributing minimal impacts. Emissions of chemical air pollutants include those from facilities that release chemicals to the atmosphere and from operations at the burn site.

Meteorology and Climatology

The climate at SNL/NM and in the surrounding region is semiarid. The ambient temperatures in the region are characteristic of high-altitude, dry continental climates. Winter daytime temperatures average approximately 50 °F, with nighttime temperatures often dropping into the low teens. Summer daytime temperatures generally do not exceed 90°F, except in July, when average maximum temperatures reach 93°F. The Albuquerque basin is characterized by low precipitation, averaging between 7.5 and 10 inches a year. Most of this precipitation falls from July through September and usually occurs from thunderstorm activities and the intrusion of warm, moist tropical air from the Pacific Ocean. The storms are accompanied by localized heavy wind gusts. Winter months are typically dry, with less than 2 inches of precipitation and limited snowfall. The average annual relative humidity is about 43 percent. New Mexico has one of the greatest frequencies of lightning in the U.S. Tornadoes are uncommon in the Albuquerque basin (SNL/NM 1997a).

Temperature, relative humidity, and precipitation do not vary dramatically across the region. Daily and seasonal wind patterns occur near the mountains and plateau. Daytime upslope flows are usually coupled with downslope flows during the night. Strong springtime, easterly winds occur near canyons, and light north-south flows occur in the Rio Grande valley.



Source: SNL/NM 1997a

Figure 4.9–1. Air Quality Region of Influence

The region of influence for nonradiological air quality extends 15 mi around the SNL/NM steam plant.

In general, areas closer to the mountains or canyons experience more frequent winds from an easterly direction at night. Daytime wind patterns are not as pronounced, but generally flow toward the mountains or along the Rio Grande valley. The Rio Grande valley experiences the most frequent calm conditions and the lowest average wind speed. In most areas, the nighttime wind direction frequency produces the most dominant average annual direction.

Ambient Air Quality

This section describes the existing ambient air quality, which includes regional and SNL/NM air quality. Existing air quality in the region and for SNL/NM is defined by air emissions and air quality monitoring data.

Regional Air Quality

From 1978 through 1996, the EPA classified the Albuquerque/Bernalillo county region as a nonattainment area for carbon monoxide. In 1983, the area experienced 74 violations of the NAAQS for carbon monoxide. Control measures, such as the vehicle emissions testing, oxygenated fuels programs, and the winter "No Burn" program, have helped decrease the amount of carbon monoxide pollution and reduce the number of NAAQS violations. The Federal Motor Vehicle Control Program, which requires improved emissions standards for new cars, has also been a major factor in reduced vehicle emissions. Since 1992, the region has not violated NAAQS standards (COA n.d. [no date] [d]). On July 15, 1996, the EPA redesignated the region from nonattainment to a maintenance level for carbon monoxide.

Few industrial emission sources exist in the region. However, more than one-third of New Mexico's population lives in the Albuquerque metropolitan area and the population is projected to increase an average of 10,000 to 15,000 per year. With increased population comes more motor vehicles, new development and housing, new employment, and more (often longer) commutes to work. Major sources of air emissions result from using motor vehicles, the seasonal use of wood-burning stoves and fireplaces, and open burning activities (COA n.d.[d]).

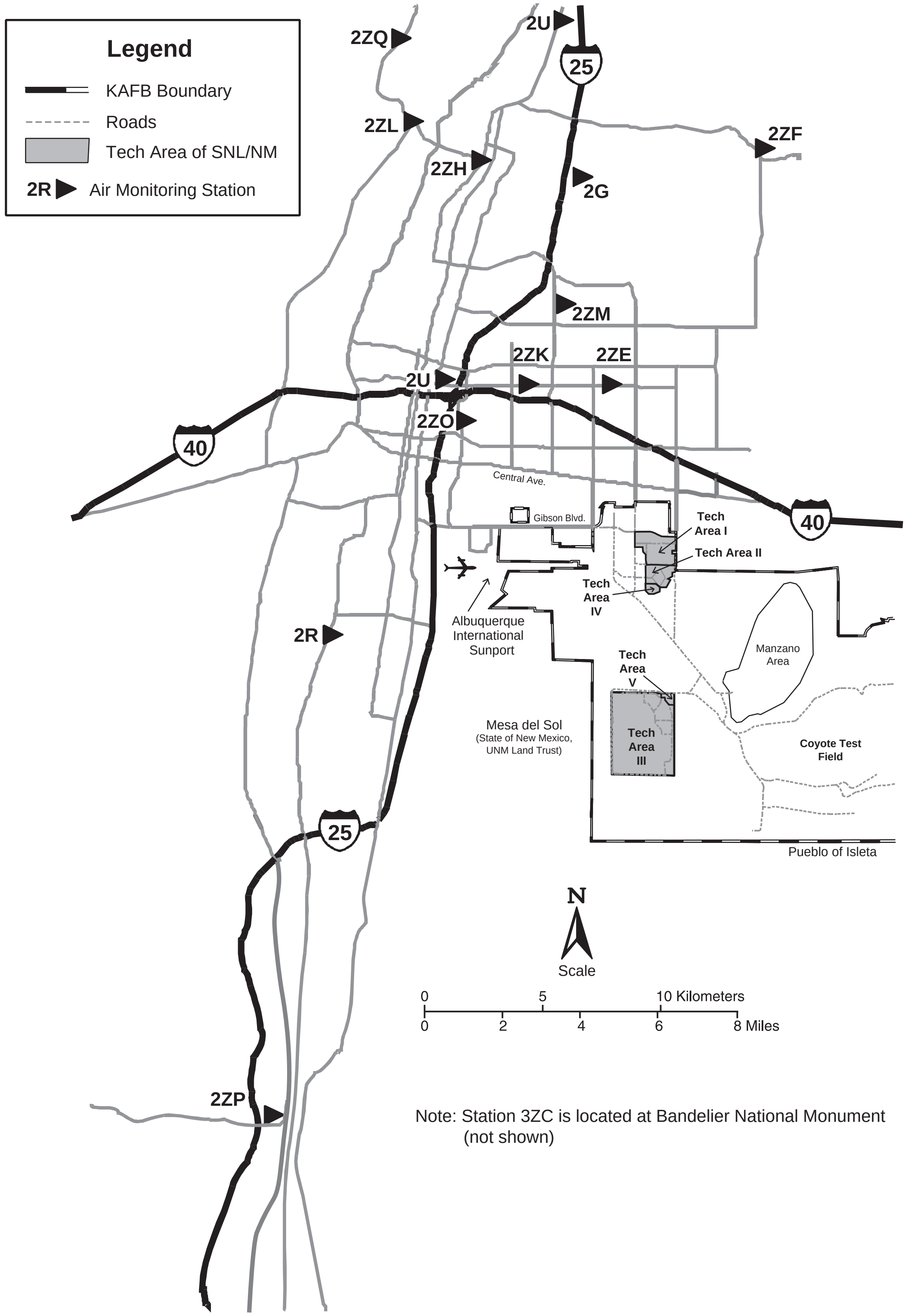
The dry climate, unpaved roads and parking lots, and wood-burning activities are primary sources of dust particles (PM_{10}) that cause poor visibility. The dry conditions result in poor soil stabilization, thereby increasing dust from agriculture, construction activities, and roads. These all contribute to high levels of particulate matter in the air. These conditions can also clog air filters in vehicles, reducing air flow to carburetors. The high elevation of this region results in incomplete and less efficient fuel burning and increased carbon monoxide emission. Wood and open burning activities also contribute to carbon monoxide pollution. However, motor vehicles have been, and continue to be, the major source of carbon monoxide (COA n.d.[d]).

SNL/NM is in the Albuquerque Middle Rio Grande Intrastate Air Quality Control Region (AQCR) 152 (40 CFR §81.83). The EPA has classified this AQCR as follows:

- Better than national standards – sulfur dioxides
- Unclassifiable/attainment – ozone
- Unclassifiable – PM_{10}
- Cannot be classified or better than national standards – nitrogen dioxide
- Maintenance – carbon monoxide
- Not designated – lead (40 CFR §81.332)

Wood burning has been an important contributor to the visible winter brown cloud. In 1985, a "No Burn" program, from October through February, began on a voluntary basis. This program, now mandatory, has become an important element of the A/BC AQCB's program for carbon monoxide abatement. The program prohibits operating a solid fuel heating device within the woodsmoke-impacted area during a declared no-burn period unless the device is a wood heater that has been emission-certified by the EPA. In recent years, the "No Burn" program has resulted in improved visibility on calm winter nights and mornings, as well as reductions in monitored carbon monoxide levels.

The AEHD and the NMED monitor the ambient air in the Albuquerque basin to determine the air quality in neighborhoods, background locations, and expected maximum impact locations and to estimate impacts from mobile vehicles. Fourteen monitoring stations throughout the Albuquerque basin measure criteria pollutants, including carbon monoxide, nitrogen dioxide, PM_{10}, and ozone. These monitoring stations do not measure lead or sulfur dioxide. An additional station, the Criteria Pollutant Monitoring Station (CPMS) located in TA-I, measures lead and sulfur dioxide. Figure 4.9–2 presents the locations of ambient air monitoring stations within the Albuquerque basin (except for station 3ZC, located at Bandelier National Monument, approximately 50 mi north-northeast of



Source: SNL/NM 1997j

Figure 4.9–2. Locations of Offsite Criteria Pollutant Monitoring Stations

Fourteen monitoring stations measure criteria pollutants throughout the Albuquerque Basin.

SNL/NM). Figure 4.9–3 presents the monitoring stations located within KAFB.

Table 4.9–1 compares maximum air concentrations monitored in the Albuquerque basin during 1996 to applicable Federal (40 CFR Part 50) and state (20 NMAC 2.3) standards for each pollutant. The annual standards are not to be exceeded. Short-term standards may be exceeded, generally once, before a violation must be reported. The preamble of the state regulation (Section 108) allows excesses over short periods of time due to unusual meteorological conditions. Air quality standards were not exceeded in 1996 or 1997 (SNL/NM 1997a).

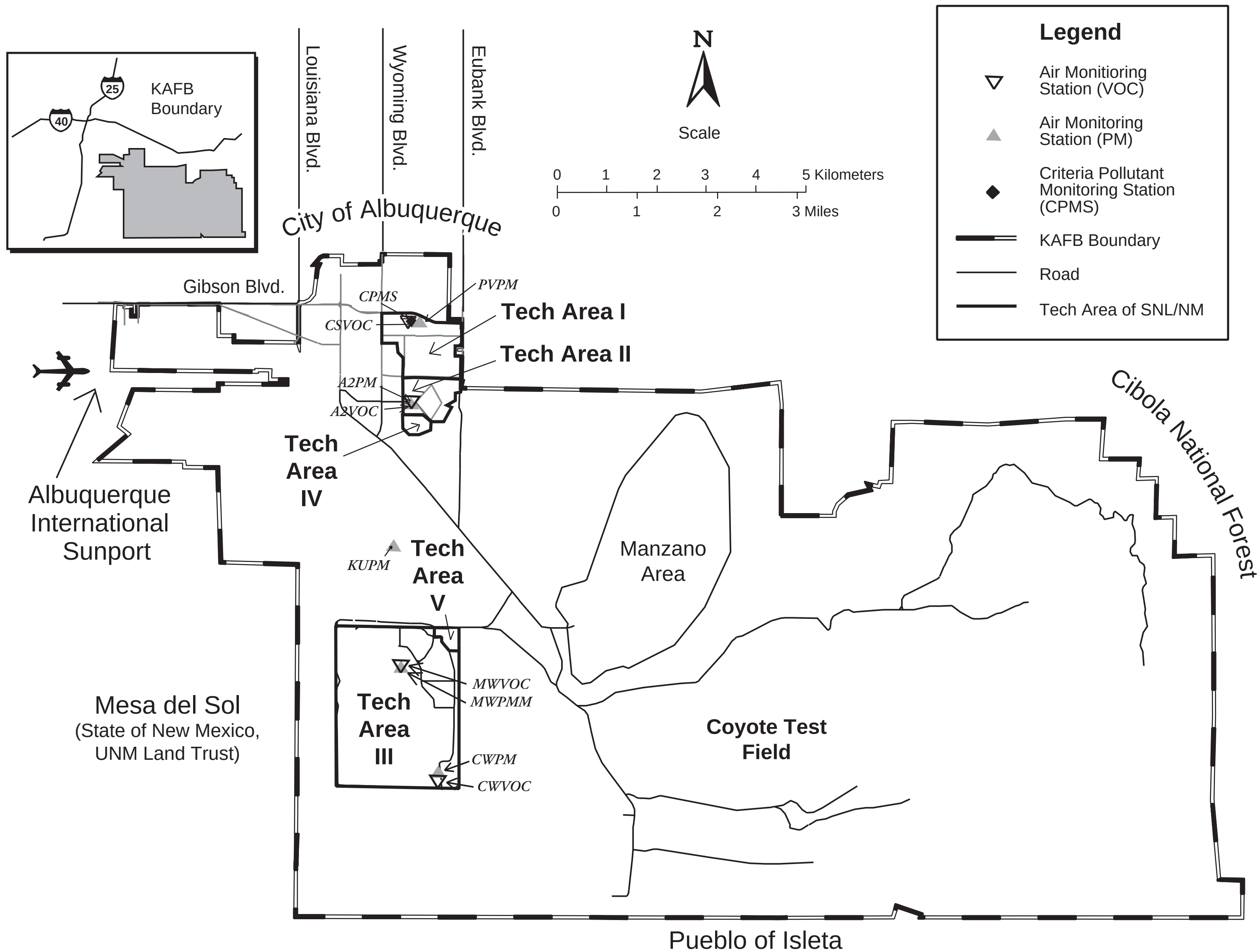
SNL/NM Air Quality

The major stationary sources of criteria pollutant emissions at SNL/NM are the steam plant, electric power generator plant, and Lurance Canyon Burn Site. Emissions from the steam plant, electric power generator plant, and Lurance Canyon Burn Site include carbon monoxide, nitrogen oxide, sulfur dioxide, and PM_{10}. The emissions factors for these facilities were developed specifically for the SNL/NM operating permit application. The emissions were calculated by using the fuel throughputs and emission factors obtained from the EPA's *Compilation of Air Pollutant Emission Factors-AP–42* (EPA 1995b). Table 4.9–2 summarizes the emissions associated with these facilities for 1992 through 1996, as well as VOC and HAP emissions from the entire site. SNL/NM annual emissions show a trend toward lower annual emissions from 1992 through 1996 for PM_{10}, sulfur dioxide, VOCs, and HAPs. The nitrogen oxide and carbon monoxide emissions fluctuate with the annual demand for steam.

Table 4.9–1. Comparison of 1996 Maximum Ambient Air Concentrations With Applicable National and New Mexico Ambient Air Quality Standards (ppm)

POLLUTANT	AVERAGING TIME	NAAQS	NMAAQS	MAXIMUM AMBIENT AIR CONCENTRATION	MONITORING LOCATION
Carbon Monoxide	8 hours 1 hour	9 35	8.7 13.1	8.30 12.0	2ZK 2ZK
Lead	Quarterly	1.5[a]	-	0.001[a]	CPMS
Nitrogen Dioxide	Annual 24 hours	0.053 -	0.05 0.10	0.022 0.045	2ZM 2ZM
Total Suspended Particulates	Annual 30 days 7 days 24 hours	- - - -	60[a] 90[a] 110[a] 150[a]	NA NA NA NA	- - - -
Particulate Matter	Annual 24 hours Annual	50[a] 150[a] 0.03	- - 0.02	37[a] 96[a] 0.0001	2R 2R CPMS
Sulfur Dioxide	24 hours 3 hours	0.14[a] 0.50[a]	0.10[a] -	0.003[a] 0.009[a]	CPMS CPMS
Ozone[b]	1 hour	0.12	-	0.111	2ZF
Hydrogen Sulfide	1 hour	-	0.01	NA	-
Total Reduced Sulfur	0.5 hour	-	0.03	NA	-

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL/NM 1997a
CPMS: Criteria Pollutant Monitoring Station
NA: not available
NAAQS: National Ambient Air Quality Standard
NMAAQS: New Mexico Ambient Air Quality Standard
ppm: parts per million
[a] micrograms per cubic meter
[b] New 8-hour, 0.08-ppm ozone standard, applicable to SNL/NM, will apply in year 2000 (see Section 4.9.1.1).



Source: SNL/NM 1997j

Figure 4.9–3. Locations of Onsite Criteria Pollutant Monitoring Stations

Ten ambient air monitoring stations are located within the boundaries of KAFB.

Table 4.9–2. Estimated Air Emissions from Stationary Sources at SNL/NM, 1992 through 1996 (tons/year)

POLLUTANT	SOURCE	1992	1993	1994	1995	1996
Nitrogen Oxide	Lurance Canyon Burn Site[c]	0.07	0.02	0.02	0.02	0.02
	Steam plant	47.78[a]	155.08[b]	148.06[b]	126.00[b]	153.00[b]
	Building 862 generators	0.03	5.55	0.61	1.11	0.90
	TOTAL	**47.88**	**160.65**	**148.69**	**127.13**	**153.92**
Carbon Monoxide	Lurance Canyon Burn Site[c]	2.87	0.77	0.79	0.75	0.78
	Steam plant	4.44[a]	16.25[b]	15.60[b]	13.80[b]	14.20[b]
	Building 862 generators	0.00	0.28	0.02	0.29	0.23
	TOTAL	**7.31**	**17.3**	**16.41**	**14.84**	**15.21**
PM_{10}	Lurance Canyon Burn Site[c]	2.60	0.70	0.71	0.69	0.71
	Steam plant	1.76[a]	3.90[b]	3.75[b]	3.45[b]	2.93[b]
	Building 862 generators	0.00	0.93	0.02	0.02	0.01
	TOTAL	**4.36**	**5.53**	**4.48**	**4.16**	**3.65**
Sulfur Dioxide	Lurance Canyon Burn Site[c]	0.14	0.04	0.04	0.04	0.04
	Steam plant	2.12[a]	0.33[b]	0.26[b]	0.22[b]	0.22[b]
	Building 862 generators	0.00	0.87	0.13	0.08	0.06
	TOTAL	**2.26**	**1.24**	**0.43**	**0.34**	**0.32**
VOCs	All facilities	NA	63.32	24.00	9.8	4.07
HAPs	All facilities	NA	50.75	17.79	5.52	2.4

Source: SNL/NM 1997a
HAPs: hazardous air pollutants
NA: not available
PM_{10}: particulate matter less than 10 microns in diameter
SMERF: Smoke Emission Reduction Facility
SNL/NM: Sandia National Laboratories/New Mexico
SWISH: Small Wind-Shielded Facility
VOCs: volatile organic compounds
[a] Based on actual stack emission measurements
[b] Based on published, theoretical emission factors in EPA AP-42
[c] Fire testing facilities include a number of open pools, the SMERF, and the SWISH located in Lurance Canyon

VOC and HAP emissions come from laboratories, miscellaneous chemical operations, and the fire testing facilities. Chemical uses and the corresponding emissions occur in each TA and in the outlying test areas. In 1996, HAP emissions associated with chemical users were 2.4 tons (SNL/NM 1997a). VOC emissions for 1996 were approximately 4.07 tons (SNL/NM 1997a).

In addition to regional ambient air quality monitoring for criteria pollutants, SNL/NM operates six onsite monitoring stations for PM_{10}. Monitoring results indicate that sampling locations closer to the most populated areas of SNL/NM generally reveal higher PM_{10} concentrations. In addition, PM_{10} concentrations generally increase during the windy season due to blowing soil particles. Dry weather conditions enhance this trend of increased concentration during windy periods. Table 4.9–3 presents the criteria pollutant concentrations at monitoring stations in TA-I. These stations measure concentrations of criteria pollutants nearest SNL/NM emission sources.

In 1996, VOC samples were collected at four onsite monitoring stations. These locations were selected for their proximity to known VOC emission sources. Table 4.9–4 presents the estimated 8-hour concentrations of VOCs calculated from onsite monitoring data for 1996 and the respective 8-hour OELs. These data are presented for comparison and indicate that the concentrations of VOCs measured at the onsite monitors are well below the respective OEL concentrations for an 8-hour workday.

The monitored VOCs represent a portion of the total chemical emissions from SNL/NM facilities. Monitoring data are not available for additional chemical compounds.

Table 4.9–3. 1996 Criteria Pollutant Concentrations from the Criteria Pollutant Monitoring Station with Applicable National and New Mexico Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	NAAQS (ppm/µg/m³)	NMAAQS (ppm/µg/m³)	BASELINE CONCENTRATION (ppm/µg/m³)	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9/8,564	8.7/8,279	2.86/2,722	33
	1 hour	35/33,305	13.1/12,466	8.30/7,898	63
	Annual	-	-	0.78/742	NA
Lead	30 days	-	-	0.0021[a]	NA
	Quarterly	1.5[a]	-	0.001[a]	0.07
Nitrogen Dioxide	Annual	0.053/83	0.05/78	0.012/19	24
	24 hours	-	0.10/156	0.035/55	35
Particulates (TSP)	Annual	-	60[a]	14.76[a]	30
	30 days	-	90[a]	NA	NA
	7 days	-	110[a]	NA	NA
	24 hours	-	150[a]	49[a]	33
Particulate Matter (PM_{10})	Annual	50[a]	-	14.76 [a,b]	30
	24 hours	150[a]	-	49 [a,b]	33
Sulfur Dioxide	Annual	0.03/65	0.02/44	0.0003/0.7	1.5
	24 hours	0.14/305	0.10/218	0.003/6.5	3
	3 hours	0.50/1,088	-	0.009/20	2
Ozone	Annual	-	-	0.033/54	NA
	1 hour	0.12/196	-	0.103/168	85.8
Hydrogen Sulfide	1 hour	-	0.01/12	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03/33	NA	NA

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL/NM 1997a
- indicates no standard for listed averaging time
°R: degrees Rankin
CPMS: Criteria Pollutant Monitoring Station
ft: feet
NA: not available
NAAQS: National Ambient Air Quality Standard
NMAAQS: New Mexico Ambient Air Quality Standard
ppm: parts per million

TSP: total suspended particulates
[a] micrograms per cubic meter
[b] highest quarterly lead monitoring data measured at the CPMS site in 1996
[c] highest one hour ozone monitoring data measured at the CPMS in 1996
[d] PM_{10} is assumed equal TSP
Note: Some of the pollutants are stated in parts per million (ppm). These values were converted to micrograms per cubic meter (µg/m³) with appropriate corrections for temperature (530°R) and pressure (elevation 5,400 ft) following New Mexico dispersion modeling guidelines (revised 1996).

Steam Plant

The steam plant produces heat for buildings in TA-I and the eastern portion of KAFB. During 1996, all five boilers at the plant used a total of 740 M standard ft³ of natural gas. These boilers can also run on diesel oil and used approximately 15,000 gal of oil during 1996 for system testing. Criteria pollutant emissions for 1992 through 1996 for the steam plant are presented in Table 4.9–2. The annual emissions for each pollutant vary from year to year based upon the heating degree days, fuel mix (natural gas versus fuel oil), and plant boiler loading, which have different efficiencies at different loadings.

Table 4.9–4. Maximum Ambient Concentrations of Volatile Organic Compounds from Onsite Monitors for 1996

VOCS	ESTIMATED 8-HOUR CONCENTRATION[a] (ppb)	8-HOUR OEL[b] (ppb)
1,1,1-trichloroethane	134.235	348,000
1,4-dioxane+2,2,4-trimethylpentane	1.35	25,000
1-butene	0.741	NA
2,2,4-trimethylpentane	0.426	NA
3-methylpentane	0.765	NA
Acetone	20.025	250,000
Benzene	1.674	100
Bromodichloromethane	0.096	NA
Carbon Tetrachloride	0.357	5,000
Chloromethane	1.371	5,000
Dichlorodifluoromethane	1.887	1,000,000
Ethylbenzene	0.411	100,000
Halocarbon 113	0.291	NA
Isobutene	0.648	NA
Isobutene + 1-butene	1.2	NA
Isohexane	1.425	NA
Isopentane	5.526	120,000
m/p-xylene	0.897	100,000
Methylene Chloride	0.258	50,000
n-Butane	5.466	800,000
n-Hexane	0.831	50,000
n-Pentane	2.496	120,000
n-Undecane	0.219	NA
o-Xylene	0.435	100,000
Tetrachloroethene	0.126	NA
Toluene	3.117	50,000
Trichloroethene	0.366	NA
Trichloroethene+Bromodichloromethane	0.195	NA
Trichlorofluoromethane	0.831	1,000,000
Total Nonmethane Hydrocarbons	259.191	NA

Source: SNL/NM 1997a
NA: not available
OEL: occupational exposure limit
ppb: parts per billion
VOC: volatile organic compound
[a] Estimated value calculated by multiplying the 24-hour measured concentration by 3.
[b] OELs are the minimum time-weighted exposure concentration for an 8- or 10-hour workday and a 40-hour work week to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect based upon the following sources:
American Conference of Governmental Industrial Hygienists
U.S. Occupational Safety and Health Administration
National Institute of Occupational Safety and Health
Deutsche Forschungsgemeinschaft (DFG), Federal Republic of Germany, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area

Electric Power Generator Plant

SNL/NM has four standby generators, each with a 600-kW capacity. These diesel-fired generators are in TA-I, Building 862. The generators have a local air quality permit limiting operation to 500 hours per year per generator. They are started monthly for maintenance and testing, as well as during electrical power outages in TA-I.

Fire Testing Facilities (Lurance Canyon Burn Site)

The fire testing facilities (Lurance Canyon Burn Site) include a number of open pools, the Smoke Emission Reduction Facility (SMERF), and the Small Wind-Shielded (SWISH) Facility. The open pools emit directly to the atmosphere, while SMERF and SWISH are closed and emit through exhaust stacks. The fire testing facilities are used to test the response of shipping containers, aerospace components, and other items to high-temperature conditions. These facilities use a variety of fuels including jet fuel (JP-8), sawdust, a sawdust-propellant-acetone (SPA) mixture, explosives, and urethane foam.

These facilities typically average 42 tests per year; each test lasts about 30 minutes, although some can last as long as 4 hours. During 1996, the fire testing facilities used 10,400 gal of JP-8 and approximately 8 tons of sawdust (or wood). Based on process knowledge, emissions from these tests are known to include carbon monoxide, nitrogen oxide, sulfur dioxide, PM_{10}, and chemical pollutants (SNL/NM 1997a).

Mobile (Vehicular) Sources

Mobile sources (motor vehicles) are a major source of criteria pollutant emissions in and around SNL/NM. Carbon monoxide levels are the highest from November through January (MRGCOG 1997c). The EPA's *Mobile Source Emission Factor* computer model, *MOBILE5a* (EPA 1994), showed an estimated 920 tons of carbon monoxide emissions from SNL/NM commuter traffic for November through January (SNL 1996c), which is approximately 3.7 percent of the estimated carbon monoxide emissions for Bernalillo county vehicular emissions during the same period. Total SNL/NM mobile source carbon monoxide emissions for 1996 are 4,087 tons.

4.9.2 Radiological Air Quality

4.9.2.1 Definition of Resource

Specific SNL/NM facilities discharge low quantities of radionuclides to the air. These releases can be evaluated according to the individual and population dose created from the combined releases of all facilities at SNL/NM. The degree of hazard to the public is directly related to the type and quantity of the radioactive materials released. How long a person is exposed to the released material is also a factor in assessing potential health effects. Dose estimates are modeled from emissions determined at each facility and compared to regulatory dose limits for the protection of public health.

4.9.2.2 Region of Influence

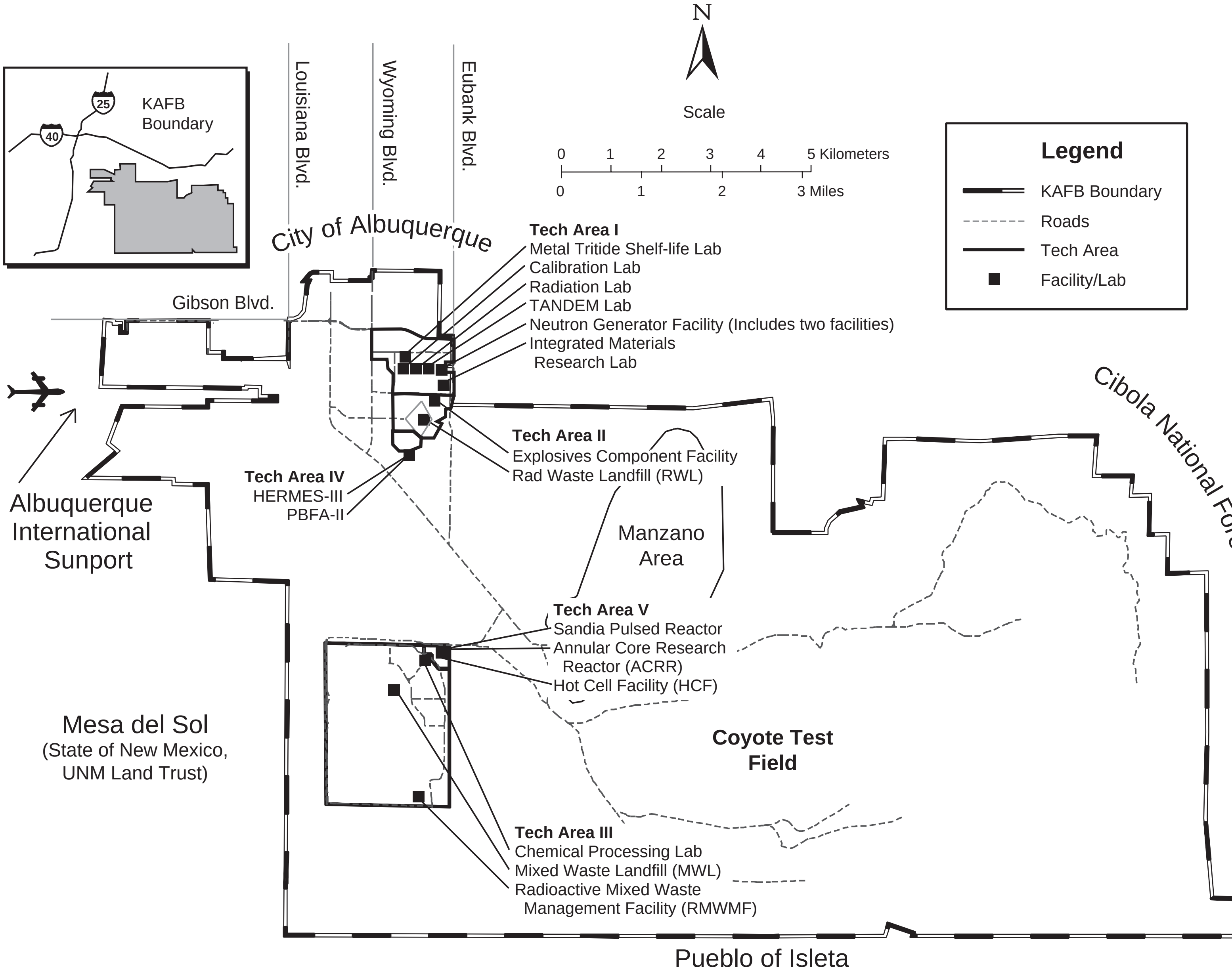
The ROI is the 50-mi radius of SNL/NM, which is consistent with the recommended DOE 5400.5 guidance. The ROI includes the counties of Bernalillo, McKinley, Cibola, San Miguel, Santa Fe, Sandoval, Valencia, Socorro, and Torrance, and the major cities of Albuquerque and Rio Rancho.

4.9.2.3 Affected Environment

Data from 1992 through 1996 were reviewed to characterize the baseline operational radiological emissions and corresponding dose estimates for specific SNL/NM facilities. The sources of this data were annual NESHAP reports, annual surveillance/monitoring reports, existing site environmental descriptions, radioactive emissions, and dose evaluations.

SNL/NM facilities that release radionuclides are shown in Figure 4.9–4. Table 4.9–5 identifies the types and quantities of radionuclides released from these facilities from 1993 through 1996. The 1992 estimated radiological emissions data and doses were not included in this baseline due to large variations in the data. These releases were used to calculate the doses at various receptors, thereby identifying a maximally exposed individual (MEI) member of the public and also the dose to the total population (732,823) within 50 mi of SNL/NM.

Because the general public (such as visitors to the golf course or National Atomic Museum) and Air Force personnel (such as families at base housing) have access to SNL/NM, both onsite and site boundary locations are considered as potential locations for an MEI. Table 4.9–6 presents the total dose to the MEI, along with the dose contributions from each facility for each year's radionuclide emissions, which are calculated using the *Clean Air Assessment Package* (*CAP88-PC)* computer model (DOE 1997e). These calculated doses are less than the regulatory limit of 10 mrem/yr of exposure to an individual of the public from airborne releases of radiological materials (40 CFR Part 61). These doses also are small compared to an individual background radiation dose of 360 mrem/yr (Section 4.10.3).



Source: SNL/NM 1997d

Figure 4.9–4. SNL/NM Radionuclide-Releasing Facilities

Radionuclide-releasing facilities are located in all five technical areas.

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Sandia Pulsed Reactor, Building 6590	TA-V	Point	Argon-41	0.48	0.55	1.7	9.51
Annular Core Research Reactor, Building 6588	TA-V	Point	Argon-41	2.70	2.1	3.0	35.4
Hot Cell Facility, Building 6580	TA-V	Point	Tritium	0	$1.1x10^{-5}$	$2.0x10^{-5}$	0
			Iodine-131	0	0	0	$1.96x10^{-3}$
			Iodine-132	0	0	0	$1.29x10^{-4}$
			Iodine-133	0	0	0	$9.51x10^{-3}$
			Iodine-135	0	0	0	$1.32x10^{-3}$
			Krypton-83m	0.068	0.017	0.016	$9.57x10^{-5}$
			Krypton-85	$3.7x10^{-6}$	$5.7x10^{-6}$	$3.3x10^{-5}$	$1.53x10^{-3}$
			Krypton-85m	0.14	0.063	0.12	0.587
			Krypton-87	0.17	0.032	0.0014	0.0294
			Krypton-88	0.36	0.11	0.10	0.527
			Rubidium-86	$1.1x10^{-7}$	$1.5x10^{-7}$	$8.0x10^{-7}$	0
			Rubidium-87	$1.0x10^{-14}$	$1.4x10^{-14}$	$8.1x10^{-14}$	0
			Rubidium-88	0.41	0.019	$4.1x10^{-4}$	0
			Rubidium-89	0.0011	$4.8x10^{-5}$	0	0
			Xenon-131m	$5.7x10^{-6}$	$5.8x10^{-4}$	$5.7x10^{-5}$	$3.45x10^{-4}$
			Xenon-133	0.026	0.034	0.24	17.5
			Xenon-133m	0.0013	0.0017	0.011	0.768
			Xenon-135	0.40	0.41	1.4	14.7
			Xenon-135m	0.18	0.0051	$2.7x10^{-4}$	0.976
			Xenon-137	0	$2.2x10^{-27}$	0	0
			Xenon-138	0.0019	$1.4x10^{-4}$	$1.4x10^{-14}$	0
High-Energy Radiation Megavolt Electron Source, Building 970	TA-IV	Point	Nitrogen-13	0.58	2.32	$5.5x10^{-4}$	$2.85x10^{-4}$
			Oxygen-15	0.0050	0.030	$5.5x10^{-5}$	$2.85x10^{-5}$
Particle Beam Fusion Accelerator Building	TA-IV	Point	Nitrogen-13	0.042	0.042	0.042	0.042
			Oxygen-15	0.0050	0.0050	0.005	0.005
Mixed Waste Landfill	TA-III	Diffuse	Tritium	1.9	0.29	0.29	0.29

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996 (continued)

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Chemical Processing Laboratory, Building 6600	TA-III	Point	Na-22	0	$2.4x10^{-12}$	$2.4x10^{-12}$	$2.4x10^{-12}$
			Gadolinium-153	0	$1.0x10^{-13}$	0	0
			Americium-241	0	$1.0x10^{-13}$	$1.0x10^{-13}$	$1.0x10^{-13}$
			Uranium-232	0	0	$1.0x10^{-13}$	$1.0x10^{-13}$
			Plutonium-241	0	0	$1.0X10^{-13}$	$1.0x10^{-13}$
Radioactive and Mixed Waste Management Facility, Building 6920	TA-III	Point	Tritium	0	0	0	4.12
Radioactive Waste Landfill	TA-II	Diffuse	Americium-241	0	0	0	$4.7x10^{-13}$
			Plutonium-239/240	0	0	0	$3.9x10^{-15}$
			Plutonium-238	0	0	0	$7.9x10^{-15}$
Explosive Components Facility, Building 905	TA-II	Point	Tritium	0	0	0	$7.0x10^{-4}$
Integrated Materials Research Laboratory, Building 897	TA-I	Point	Carbon-14	0	0	0	$2.21x10^{-5}$
Neutron Generator Facility, Building 870	TA-I	Point	Tritium	0	0	0	0.11
TANDEM Accelerator, Building 884	TA-I	Point	Tritium	0	0	0	$1.0x10^{-6}$
			Carbon-11	$4.2x10^{-5}$	$5.2x10^{-5}$	$8.8x10^{-6}$	$5.3x10^{-3}$
			Nitrogen-13	$9.9x10^{-5}$	$1.2x10^{-4}$	$2.1x10^{-5}$	$9.3x10^{-8}$
			Oxygen-14	0	$3.2x10^{-7}$	$5.3x10^{-8}$	0
			Oxygen-15	0.0017	0.0021	0.00035	0.021
			Fluorine-17	0	$8.0x10^{-6}$	$1.3x10^{-6}$	$8.0x10^{-4}$
			Fluorine-18	$9.4x10^{-6}$	$1.2x10^{-5}$	$2.0x10^{-6}$	$4.4x10^{-5}$

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996 (concluded)

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Radiation Laboratory, Building 827 & Building 805	TA-I	Point	Tritium	$1.0x10^{-5}$	$1.0x10^{-5}$	$2.0x10^{-5}$	$1.00x10^{-5}$
			Nitrogen-16	0	$2.0x10^{-7}$	$2.0x10^{-7}$	$2.00x10^{-7}$
			Nitrogen-17	0	0	$1.0x10^{-8}$	0
			Nitrogen-13	$1.0x10^{-8}$	$1.0x10^{-8}$	0	$1.0x10^{-8}$
			Nitrogen-15	0	0.10	0	0
			Argon-41	$1.0x10^{-9}$	$1.0x10^{-9}$	$1.0x10^{-9}$	$1.00x10^{-9}$
			Carbon-13	0	0.20	0	0
			Carbon-14	$2.0x10^{-12}$	$2.0x10^{-12}$	$2.0x10^{-12}$	0
			Curium-244	$7.0x10^{-11}$	$7.0x10^{-11}$	0	0
			Lead-210	$4.0x10^{-13}$	$4.0x10^{-13}$	0	0
			Uranium-238	$4.0x10^{-12}$	$4.0x10^{-12}$	0	0
			Plutonium-239	$6.0x10^{-12}$	$6.0x10^{-12}$	0	0
			Americium-241	$1.0x10^{-11}$	$1.0x10^{-11}$	0	0
Metal Tritide Shelf-Life Laboratory, Building 891	TA-I	Point	Tritium	$6.0x10^{-5}$	$6.0x10^{-5}$	$5.0x10^{-9}$	$5.0x10^{-9}$
Calibration Laboratory, Building 869	TA-I	Point	Tritium	0	$1.5x10^{-6}$	$3.7x10^{-5}$	$2.51x10^{-4}$
Neutron Generator Testing Facility, Building 935	TA-I	Point	Tritium	0	0	$2.8x10^{-5}$	0

Sources: SNL 1994b, 1995c, 1996a, 1997d
- concentration not measured or facility inactive
SNL/NM: Sandia National Laboratories/New Mexico
TA: technical area
yr: year
[a] Historical releases do not necessarily equate to projected releases presented in Sections 5.3.7.2, 5.4.7.2, and Appendix D.2. This is due in part to DOE project and program changes expected through 2008.

Table 4.9–6. Summary of Dose Estimates to SNL/NM Public from Radioactive Air Emissions (1993 to 1996) Modeled Effective Dose Equivalent (mrem/yr) to SNL/NM MEI and (person-rem) to Population

SOURCE	YEAR			
	1993	1994	1995	1996
MEI (mrem/yr)				
Sandia Pulsed Reactor, Building 6590	5.9×10^{-5}	$[5.0 \times 10^{-4}]$[a]	2.5×10^{-4}	1.2×10^{-3}
Annular Core Research Reactor, Building 6588	1.6×10^{-3}		6.0×10^{-4}	5.4×10^{-3}
Hot Cell Facility, Building 6580	-	-	-	3.9×10^{-4}
High-Energy Radioactive Megavolt Electron Source	1.7×10^{-5}	2.9×10^{-5}	5.8×10^{-9}	2.0×10^{-9}
Particle Beam Fusion Accelerator, Building 983	1.2×10^{-6}	0	4.0×10^{-7}	3.3×10^{-7}
Mixed Waste Landfill	8.5×10^{-6}	5.0×10^{-6}	4.0×10^{-6}	4.0×10^{-6}
Chemical Processing Laboratory, Building 6600	-	1.3×10^{-11}	3.7×10^{-11}	3.2×10^{-11}
Radioactive and Mixed Waste Management Facility, Building 6920	-	-	-	1.4×10^{-5}
Radioactive Waste Landfill	-	-	-	7.6×10^{-12}
Explosive Components Facility, Building 905	-	-	-	3.1×10^{-9}
Integrated Materials Research Laboratory, Building 897	-	-	-	4.8×10^{-12}
Neutron Generator Facility, Building 870	-	-	-	4.7×10^{-8}
TANDEM Accelerator, Building 884	2.7×10^{-9}	1.2×10^{-9}	3.0×10^{-10}	4.5×10^{-8}
Radiation Laboratory, Building 827 & Building 805	2.8×10^{-9}	8.8×10^{-10}	2.9×10^{-10}	4.6×10^{-11}
Metal Tritide Shelf-Life Laboratory, Building 891	1.0×10^{-9}	1.9×10^{-10}	3.0×10^{-14}	1.8×10^{-14}
Calibration Laboratory, Building 869	-	7.7×10^{-12}	5.7×10^{-10}	1.2×10^{-9}
Neutron Generator Test Facility, Building 935	-	-	2.1×10^{-9}	-
TOTAL	**1.6×10^{-3}**	**5.3×10^{-4}**	**8.5×10^{-4}**	**7.0×10^{-3}**
Collective Dose (person-rem) for Population Within 50 Miles Population Dose, person-rem	0.026	0.012	0.016	0.14

Sources: SNL 1994b, 1995c, 1996a, 1997d
- concentration not measured or facility inactive
MEI: maximally exposed individual
mrem/yr: millirems per year
SNL/NM: Sandia National Laboratories/New Mexico
[a] Dose total for Sandia Pulsed Reactor and Annular Core Research Reactor

Both the dose to the MEI and the collective dose to the entire population within 50 mi of SNL/NM were assessed. Although releases from separate facilities contribute to the collective population dose, the computer model evaluated emissions out to a 50-mi radius, based on a single common release point centered at TA-V. The distances between buildings are relatively small compared to 50 mi, therefore, dose estimate results were only minimally affected. The calculated collective doses for SNL/NM operations from 1993 through 1996 are presented in Table 4.9–6.

Looking at the trend in SNL/NM radiological air emissions, higher releases occurred in 1996 than in the years 1993 through 1995 (Table 4.9–5). This has been attributed to converting and refurbishing the Annular Core Research Reactor (ACRR) for medical isotope production. Also, NESHAP "confirmatory measurements" requirements for radioactive air emissions were instituted at the Sandia Pulsed Reactor (SPR) and ACRR; these measurements were higher than calculated emissions. Since the SWEIS is addressing potential impacts for projected and planned future operations, the 1996 operations are considered representative of radiological air emissions for characterizing future SNL/NM operations. It can be seen from Table 4.9–5, that MEI dose is dominated by SPR, ACRR, and HCF source emissions.

4.10 HUMAN HEALTH AND WORKER SAFETY

4.10.1 Definition of Resource

This section on human health and worker safety describes how existing physical and environmental conditions affect public health and worker health and safety. It includes all individuals who could be affected by radioactive and nonradioactive hazardous materials released from SNL/NM operations. These individuals are referred to as receptors.

This section compares SNL/NM worker health and safety performance records from 1992 to 1996 to equivalent national, regional, or local health statistics. The current relationship of people to the SNL/NM environment is assessed by resource area. These assessments constitute the framework for understanding the impacts from the alternatives presented in Chapter 5.

4.10.2 Region of Influence

For a human to be exposed to a released material, there must be both complete transport and exposure pathways (Figure 4.10–1). Since pathways differ, the ROI for assessing health impacts to people in and around SNL/NM is specific to each exposure pathway. The ROIs for impacts to public health from radiological and nonradiological air emissions are the population living and working within 50 mi and 15 mi of SNL/NM, respectively. The ROIs for impacts to public health from pathways associated with groundwater, soils, and surface water relate more to the physical extent of that resource (such as the extent of groundwater used for drinking by the city of Albuquerque, discussed in Section 4.6.2).

4.10.3 Affected Environment

The environment within the ROI includes environmental resources such as air, groundwater, and soil, which, if affected, could subsequently affect public health and worker health and safety. See the specific resource sections for descriptions of existing conditions for these resources.

Any environmental releases due to activities described in the SWEIS have the potential to affect the health of people who live around and work at SNL/NM. Specifically, the SWEIS addresses the effects of radiation from radiological materials and the effects of hazardous materials on human health, as well as occupational safety issues common to laboratory and industrial work sites.

4.10.3.1 National and Regional Health Information

The general health of the population within the U.S., based on the types and rates of cancer, is assessed

Transport and Exposure Pathways

The pathways that release materials to the environment and subsequently reach people are known as transport and exposure pathways. A *transport pathway* is the environmental medium, such as groundwater, soils, or air, by which a contaminant is moved (for example, chemicals carried in the air or dissolved in groundwater and moved along by wind or groundwater flow). An *exposure pathway* is how a person comes into contact with the contaminant, for example, breathing (inhalation), drinking water (ingestion), or skin contact (dermal).

Source: Original

Figure 4.10–1. Transport and Exposure Pathways

For a human to be exposed to a released material, there must be both complete transport and complete exposure pathways.

annually by the American Cancer Society (ACS). In the U.S., men have a 1 in 2 lifetime risk of developing cancer; for women, the risk is 1 in 3. The National Cancer Institute estimates that approximately 7.4 M Americans alive today have a history of cancer and that one out of every four deaths in the U.S. is from cancer (ACS 1997a).

The ACS annually estimates the number of cancer deaths and the number of new cancer cases nationally and by state. Nationally, the estimated 1997 cancer mortality rate was 173 deaths per 100,000 persons; for New Mexico, the rate was 146 per 100,000 persons. The estimated 1997 number of new cancer cases likely to occur in the U.S. was 1.4 M, with 7,000 occurring in New Mexico (excluding skin cancer cases). Estimates were based on 1997 population growth estimates.

The DOE has developed various programs and data collection/tracking systems that can be analyzed for epidemiological trends or for epidemiological studies by independent agencies or individuals. The DOE Office of Epidemiological Surveillance Program tracks the illnesses and injuries (incidence rates) of more than 65,000 DOE workers. SNL/NM has electronically coded and archived over 10 years of employee health information through this program. The database gives epidemiologists the opportunity to analyze health events that have affected the SNL/NM workforce over an extended time. The archived information has been categorized and summarized in the DOE *1993 Epidemiologic Surveillance Report* (DOE n.d. [b]).

These studies document health conditions of the worker population in general, but do not assess the effects of specific chemicals or radiation doses from SNL/NM operations on human health. Therefore, the health effects data are not associated with specific SNL/NM operations, environmental releases, or worker or public exposures to hazardous or radioactive materials.

4.10.3.2 Public Health

Radiological and nonradiological hazardous materials released from SNL/NM facilities reach the environment and people through different transport pathways. The SWEIS focuses on transport media associated with inhalation, ingestion, or direct contact exposure pathways, such as air and drinking water, because they are the ways in which the greatest amount of a pollutant can reach people. The SWEIS evaluates the possibility of collective effects due to multiple pathways and indirect pathways for any impact contribution.

Radiological

Figure 4.10–2 presents major sources and levels of background radiation exposure to individuals in the vicinity of SNL/NM (SNL 1997d). All annual doses to individuals from background radiation are practically constant over time. The collective dose to the population varies as a result of increases or decreases in population size. The background radiation dose of 360 mrem/yr is unrelated to SNL/NM operations.

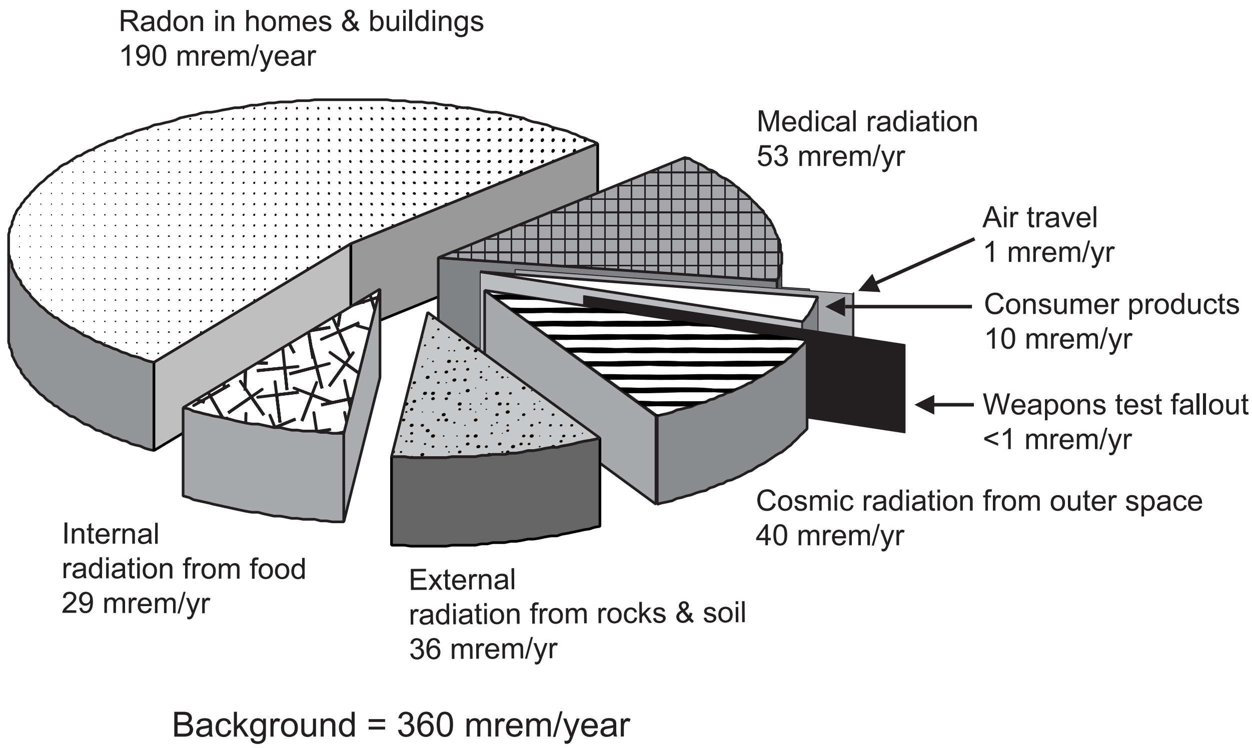
Air releases of radionuclides from the operation of a specific facility at SNL/NM result in radiation exposures to people in its vicinity. The radiation dose is calculated annually based on actual facility emissions monitoring data. Table 4.9–6 shows radiation doses from 1993 through 1996 for maximally exposed individual members of the public at SNL/NM. Based on the risk estimator of 500 fatal cancers per 1 M person-rem (ICRP 1991) to the public, a person exposed to the greatest amount of these SNL/NM radiological air releases would have an annual increased risk of dying from cancer of $3.5x10^{-9}$. In other words, the likelihood of this person dying of cancer because of the maximum 1-year dose from SNL/NM operations is less than 4 chances in 1 B. This annual release has the potential to increase the number of latent cancer fatalities in the entire population within 50 mi of SNL/NM by $7.0x10^{-5}$.

Radiological contamination contained in other environmental resources affected by SNL/NM has the potential to reach the public by different transport pathways. Environmental sampling programs involving resources such as groundwater, soils, and surface water are designed to monitor and assess the potential for public exposures to these pollutants through these different media.

Radiation exposures are not expected through surface water, soils, groundwater, and natural vegetation, based on information in the SNL/NM *1996 Site Environmental Report* (SNL 1997d). Data collected from environmental sampling show that these media do not present complete exposure pathways that connect SNL/NM to the general population. The public, therefore, is not in contact with radiological pollutants from these media.

Maximally Exposed Individual

A hypothetical person at a location who could potentially receive the maximum dose of radiation or hazardous chemicals.



Sources: NCRP 1987, SNL 1997d
mrem/yr: millirems per year

Figure 4.10–2. Major Sources and Levels of Background Radiation Exposure in the SNL/NM Vicinity

The total annual background dose of radiation to an individual in the vicinity of SNL/NM is 360 millirem.

Nonradiological

Nonradiological chemical air pollutants are released from SNL/NM facilities that house chemistry laboratories or chemical operations. Air samples collected near known chemical emission sources are presented as the highest expected chemical air pollutant levels from current SNL/NM operations. Due to dilution and dispersion, lower levels of these air pollutants would occur at locations offsite and further away from the sources.

The maximum ambient concentrations of VOCs measured by monitoring stations onsite at SNL/NM in 1996 are identified in Table 4.9–4 (SNL/NM 1997a). These concentrations are below safety levels established for workers in industrial areas. Although there are no SNL/NM-operated monitoring stations offsite, it is possible to make the assessment that concentrations decrease with distance from the source and, therefore, are also below health-risk levels for impacts to public health.

Small amounts of nonradiological chemical contamination, which have been caused by past SNL/NM operations, have been identified in other environmental resources (such as groundwater and soils-subsurface [Sections 4.5 and 4.6]). Chemicals existing in the environment have the potential to reach members of the public through these different transport pathways. Environmental sampling programs involving resources such as groundwater, soils, and surface water, are designed to monitor and assess the potential for public exposure to these pollutants through these different media. Evaluations of groundwater, soils, and surface water information indicate that the public is not in contact with these areas of contamination within SNL/NM site boundaries and that the contamination is not being transported offsite (Sections 4.5.3, 4.6.3, and 4.6.6).

4.10.3.3 Worker Health and Safety

SNL/NM operations are required to be in compliance with the DOE and Occupational Safety and Health Administration (OSHA) requirements for worker health and safety. DOE ES&H programs regulate the work environment and seek to minimize the likelihood of work-related exposures, illnesses, and injuries.

Calculating Radiological Effects

Estimating potential human health effects involves a series of calculations that indicate the potential health consequence of a particular action or accident. Effects can be calculated both for individuals and for a population. The health effect of concern is a person dying from cancer caused by being exposed to low levels of radiation. To quantify the radiological impact, the radiation dose must be calculated.

The dose is a function of the exposure pathway (external, inhalation, or ingestion) and the type and quantity of radionuclides involved. The calculated concentrations of radionuclides in the air from emissions are used in conjunction with uptake parameters, usage rates, duration times, and radionuclide-specific dose factors in determining internal dose. The total dose is the sum of external and internal doses from all pathways.

After the dose is estimated, the health impacts (number of additional latent cancer fatalities in a population or probability of additional latent cancer fatalities for an individual) are calculated from current internationally recognized risk factors (Section 4.10.3). These health impacts are further explained in Section 4.10.

Radiological

SNL/NM's Occupational Radiation Protection Program complies with the Federal requirements in 10 CFR Part 835, *Occupational Radiation Protection,* and DOE N 441.1, *Radiological Protection for DOE Activities*. These requirements provide protection to onsite workers and visitors at SNL/NM.

Workers receive approximately the same background radiation dose as members of the general public. Some workers receive an additional dose from working in specific radiation facilities. The Radiation Exposure Monitoring System (REMS) database records worker radiation dose information as the total effective dose equivalent (TEDE), which is a sum of external and internal radiation doses. Radiation monitoring devices, known as dosimetry badges, report an individual's external dose information. Bioassays provide internal dose information. Annually, information from dosimetry badges and bioassays is totaled as an individual TEDE and provided to each worker.

The REMS database also contains information on the number of badges issued. This is used to compile the annual average dose to workers at SNL/NM. Because the detection limit used to assess dosimetry badges is 10 mrem (external and internal radiation dose) above background, only exposures greater than 10 mrem above background are used in deriving the annual average collective TEDE to workers. For purposes of the SWEIS, this annual average collective TEDE is applied to this group of workers characterized as radiation-badged workers

Exposure to Radiation

All people are constantly exposed to some form of radiation. This radiation can be from different sources: cosmic from space, medical from X-rays, internal from food, and external from rocks and soil (such as radon in homes) (Figure 4.10–2). The "roentgen equivalent, man" (rem) unit is a measurement of the dose from radiation and its physical effects and is used to predict the biological effects of radiation on the human body. Therefore, one rem of one type of radiation is presumed to have the same biological effects as one rem of any other type of radiation. This allows comparison of the biological effects of radiological materials that emit different types of radiation. A commonly used dose unit of measure is millirem (mrem), which is equal to 0.001 rem.

Dosimetry Badges

All employees, contractors, and visitors entering or working in radiation areas are issued radiation monitoring devices known as dosimetry badges. The Radiation Exposure Monitoring System (REMS) database records individual worker radiation dose information as the total effective dose equivalent (TEDE), which is a sum of external and internal radiation doses. The detection limit for dosimetry badges used is 10 mrem above background, and therefore only exposures greater than 10 mrem are recorded, compiled, and used in deriving the annual average collective TEDE for the radiation-badged worker population (workers receiving 10 mrem or more above background).

(badges with greater than 10 mrem). The actual annual average worker dose for the entire SNL/NM workforce is much lower than the annual average radiation-badged worker dose.

Table 4.10–1 lists the annual average, maximum, and collective radiation-badged worker doses, based on data for 1992 through 1996. Based on the International Commission on Radiation Protection (ICRP 1991)-recommended risk estimator of 400 fatal cancers per 1 M person-rem among workers (ICRP 1991), the annual average collective dose increases the number of additional fatal cancers by $4.8x10^{-3}$ in the radiation-badged worker population from routine SNL/NM operations. The annual average radiation-badged worker dose (based on the 5-year average) increases the radiation-badged worker's lifetime risk of fatal cancer from a one-year exposure by $1.68x10^{-5}$. The radiological limit for an individual worker is 5,000 mrem/year (10 CFR Part 835). The maximum annual dose of 2,000 mrem/yr for an individual worker is set as an administrative guideline limit at SNL/NM.

Nonradiological

Occupational Injuries/Illnesses

OSHA has identified the most important risks to the health of workers as common industrial accidents that normally involve falls, slips, trips, contact with objects, and so on, and that result in sprains, cuts, abrasions, fractures, and other injuries. Monitoring and using personal protective equipment minimize or prevent overexposures to hazardous chemicals.

SNL/NM must comply with Federal requirements to track and report occupational illnesses and injuries as required by 29 CFR Part 1904, DOE O 231.1, DOE O 232.1, and the associated *OSHA Record Keeping Guidelines for Occupational Injuries and Illness, 1986* (29 CFR Part 1904). DOE contractors must report to DOE/Headquarters (HQ) the same type of information on occupational injuries and illnesses that private industry provides to the Bureau of Labor Statistics (BLS). SNL/NM and its contractors annually report all illnesses and injuries as required by OSHA. Table 4.10–2 and Figure 4.10–3 compare the

Table 4.10–1. Radiation-Badged Worker Doses (TEDE) at SNL/NM (1992-1996)

RADIATION-BADGED WORKER[a]	YEAR	RADIATION DOSES	FEDERAL STANDARD/DOE GUIDELINE
Annual Average Dose[b] (millirem/year)	1992	35	ALARA
	1993	40	ALARA
	1994	52	ALARA
	1995	34	ALARA
	1996	47	ALARA
AVERAGE	--	**42**	**ALARA**
Annual Maximum Dose (millirem/year)	1992	920	5,000
	1993	520	5,000
	1994	830	5,000
	1995	500	5,000
	1996	845	5,000
AVERAGE	--	**723**	**5,000**
Annual Collective Dose (person-rem)	1992	16	ALARA
	1993	12	ALARA
	1994	10	ALARA
	1995	10	ALARA
	1996	12	ALARA
AVERAGE	--	**12**	**ALARA**

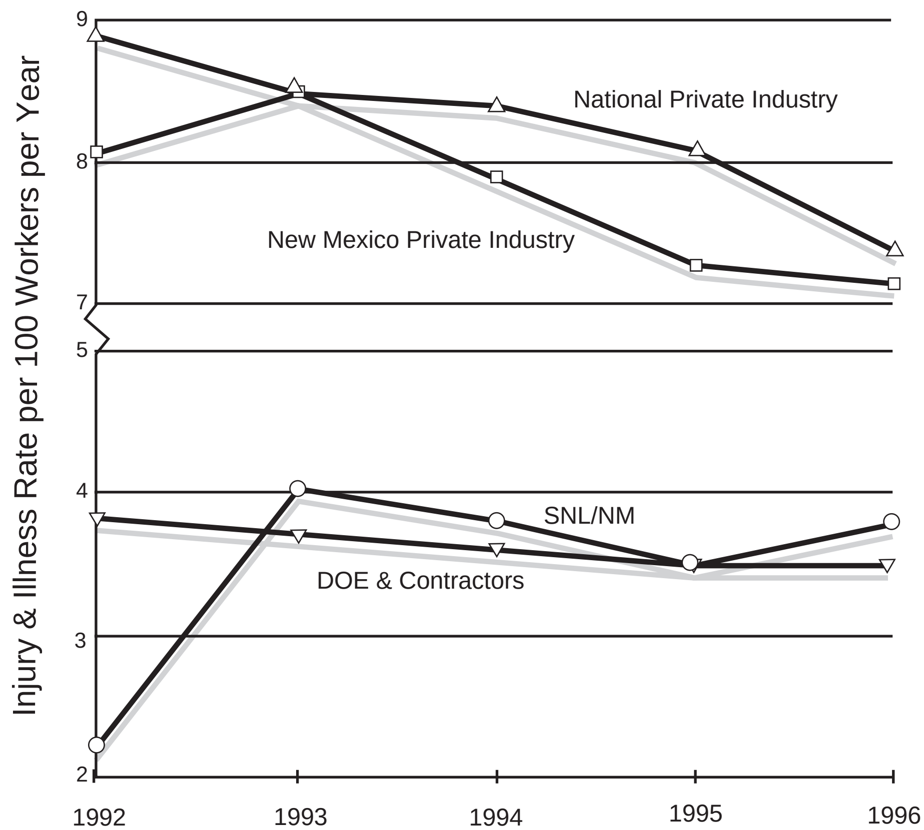
Source: SNL/NM 1997k
ALARA: as low as reasonably achievable
mrem: millirem
TEDE: total effective dose equivalent

[a] Radiation-badged workers are those having badges measuring greater than 10 mrem.
[b] Annual average dose equals the collective TEDE divided by the number of badges with a measured dose greater than 10 mrem above background, which is the detection limit of the dosimetry used.

Table 4.10–2. Comparison of Nonfatal Occupational Injury/Illness Rates[a] (1992 through 1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	2.3	4.1	3.8	3.5	3.8
DOE & Contractors	3.8	3.7	3.6	3.6	3.5
New Mexico Private Industry	8.1	8.5	7.9	7.3	7.3
National Private Industry	8.9	8.5	8.4	8.1	7.4

Sources: DOE 1997b, n.d.(h); DOL 1996, 1997b-f, j, i, n, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l
[a] Rates are per 100 workers per year.



Sources: DOE 1997b, n.d. (n); DOL 1996, 1997b-f, i, j, n, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l

Figure 4.10–3. Comparison of Nonfatal Occupational Injury/Illness Rates (1992 through 1996).

SNL/NM's nonfatal occupational injury/illness rates compared favorably with local and national private industry rates.

1992 through 1996 nonfatal injury/illness case rates per 100 workers (or 200,000 hours equivalent) for SNL/NM, the DOE, private industry in New Mexico, and private industry nationally. SNL/NM injury/illness rates are much lower than those of private industry (national or local) and are similar to the DOE as a whole.

The numbers of lost workdays resulting from nonfatal injuries and illnesses are also recorded annually. Table 4.10–3 and Figure 4.10–4 compare the lost workday case rates (number of lost workdays per 100 workers or 200,000 hours equivalent) for SNL/NM, the DOE and contractors, private industry in New Mexico, and private industry nationally. Both the DOE and SNL/NM show lower lost workdays than those of private industry (national and local).

Occupational Fatalities

As shown in Table 4.10–4, approximately 6,000 occupational fatalities occur each year nationwide (SNL/NM 1997b). Private industry accounts for approximately 5,500 of that total. Based on 5 years of data listed in Table 4.10–4, New Mexico has an average of 57 occupational fatalities per year. Ninety percent of occupational fatalities occur in private industry, while government, including Federal, state, and local, account for 10 percent (DOL 1997j). SNL/NM has never experienced a fatal occupational injury (SNL/NM 1997b).

Occurrences

DOE O 231.1, *Environment, Safety and Health Reporting* (see Chapter 7), and its predecessors specify criteria for reporting specific conditions, incidences, or situations related to the safety and security of operations of DOE and its contractors in formal occurrence reports. Occurrence reporting increases sensitivity to potentially unsafe conditions, requires analyses to determine the causes of events, provides a vehicle for formal corrective actions, and fosters lessons-learned programs. The *ORPS* database tracks occurrences (DOE 1998h).

Table 4.10–5 lists, by reporting category, the SNL/NM occurrence reports between 1993 and 1996. The number of reportable occurrences in categories "personnel safety" and "personnel radiation protection" have remained relatively constant at SNL/NM (SNL/NM 1997b). The personnel safety category, which includes any reportable injury, illness, or overexposure to hazardous chemicals or radiation, accounts for less than 10 percent of reportable occurrences. Not all reported occurrences in Table 4.10–5 result in adverse effects on human health; they also report on other categories, such as security violations and observations that are potentially hazardous conditions.

Industrial Hygiene Reports

The industrial hygiene (IH) program monitors airborne chemicals and hazards in the workplace. A wide variety of workplace chemicals are monitored, such as heavy metals, VOCs, solvents, acids, as well as other potentially harmful health hazards, including noise and radio frequency.

The IH program investigates a wide variety of conditions and situations potentially involving health impacts to workers. An Industrial Hygiene Investigation Report (IHIR) is completed when formal investigations are conducted. IHIRs are performed or initiated through various avenues such as a worker complaint, scheduled monitoring, use assessments, worker risk assessments, change of building use (for example, changing laboratory to office space), and for other health and safety-related reasons.

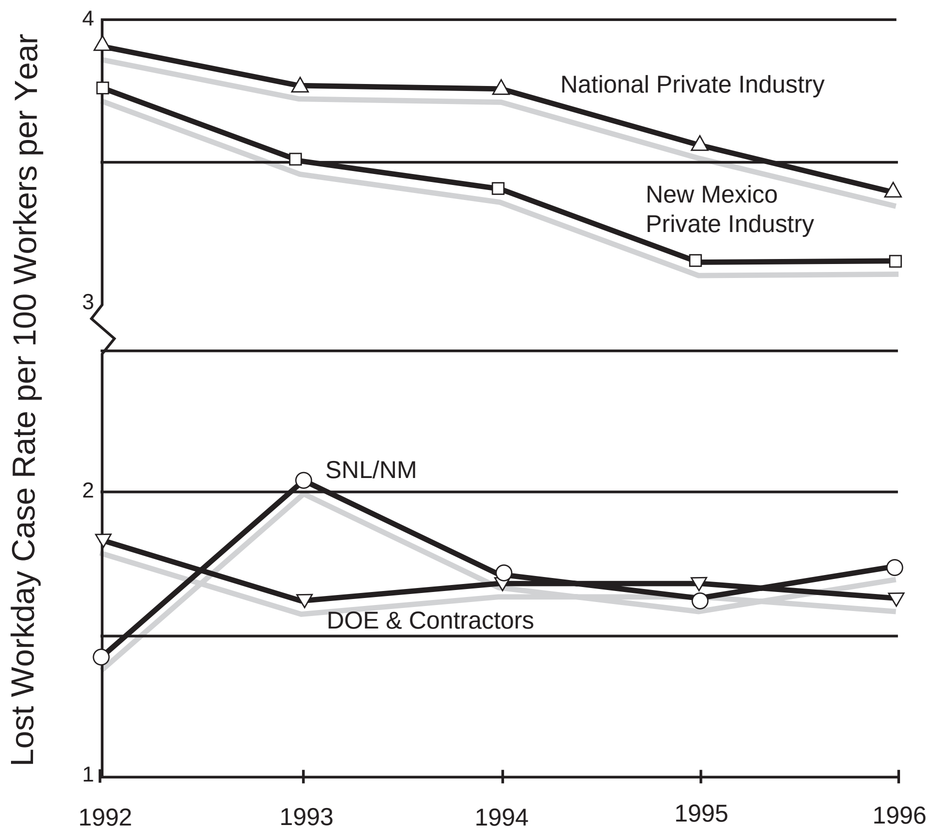
Table 4.10–6 identifies the total number of IHIRs performed by IH program staff from 1992 through 1996. Less than 25 percent of these investigations involved air monitoring for worker exposures to hazardous materials, including chemicals in the workplace. Very few of these investigations ever revealed an environment where an overexposure to a chemical (above a health control limit) might occur. Reportable/recordable chemical exposures to an individual are reported in the *ORPS* database (DOE 1998h). The SNL/NM *Worksite Accident Reduction Expert (WARE)* database captures personal chemical exposure incidents (both OSHA/DOE recordable/reportable) (SNL/NM 1998d, 1998k). These incidents are investigated by either safety or industrial hygiene representatives, depending upon the type of accident, illness, or injury. Investigation report results are entered by safety representatives into the SNL/NM *WARE* database, which ultimately feeds recordable incidents into the DOE's *Computerized Accident/Incident Reporting System (CAIRS)* database, or directly by industrial hygiene personnel into the *CAIRS* database through completed IHIR reports. These databases identify personal chemical exposures exceeding a health control limit and are investigated or reported in the *ORPS* database.

A search was performed in the DOE's *ORPS* and *CAIRS* databases and SNL/NM's *WARE* database for personal chemical overexposures exceeding a health control limit. Data showing SNL/NM personal chemical exposures for 1992 through 1996 are listed in the bottom row of Table 4.10–6. Within SNL/NM facilities, one or two

Table 4.10–3. Comparison of Lost Workday Case Rates[a] (1992 through 1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	1.44	2.05	1.77	1.63	1.73
DOE & Contractors	1.8	1.6	1.7	1.7	1.6
New Mexico Private Industry	3.8	3.5	3.4	3.2	3.2
National Private Industry	3.9	3.8	3.8	3.6	3.4

Sources: DOE 1997b; DOL 1996, 1997b-f, i, j, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l;
[a] Rates are per 100 workers per year.



Sources: DOE 1997b; DOL 1996, 1997b-f, i, j, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l

Figure 4.10–4. Comparison of Lost Workday Case Rates (1992 through 1996)
SNL/NM's lost workday case rates compared favorably with local and national private industry rates.

Table 4.10–4. Comparison of Total Fatal Occupational Injuries (1992-1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	0	0	0	0	0
New Mexico Private Industry	35[a]	55	54	58	60
National Private Industry	5,497	5,590	5,923	5,495	5,521
National Total (Government & Private Industry)	6,217	6,331	6,632	6,275	6,112

Sources: DOL 1992, 1993, 1994, 1995, 1997a, g, h, k-m; SNL/NM 1997b
[a] Reflects startup of collection program; number is considered low/conservative.

Table 4.10–5. SNL/NM Safety and Security Occurrences by Reporting Category (1993-1996)[a]

CATEGORY	YEAR			
	1993	1994	1995	1996
Facility Condition	48	25	27	33
Environmental	11	16	6	2
Personnel Safety	1	5	2	4
Personnel Radiological Protection	2	2	4	3
Safeguards & Security	7	1	5	3
Transportation	1	2	2	1
Value Basis Reporting	2	4	4	3
Facility Status	0	0	0	0
Nuclear Explosive Safety	0	0	0	0
Cross Category Items	5	4	4	12
GRAND TOTAL	**77**	**59**	**54**	**61**

Source: SNL/NM 1997b
[a] Some occurrences received more than one classification, so the total differs slightly from the total number of occurrences.

Table 4.10–6. SNL/NM Industrial Hygiene Investigation Reports Summary (1992-1996)

IHIRs	YEAR				
	1992	1993	1994	1995	1996
Total Number of IHIRs	436	702	933	799	411
Number With Hazardous Material Air Monitoring Data	151	210	207	113	65
Number With Data Showing Personal Chemical Exposures	1	1	2	0	2

Sources: SNL/NM 1997e, 1998d, 1998k
IHIR: Industrial Hygiene Investigation Report

reportable chemical exposures occurred each year during the past 5 years. None of these were monitored overexposures. SNL/NM has an extensive safety and health program, compliance policies, and personal protective procedures in place to reduce or minimize the potential for work-related chemical exposures to hazardous or toxic chemicals.

4.11 TRANSPORTATION

4.11.1 Definition of Resource

This section describes current regional and local transportation activities, including descriptions of any highway, rail, air, or marine transportation infrastructure that the DOE uses to support hazardous material and waste movements at SNL/NM. Transportation activities at SNL/NM involve the receipt, shipment, and transfer of hazardous and nonhazardous materials and waste. Receipt refers to material received from an offsite location; shipment refers to material sent to an offsite location; and transfer refers to material moved from one onsite location to another.

4.11.2 Region of Influence

The transportation ROI consists of three areas: within KAFB, the major transportation corridors in Albuquerque, and the routes to and from DOE facilities and waste disposal sites.

4.11.3 Affected Environment

Moving or transporting hazardous material and waste under any conditions can pose inherent risks and impacts to workers and the public. However, SNL/NM has standard operating procedures in place to minimize these risks, and to ensure worker and public safety. Normal transportation activities affect air quality, noise and vibration, and traffic congestion. Some degree of external radiation exposure to workers and the public, which is known as incident-free exposure, also occurs during routine operations.

4.11.3.1 Responsible Organizations and Materials Tracking

SNL/NM organizations share responsibility for ensuring the safe receipt, shipment, and transfer of hazardous material and waste. These organizations perform the administrative and logistical operations involved in inspecting, packaging, handling, loading, transferring, shipping, and receiving these materials.

Accountable radioactive material receipts, shipments, and onsite transfers are tracked through the *Local Area Network Nuclear Material Accountability System (LANMAS)*, a database that tracks the location of nuclear materials inventory. Explosive material shipments are tracked through the Explosive Inventory System, which records all receipts, onsite transfers, and shipments of explosive materials by tracking the movement of each individual unit. It is common for several trackable units to be moved simultaneously on the same conveyance.

Chemical purchases are tracked through the Chemical Inventory System (CIS) maintained by SNL/NM. The majority of chemical purchases, received in small quantity containers, are made through the just-in-time (JIT) procurement procedures, which are designed to limit any excess chemical inventory in storage onsite. Other purchases, delivered in bulk loads, include compressed gasses such as hydrogen and liquid nitrogen, large quantity acids and bases, and bulk fuels. JIT chemical vendors are required to issue a 10-digit barcode to each chemical container and to compile the following delivery information: vendor catalog number, quantity, unit of measure, delivery location (building, room, and quad), organization number, delivery date and time, person delivered to, price, and the material requisition number. The vendor is also responsible for providing the following chemical-specific data for inclusion in the CIS files: chemical name, physical state, manufacturer/supplier name, standard industry barcode number, Chemical Abstract Service (CAS) numbers of ingredients, *Superfund Amendments and Reauthorization Act* (SARA) storage code, SARA temperature code, SARA pressure code, and National Fire Protection Association (NFPA) codes. The vendors are required to transfer the accumulated data and catalog updates to the SNL/NM CIS every Monday, Wednesday, and Friday, or as otherwise agreed upon by the vendor and the CIS department. Each vendor is responsible for the accuracy of the data they submit to the CIS. In addition, vendors also provide Material Safety Data Sheets (MSDSs) for all chemicals not having an MSDS on record.

4.11.3.2 Types and Quantities of Material and Waste Transported

The affected environment considered under this analysis includes all transportation activities related to normal operations at SNL/NM. Normal operations encompass all operations required in order to maintain production at SNL/NM facilities. However, special operations, those operations outside the scope of normal facility production, sometimes occur and can have a substantial effect on the overall transportation activities at SNL/NM. Special operations and new programs routinely undergo program-specific assessments to consider any impacts that may result from their inception. These are also included in the site-wide analysis. One special program, the ER Project, is discussed separately because, within its limited duration, this project will be the single largest waste generator at SNL/NM through 1999, based on current projections.

Table 4.11–1 lists the number of hazardous material and waste shipments, receipts, and transfers made by SNL/NM during 1996. U.S. Department of Transportation (DOT) definitions and standards (49 CFR Part 173) establish the means to determine if a material constitutes a hazard for offsite transportation. SNL/NM standards, which were developed in accordance with DOE, DOT, and USAF policies, determine if a material constitutes a hazard for onsite transportation. A *hazardous material*, as defined in 49 CFR Part 173, is one that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, can, without proper management, significantly contribute or pose a potential hazard to human health or the environment. The types of SNL/NM hazardous materials regulated by the DOT include radioactive materials, chemicals, explosive materials, and fuels. There are also three types of waste transported by SNL/NM: radioactive waste; hazardous waste (which includes RCRA chemical and explosives waste, medical waste, and TSCA waste, primarily asbestos and polychlorinated biphenyls [PCBs]); and nonhazardous solid waste.

In 1997, SNL/NM received more than 25,000 chemical containers in approximately 2,750 shipments. The majority of these receipts were small quantity purchases made through the JIT vendors. The remainder of the receipts were large quantity purchases received as bulk loads, including compressed hydrogen tube trailers, and acids received from tanker trucks. Typically, JIT chemicals are provided through local vendors and are usually shipped from locations within 40 km of SNL/NM.

In 1997, the JIT materials received from Fisher Scientific (representing 25 percent of all JIT chemicals received from vendors) were primarily flammable, approximately 46 percent (DOT Hazard Class [HC] 3); corrosive, approximately 35 percent (HC 8); and toxic substances, approximately 2 percent (HC 6.1) (FWENC 1998a). Flammables include materials such as acetone, isopropyl alcohol, methanol, propyl alcohol, and toluene. Corrosives include materials such as nitric acid, acetic acid, sulfuric acid, hydrogen chloride, and sodium hydroxide. Toxic chemicals include materials such as methylene chloride, trichloroethene, and chloroform.

Chemicals are the most frequently received hazardous materials at SNL/NM. The second most frequently received hazardous material is radioactive material. Radioactive and explosive materials shipments are often delivered through government carriers, unless the quantities and activities being transported are low enough to meet Federal guidelines and restrictions in place for authorized commercial transporters.

SNL/NM ships radioactive material in both excepted and DOT-specific packaging. The most common type of shipments is excepted packaging shipments. Packaging includes containers and all accompanying components or materials required to adequately contain the material. Radioactive material that is shipped in excepted packaging has a radioactive level below the limit established in specific regulations contained within 49 CFR Part 173. Generally, in order to be shipped as excepted packaging, the radiation level at any point along the surface of the package cannot exceed 0.5 mrem per hour. The package type used must meet the standards set by the carrier and a statement must be included with the package that cites the specific regulation within 49 CFR Part 173 allowing the material to be shipped without shipping papers. Typical materials that fall under the excepted material criteria are low-level radioactive source material, instruments, and empty packaging.

Material with radioactive levels in excess of the excepted packaging regulations must be shipped in either a Type A or Type B container. Type A containers are designed to undergo the routine stresses of transport and can be drums, metal boxes, or wooden boxes. For a container to be considered Type A, it must be constructed and identified as following specific guidelines found within 49 CFR Part 173. Radioactive material requiring Type A containers consists of two categories, A1 and A2. A1 material is "special form" radioactive material, and A2 material is radioactive material in forms other than special form and low-specific-activity (LSA) radioactive material. Maximum activities of isotopes for A1/A2 are found in both 10 CFR Part 71 and 49 CFR Part 173. Radioactive material exceeding the activities posted in the A1/A2 table must be shipped in a Type B container. Type B containers are designed and tested to undergo stresses that exceed those usually associated with routine shipping, such as wrecks, fires, and so on. LSA radioactive material is shipped in industrial packing containers. Specifications for these containers are also found in 49 CFR Part 173. Chapter 7 provides detailed information regarding the specific regulations cited above.

SNL/NM also purchases propane to provide space heating to TAs-III and -V and other remote areas. Propane purchases should diminish significantly in the near future as remote facilities convert to natural gas heating. Offsite sources deliver other fuels, such as gasoline, diesel, and jet fuels, directly to KAFB. Then SNL/NM

Table 4.11–1. Annual Receipts, Shipments, and Transfers of Hazardous Material at SNL/NM

TYPE OF MOVEMENT		HAZARDOUS MATERIAL/WASTE	NUMBER OF MOVEMENTS[a]
Receipt	***Materials***	Radioactive material[b]	109 (1997)
		Chemical material	2,750 (1997)
		Explosives	123 (1997)
		Fuels:	
		Diesel/unleaded	0
		Jet	0
		Propane	136
	Waste	TRU	0
		MTRU	0
		LLW	0
		LLMW	1
		Hazardous waste[c]	12 (1997)
		Solid waste	0
Shipment	***Materials***	Radioactive material[b]	196 (1997)
		Chemical material	164
		Explosives	180 (1997)
	Waste[d]	TRU	0
		MTRU	0
		LLW	4
		LLMW	1
		Hazardous waste[c]	64 (1997)
		Recycled	8 (1997)
		Solid waste	51 (1997)
	ER Waste[f]	TRU	0
		MTRU	0
		LLW	22
		LLMW	0
		Hazardous waste[c]	27 (1997)
Transfer	***Materials***	Radioactive material[b]	10 (1997)
		Chemicals[h]	0
		Explosives	1,453 (1997)
		Fuels:	
		Diesel/unleaded	72
		Jet	1
		Propane	0
	Waste	TRU[g]	0 (1997)
		MTRU[g]	4 (1997)
		LLW[g]	761 (1997)
		LLMW[g]	35 (1997)
		Hazardous waste[c]	Daily
		Solid waste	Daily

Source: SNL/NM 1997a
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
TSCA: *Toxic Substance Control Act*
[a] 1996 figures unless otherwise noted
[b] Data are restricted to accountable nuclear material
[c] Hazardous waste includes RCRA, TSCA, and medical waste.
[d] Waste shipments due to normal operations
[e] The Hazardous and Solid Waste Department records the quantity of waste shipped offsite. This assumes that the quantity of waste collected on the site in any year is approximately equal to the quantity shipped offsite for disposal.
[f] Waste shipments due to the ER Project, a limited duration special project
[g] Data are in terms of the estimated maximum collection trips per year by the Radioactive and Mixed Waste Department. Actual onsite conveyances of radioactive and mixed wastes are not included in the table.
[h] Chemical transfers are included within the chemical waste shipments.

purchases these fuels from KAFB as needed; thus, most fuel shipments are considered transfers rather than receipts.

4.11.3.3 Destinations and Origins of Shipments, Receipts, and Transfers

SNL/NM receives radioactive material and explosives from a number of locations across the U.S. and, since 1994, has shipped radioactive material to 96 locations. The common and recently used destinations are listed in Table 4.11–2. At present, SNL/NM ships hazardous waste offsite to several facilities for treatment and disposal. Most of these sites are located in the southwestern U.S. (Table 4.11–2).

4.11.3.4 Historic Records of Hazardous Material Transportation Incidents

Since 1994, SNL/NM has had six transportation-related incidents involving the onsite transfer of hazardous material. One incident occurred in 1997, two in 1996, and three in 1994 (Table 4.11–3). None resulted in the release of a hazardous cargo to the environment. No member of the workforce or the public was exposed to or harmed by hazardous material related to the incidents. Only one incident, on April 12, 1994, involved injuries to occupants of the vehicle involved.

Since 1994, SNL/NM has had seven transportation-related incidents involving the offsite shipment or receipt of hazardous material. Two incidents occurred in 1998, two in 1996, two in 1995, and one in 1994 (Table 4.11–3). None resulted in the release of a hazardous cargo to the environment and no member of the workforce or the public was exposed to or harmed by hazardous material related to the incidents.

4.11.3.5 Emergency Response and Training

The *Emergency Preparedness Plan* describes the process SNL/NM uses to prepare for and respond to emergencies (SNL/NM 1997a). The plan is reviewed annually and revised as necessary. Emergency planning is required under the *Emergency Planning and Community Right-to-Know Act of 1996* (42 U.S.C. §11001).

4.11.3.6 SNL/NM Site-Related Traffic

Road Network

Albuquerque is intersected by Interstate 40, which runs east-west, and Interstate 25, which runs north-south (Figure 4.2–1). Figure 4.11–1 shows the road network for the city of Albuquerque. Figure 4.11–2 shows the road network for SNL/NM and KAFB and the onsite routes specified for transporting hazardous material.

In 1995, approximately 7,868 trucks were estimated to have entered Albuquerque by way of interstates on any given work day; however, only 1,514 were placarded, and only 383 of these were indicated to be carrying hazardous materials. SNL/NM made an estimated 15 offsite truck shipments per day in 1996.

Traffic enters SNL/NM through three principal KAFB gates; Wyoming, Gibson, and Eubank. These gates handle 26 percent, 30 percent, and 20 percent of the total traffic entering KAFB, respectively. An additional entrance to KAFB, the Truman gate, serves KAFB's western area, and exclusively handles KAFB-related traffic. The principal mode of transportation for moving hazardous material shipments to or from SNL/NM is by truck. Most commercial truck traffic to SNL/NM uses the Eubank gate because it provides easy access to SNL/NM shipping and receiving in Building 957 (TA-II).

Other SNL/NM Modes of Transportation

SNL/NM uses the Albuquerque International Sunport for passenger and airfreight services. Commercial airfreight services, such as Emery Air Freight or Federal Express, are available at the Sunport. Ross Aviation, Inc., also located at the Sunport, is available to support DOE programs and operations. Access to Ross Aviation is at the east end of KAFB.

Occasionally, SNL/NM may ship materials to or from Kauai, Hawaii, either by way of air or marine transport, based on regulatory requirements and restrictions. Such shipments occur as needed and could be hazardous in nature. However, since 1994, no identified shipments have used marine transport.

Since the Burlington Northern & Santa Fe Railroad, located in Albuquerque, discontinued its spur to KAFB in 1994, SNL/NM has not had an active rail spur. Any current or future rail shipments would have to travel by truck to the Santa Fe railway yard in downtown Albuquerque.

Employee-Related Traffic Volume

SNL/NM staff coming to and leaving KAFB and traffic from maintenance and contractor vehicles are significant contributors to KAFB traffic. A recent estimate of the employee-related traffic volume describes the traffic from SNL/NM commuters and SNL/NM and DOE-owned vehicles (SNL 1996c). The Sandia Vehicle Decal Office issued 22,940 decals in a 3-year period for SNL/NM

Table 4.11–2. Most Common Origins/Destinations of SNL/NM Materials and Waste Receipts and Shipments

TYPE OF MOVEMENT	TYPE OF MATERIAL/WASTE	MOST COMMON ORIGIN/DESTINATION	MOVEMENTS[a]
RECEIPTS			
Materials	Radioactive	Los Alamos National Laboratory, Los Alamos, NM	30
		Pantex Plant, Amarillo, TX	31
		Martin Marrietta, Largo, FL	17
	Chemical	Various local vendors, Albuquerque, NM (1997)	2,750
	Explosive[b]	Pantex Plant, Amarillo, TX (1997)	22
		SNL/CA, Livermore, CA (1997)	18
		Strategic Weapons Facility Pacific, Silverdale, WA	9
		Tonopah Test Range, Tonopah, NV (1997)	19
		New explosive material (1997)	423
Waste	Hazardous	SNL/NM, Albuquerque offsite laboratories	12
	LLMW	SNL/CA, Livermore, CA	2
	TRU	Lovelace, Albuquerque, NM	0
SHIPMENTS			
Materials	Radioactive	Harris Semiconductor, Mountaintop, PA	65
		El Segundo, CA	33
		Pantex Plant, Amarillo, TX	13
	Chemical	Burnet, TX	12
		Carlsbad, CA	16
		Livermore, CA	9
	Explosive (1997)	Los Alamos National Laboratory, Los Alamos, NM	11
		SWFLANT, Kings Bay, GA	26
		Vandenberg AFB, CA	25
		Strategic Weapons Facility Pacific, Silverdale, WA	24
		Tonopah Test Range, Tonopah, NV	20
Waste	LLW	Envirocare, Clive, UT	0 (22 ER)
		Nevada Test Site, Mercury, NV	4
	LLMW	Permafix, Gainesville, FL	1
		DSSI, Oak Ridge, TN (from Permafix)	0
		Envirocare, Clive, UT	14
	TRU/MTRU	Los Alamos National Laboratory, Los Alamos, NM (1997)	0

Table 4.11–2. Most Common Origins/Destinations of SNL/NM Materials and Waste Receipts and Shipments (concluded)

TYPE OF MOVEMENT	TYPE OF MATERIAL/WASTE	MOST COMMON ORIGIN/DESTINATION	MOVEMENTS[a]
Waste (continued)	Hazardous (1997)	Deer Park, TX	5
		ENSCO, El Dorado, AR	11
		Keers, Mountainair, NM	9
		Kirtland AFB, Albuquerque, NM	7
		Laidlaw Gray Back, UT	1
		Laidlaw Grassy Mountain, UT	8 (27 ER)
		Laidlaw Lone Mountain, Waynoka, OK	1
		Laidlaw Aptus, Aragonite, UT	12
		Laidlaw BDT, Clarence, UT	4
		NSSI Sources & Services, Inc, Houston, TX	1
		Salesco Systems, Inc, Phoenix, AZ	4
		Transformer Disposal Specialists, Tonkowa, OK	2
	Solid Waste	Rio Ranch Sanitary Landfill, Rio Rancho, NM (1997)	51
	Recyclable Hazardous (1997)	Kinsbursky Brothers, Anaheim, CA	2
		Safety-Kleen Corp, Albuquerque, NM	2
		Tab Manufacturing, Albuquerque, NM	4

Sources: FWENC 1998a; Rinchem 1998a; SNL/NM 1997a, 1998z, 1998aa
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
SNL/CA: Sandia National Laboratories/California
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
[a] Figures given for 1996 unless otherwise noted
[b] Many explosives received were new explosives. In 1997, 423 of 638 trackable units received were new with no tracking unit number. Because unit numbers were identified, actual numbers of these receipts is unknown.

employees, SNL/NM contractors, and DOE personnel. During the same period, 40,959 decals were issued for KAFB (exclusive of those associated with SNL/NM). Thus, SNL/NM accounted for 36 percent of the 63,899 decals issued.

An earlier traffic study by the Middle Rio Grande Council of Governments also determined that SNL/NM accounted for 36 percent (13,582 vehicles) of daily KAFB commuters (SNL 1996c).

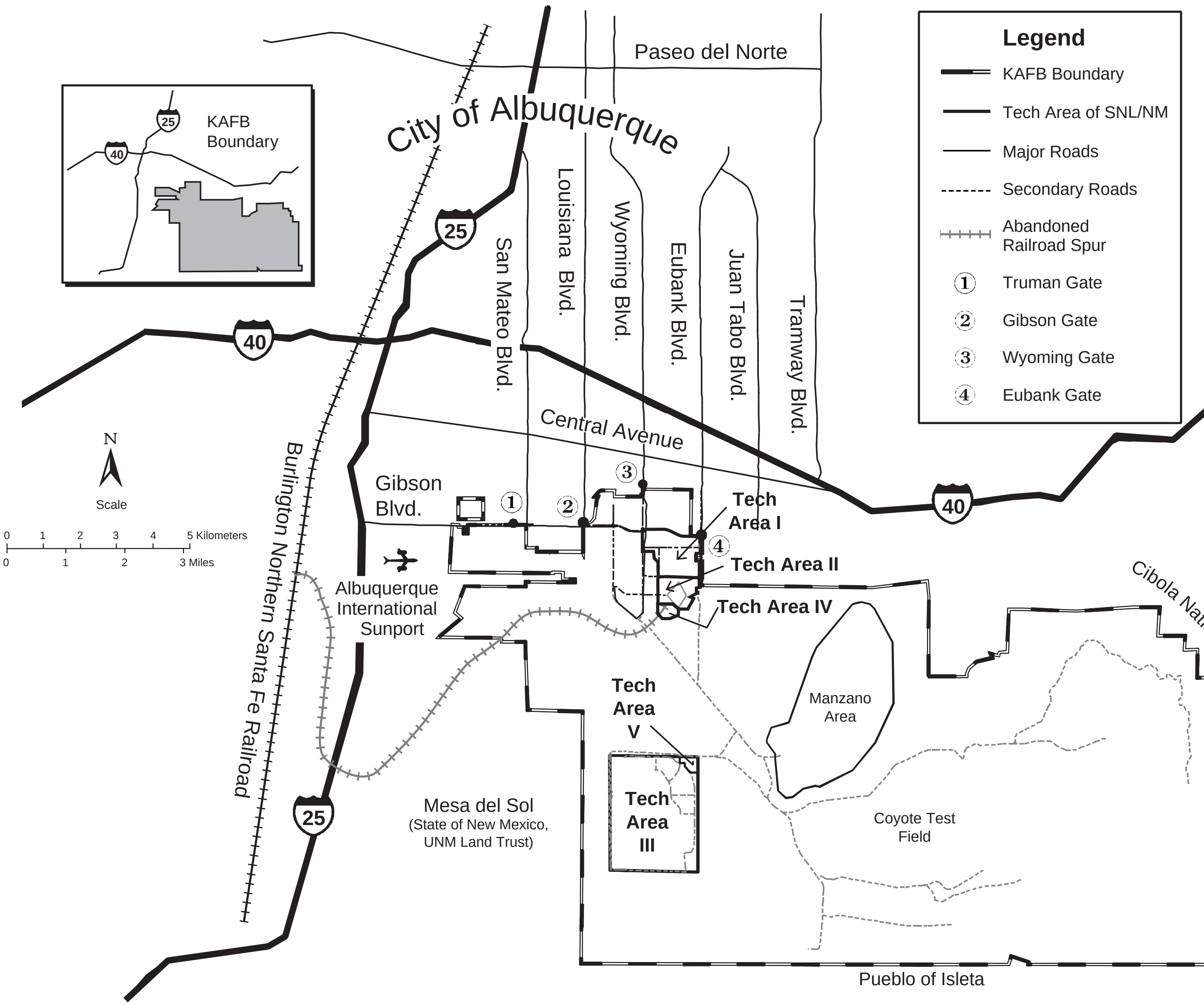
4.11.3.7 Traffic Accident Injuries and Fatalities

Table 4.11–4 lists SNL/NM traffic accidents from 1994 through 1997. Some of the accidents caused minor injuries, but none caused fatalities.

Table 4.11–3. SNL/NM Transportation Incidents, 1994 to 1998

DATE	INCIDENT DESCRIPTION	INJURIES	DEATHS	HAZARDOUS MATERIAL	MATERIAL RELEASED
ONSITE INCIDENTS					
4/12/94	Truck rollover with minor injuries	Yes	No	Two compressed gas cylinders	No
4/12/94	Radioactive material being transported in improperly placarded vehicle	No	No	Radioactive material	No
6/10/94	Material being moved sustained a leak of nonPCB-bearing transformer oil.	No	No	Oil	No
2/13/96	Radioactive contamination found in container in a nonradioactive control area.	No	No	Radioactive contamination	No
8/1/97	Radioactive Class II item being transported was improperly shipped as a radioactive limited quantity material.	No	No	Radioactive material	No
8/12/96	Survey found radioactive material in items sent to property reapplication.	No	No	Radioactive material	No
OFFSITE INCIDENTS					
6/20/94	Sample material sent to contract laboratory was identified as radioactive.	No	No	Radioactive material	No
1/11/95	SNL/NM assessed two violations for hazardous materials that were not properly classified, marked, or labeled.	No	No	Hazardous material	No
3/21/95	Explosives shipped in shipping pipe labeled as empty	No	No	Explosives	No
1/23/96	Follow-up survey found a container with internal radioactive contamination.	No	No	Radioactive material	No
9/11/96	Hazardous material package incorrectly packaged and labeled	No	No	Hazardous material	No
2/19/98	Shipment from vendor of explosive components received with cap not attached to safety containment cylinder.	No	No	Explosives	No
3/18/98	Radioactive material contamination levels found to exceed DOT limits concerning receipt and subsequent shipment offsite. Follow-up surveys at destination indicated material to be below DOT limits.	No	No	Radioactive material	No

Source: SNL/NM 1998f
PCB: polychlorinated biphenyl
DOT: U.S. Department of Transportation



Source: SNL/NM 1997j

Figure 4.11–1. Major Albuquerque Transportation Routes

Interstates 40 and 25 and a network of streets maintained by the city of Albuquerque serve KAFB.

Source: SNL/NM 1997j

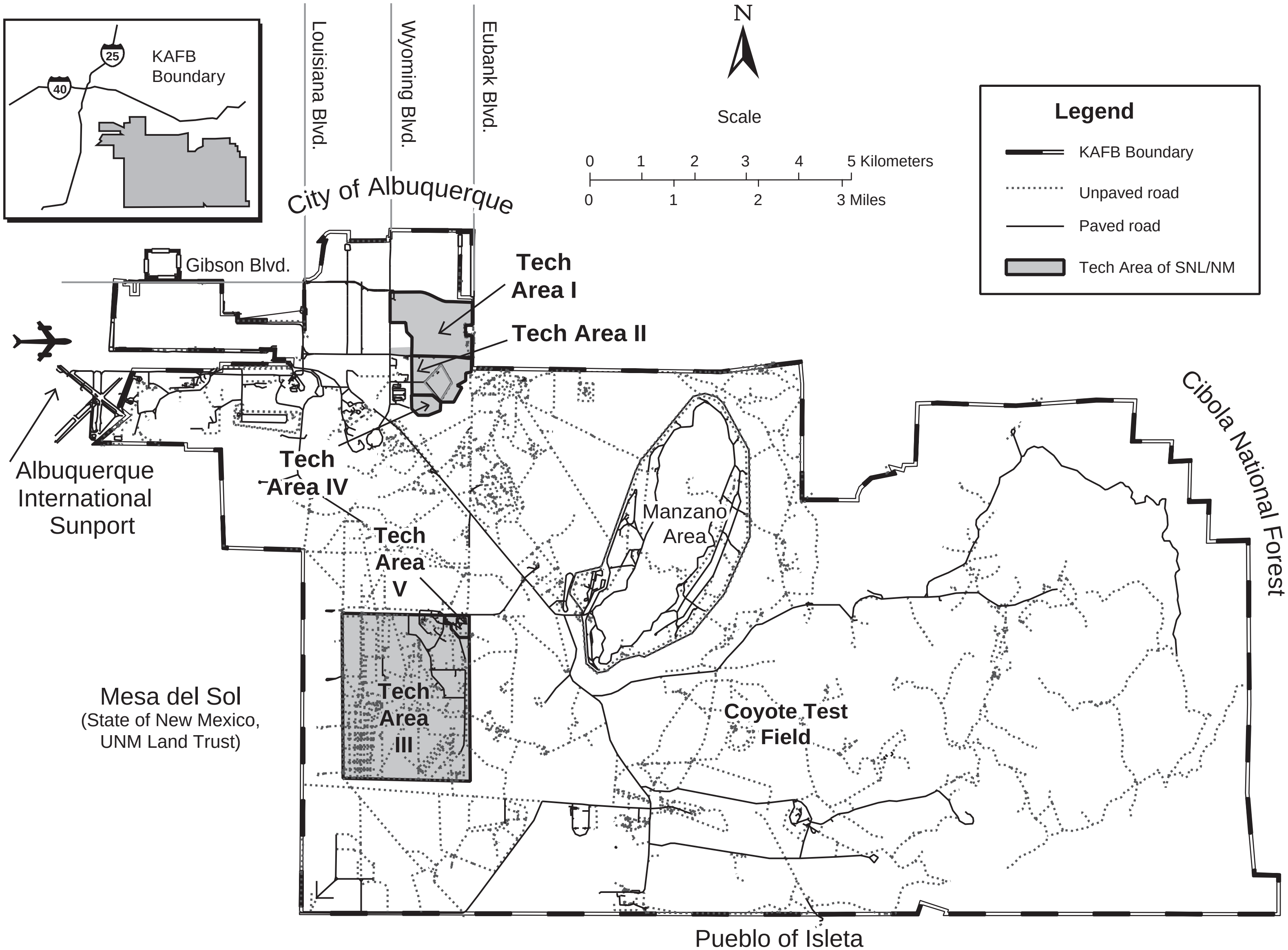


Figure 4.11–2. KAFB Transportation Routes

A large network of roads is used to transport material and wastes from site to site on KAFB.

Table 4.11–4. Traffic Accidents Involving SNL/NM Vehicles

DATE	ACCIDENT	INJURIES	DEATHS
2/23/94	Pedestrian accident with minor injuries	Yes (minor)	No
4/12/94	Truck rollover with minor injuries	Yes	No
11/17/94	SNL/NM employee suffered broken arm during palletizing activity	Yes	No
12/17/94	Truck caught fire	Yes	No
2/2/94	Security vehicle backed into 2-ft post; gas tank punctured	No	No
7/17/96	Government van involved in collision in downtown Albuquerque	Yes (minor)	No
1/13/97	Pedestrian struck by motorized cart at SNL/NM	Yes	No

Source: SNL/NM 1997a

4.12 WASTE GENERATION

4.12.1 Definition of Resource

Waste generation activities consist of managing, storing, and preparing for offsite disposal of all wastes in accordance with applicable Federal and state regulations, permits obtained under these regulations, and DOE orders. The waste categories generated onsite under normal operations include radioactive waste (including LLW, LLMW, transuranic [TRU] waste and mixed transuranic [MTRU] waste); hazardous waste, which includes RCRA hazardous (chemical and explosives) waste and biohazardous (medical) waste; TSCA waste (primarily asbestos and PCBs); and nonhazardous solid waste and process wastewater.

4.12.2 Region of Influence

The ROI for waste generation involves SNL/NM and its facilities, including the HWMF, the TTF, the Solid Waste Transfer Facility (SWTF), the RMWMF, the High Bay Waste Storage Facility (HBWSF), the Interim Storage Site (ISS), and offsite SNL operations that generate and ship waste to SNL/NM (Table 4.11–2). The process design capacities for radioactive waste storage units covered under existing permits are shown in Table 4.12–1. The ROI does not include offsite waste disposal facilities because they involve the private sector or other Federal facilities. Waste management facility locations are shown in Figure 4.4–2.

4.12.3 Affected Environment

The generation of the many different waste streams at SNL/NM creates a continuous need for proper packaging, labeling, manifesting, transporting, storing, and disposing solutions.

Radioactive Waste Categories

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

Low-Level Mixed Waste (LLMW)—Waste that contains both hazardous waste regulated under the *Resource Conservation and Recovery Act* (42 U.S.C. §6901) and LLW.

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

Mixed Transuranic Waste (MTRU)—TRU waste that also contains hazardous waste, as defined and regulated under the *Resource Conservation and Recovery Act* (42. U.S.C. §6901).

Table 4.12–1. Process Design Capacity for Radioactive Waste Storage Units at SNL/NM

UNIT	CONTAINER STORAGE (m^3)
RMWMF	8,000
HBWSF	1,800
Manzano Bunker 37034[a]	235
Manzano Bunker 37045[a]	176
Manzano Bunker 37055[a]	176
Manzano Bunker 37057[a]	176
Manzano Bunker 37063[a]	235
Manzano Bunker 37078[a]	279
Manzano Bunker 37118[a]	279
ISS	510
TOTAL	**11,866**

Source: DOE 1996c
HBWSF: High Bay Waste Storage Facility
ISS: Interim Storage Site
m^3: cubic meters
RMWMF: Radioactive and Mixed Waste Management Facility
[a] Bunkers are located within the Manzano Area (see Figure 4.4–2).

4.12.3.1 Normal Operations

The affected environment considered under this analysis is limited to those facilities that generate waste under normal operations at SNL/NM. Normal operations encompass all current operations that are required to maintain production at SNL/NM facilities. Other waste considered includes small amounts generated from SNL or DOE-funded operations at other DOE or Federal facilities that may also be managed at SNL/NM. For example, historically, TRU waste generated by the Lovelace Respiratory Research Institute has been managed at SNL/NM.

4.12.3.2 New Operations

Several new operations are currently in the planning stages at SNL/NM. However, they are considered outside of the scope of the current affected environment description for this analysis because they have not yet reached operational status. New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future. SNL/NM has identified operations at four facilities that fall under this category: Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA), Radiographic Integrated Test Stand (RITS), Hot Cell Facility (HCF), and Annular Core Research Reactor (ACRR). The latter two are associated with the Molybdenum Isotopes Production Project (MIPP) (DOE 1996b). Due to the specific nature of waste material, it will be handled at the originating facilities until shipped offsite for disposal. Waste generated during the preparations for these operations has been omitted from assessments of existing operations in this SWEIS.

4.12.3.3 Special Projects

Special projects are limited-duration projects, such as corrective actions, that are considered separately from facility production. These projects can make a large contribution to the overall waste generation activities at SNL/NM. However, special projects and new programs routinely undergo program-specific assessments to consider any impacts that may result from their inception and are, therefore, not considered in-depth in the SWEIS.

One special project, the ER Project, within its limited duration, will actually be the single largest waste generator at SNL/NM, although it is not a component of normal operations. The Office of Environmental Management (EM) manages the ER Project, which is a phased program designed to identify, assess, and remediate DOE-owned or -operated facilities that have contamination from disposal sites, releases, or spills. SNL/NM has received a permit modification from EPA Region VI and the NMED for a Corrective Action Management Unit (CAMU) designed to be a treatment and disposal unit exclusively for ER Project-generated hazardous waste. The CAMU is near the former Chemical Waste Landfill (CWL), an ongoing ER Project remediation site near the southern boundary of TA-III. Authorization has been received from the EPA and NMED to treat metal-contaminated soil and organic compound-contaminated soil, respectively. Construction of the bulk waste staging area and temporary storage area components of the CAMU has been completed. Construction will be completed on the treatment area and disposal cell components of the CAMU as needed to accommodate contaminated soil from the CWL and other ER Projects. Excavation of the CWL was scheduled to begin in September 1998. The *Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* analyzes potential environmental effects of the characterization and waste cleanup or corrective action at ER sites (DOE 1996c).

Other facility maintenance and infrastructure support operations would continue (as outlined in Section 2.3.5) with refurbishment, renovation, and removal of outdated facilities such as small office buildings, temporary structures, and trailers. Appendix D of the SNL Sites Comprehensive Plan identifies the specific structures under consideration over the next 10 years (SNL 1997). This program will potentially generate large volumes of TSCA waste, primarily asbestos, and building debris that will increase SNL/NM's disposal needs. One hundred thirty-eight buildings, accounting for 179,204 gross ft^2, are scheduled for removal within FY 1998 and FY 1999. Building debris estimates associated with this special project are included in the assessments of the waste generated from existing operations. Separate NEPA review may be required in the future depending on the scale and extent of the work involved.

4.12.3.4 Radioactive Waste

Radioactive waste generated at SNL/NM includes LLW, TRU waste, LLMW, and MTRU waste. Radioactive waste is characterized as either TRU or LLW, according to its radiological characteristics. Either type is considered mixed waste (MTRU or LLMW) if it also contains a RCRA hazardous waste component. LLW and LLMW are produced primarily in laboratory experiments and component tests. Other R&D activities that use radioactive materials may also generate LLW. TRU and MTRU wastes are produced in reactors and from the cleanup of reactor tests.

As part of the effort to minimize the total quantity of radioactive waste that is generated at SNL/NM, facilities that generate this type of waste are designated as Radioactive Materials Management Areas (RMMA). An RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material or an area that is exposed to beams or other sources of radioactive particles (such as neutrons and protons) capable of causing activation. Managers of facilities must document the location of all RMMAs. Procedures to minimize the generation of radioactive wastes are then developed with the Generator Interface and Pollution Prevention Department, Health Protection Department, and the Radiation Protection Operation Department.

SNL/NM has the capability to treat some mixed wastes onsite at the RMWMF and HBWSF. Treatment methods, quantity limits, and amounts treated in 1996 are shown in Table 4.12–2. Although treatment capacity appears to exceed demand, this is a permitted treatment quantity, based on the actual equipment, and often assumes conditions for operation not intended by the facility.

Table 4.12–2. Mixed Waste Treatments, Quantity Limits, and Amounts Treated Onsite in 1996

TREATMENT	PROCESS LIMIT		AMOUNT TREATED IN 1996
	RMWMF	HBWSF	
Container Storage	8,000,000 L	1,500,000 L	
Thermal Treatment	110 kg per hour	110 kg per hour	None
Neutralization	1,000 L per day	1,000 L per day	21 L
Chemical Treatment	537 kg per hour	537 kg per hour	<1 kg
Centrifugation	360 gal per hour	360 gal per hour	None
Encapsulation	0.3 L per hour	0.3 L per hour	None
Flocculation	360 gal per hour	360 gal per hour	None
Physical Treatment	6,500 L per day	6,500 L per day	None
Reverse Osmosis	100 L per day	100 L per day	None
Mechanical Processing	1,500 kg per hour	1,500 kg per hour	None
Other Treatment	30 kg per hour	30 kg per hour	None

Source: SNL/NM 1997a
gal: gallon
HBWSF: High Bay Waste Storage Facility
kg: kilogram
L: liter
RMWMF: Radioactive and Mixed Waste Management Facility

Limits are often rate-oriented (for example, kg per hour) even though the actual operations are of short duration.

Historic Radioactive Waste Generation

Radioactive waste has historically been generated from the use of plutonium and other TRU isotopes, experiments involving nuclear reactor fuels, or R&D activities that used radioactive materials. In addition, small quantities are periodically received from remote test facilities and the Lovelace Respiratory Research Institute on KAFB. Table 4.12–3 summarizes radioactive waste quantities generated onsite from 1992 through 1995.

Table 4.12–3. Radioactive Waste Generated from 1992 through 1995[a]

RADIOACTIVE WASTE GENERATED[b]	LLW	TRU	LLMW	MTRU
1992	42	0	6	0
1993	40	0	7	0
1994	54	0	2	0
1995	45	0	18	0

Source: SNL/NM 1997a
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] Values are in cubic meters, rounded to two significant digits
[b] It was assumed that the amount of waste placed into storage correlates to the amount of waste generated during a similar period of time.

Current Radioactive Waste Generation

Table 4.12–4 presents information on the generation of radioactive waste during 1996. It lists totals by waste type and major generators.

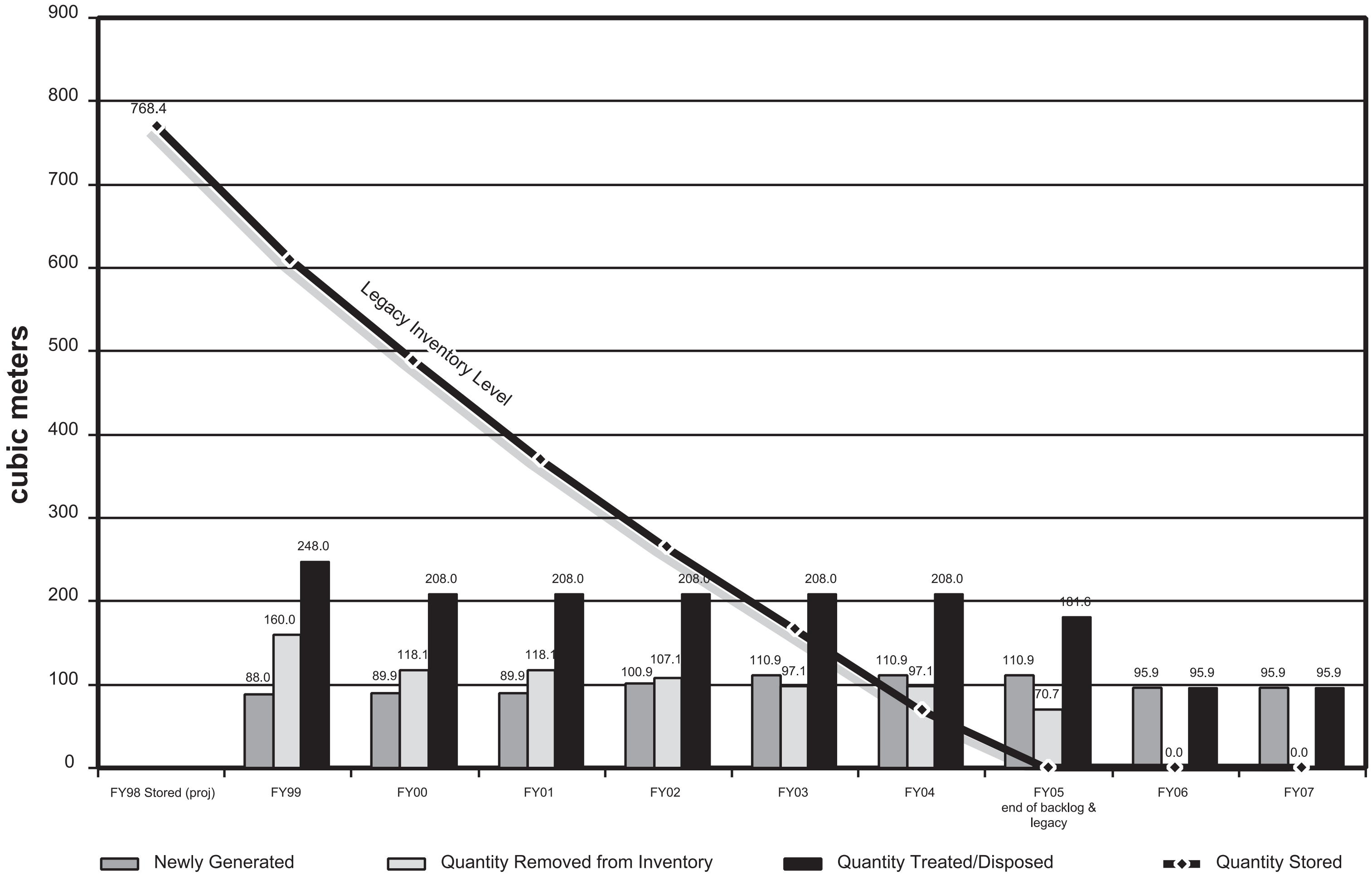
Legacy Waste

Legacy waste is considered to be waste material currently in storage pending disposal. SNL/NM is in the process of disposing of this waste as treatment and disposal capacity becomes available. For the most part, legacy waste is either radioactive or classified. Radioactive legacy waste, currently in storage pending treatment or disposal, is discussed in Appendixes G and H. ER Project-generated waste is considered a type of legacy waste; however, within the SWEIS, ER Project waste is addressed separately. Projections for elimination of radioactive legacy waste are shown in Figures 4.12–1, 4.12–2, and 4.12–3. All radioactive waste in storage at the end of FY 1998 is considered to be legacy waste. Figure 4.12–1 shows that LLW inventory will be reduced to zero by the end of FY 2005. Figure 4.12–2 shows that LLMW inventory will be reduced to zero by the end of FY 2002. Figure 4.12–3 shows that the TRU/MTRU inventory will be reduced to zero in FY 2004, with shipment of this waste to LANL for certification.

Table 4.12–4. 1996 Radioactive Waste Generation by Major Contributors and Special Projects[a]

GENERATORS	LLW	LLMW	TRU	MTRU
Environmental Restoration Project[b]	310	62	0	0
Neutron Generator Facility, Building 870 and Related Production Activities	11	<0.1	0	0
Research Accelerator Facilities, TA-IV	0.3	0	0	0
Research Reactor Facilities, TA-V	140	6	4	0
Decontamination and Decommissioning	31	4	0	0
Waste Management of Legacy Waste	11	71	0	0
Other (Balance of Plant)[c]	74	0.3	0	0
TOTALS	**577**	**143**	**4**	**0**

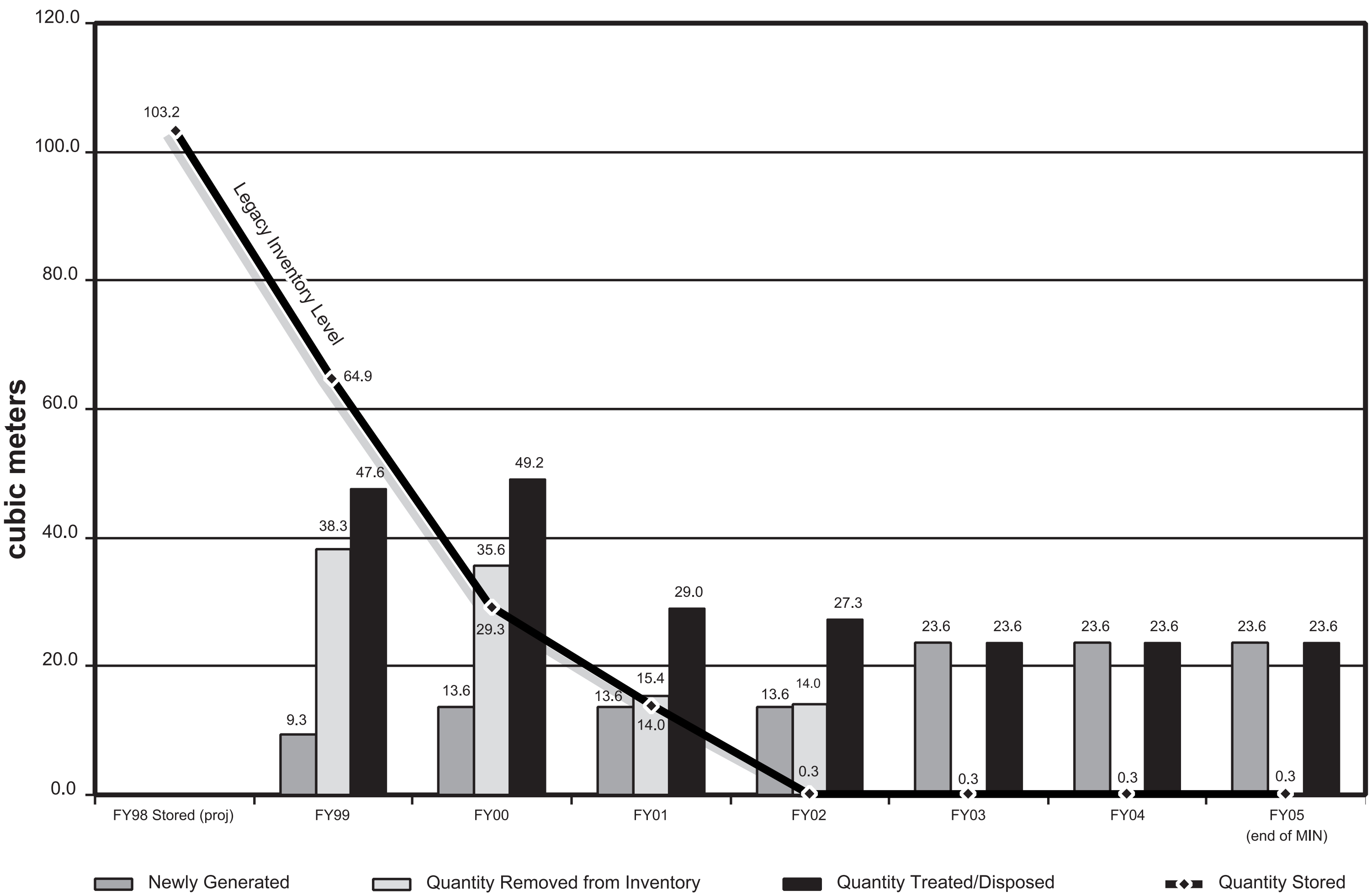
Source: SNL/NM 1997a
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic waste
TA: technical area
TRU: transuranic waste
[a] Values are in cubic meters, rounded to two significant digits.
[b] Special program, not a component of normal operations
[c] Balance of operations refers to generation of mission-related waste not otherwise accounted
for under selected facilities or special projects.



Source: Losi 1998

Figure 4.12–1. Projected Low-Level Waste Inventory, Fiscal Years 1999 through 2007

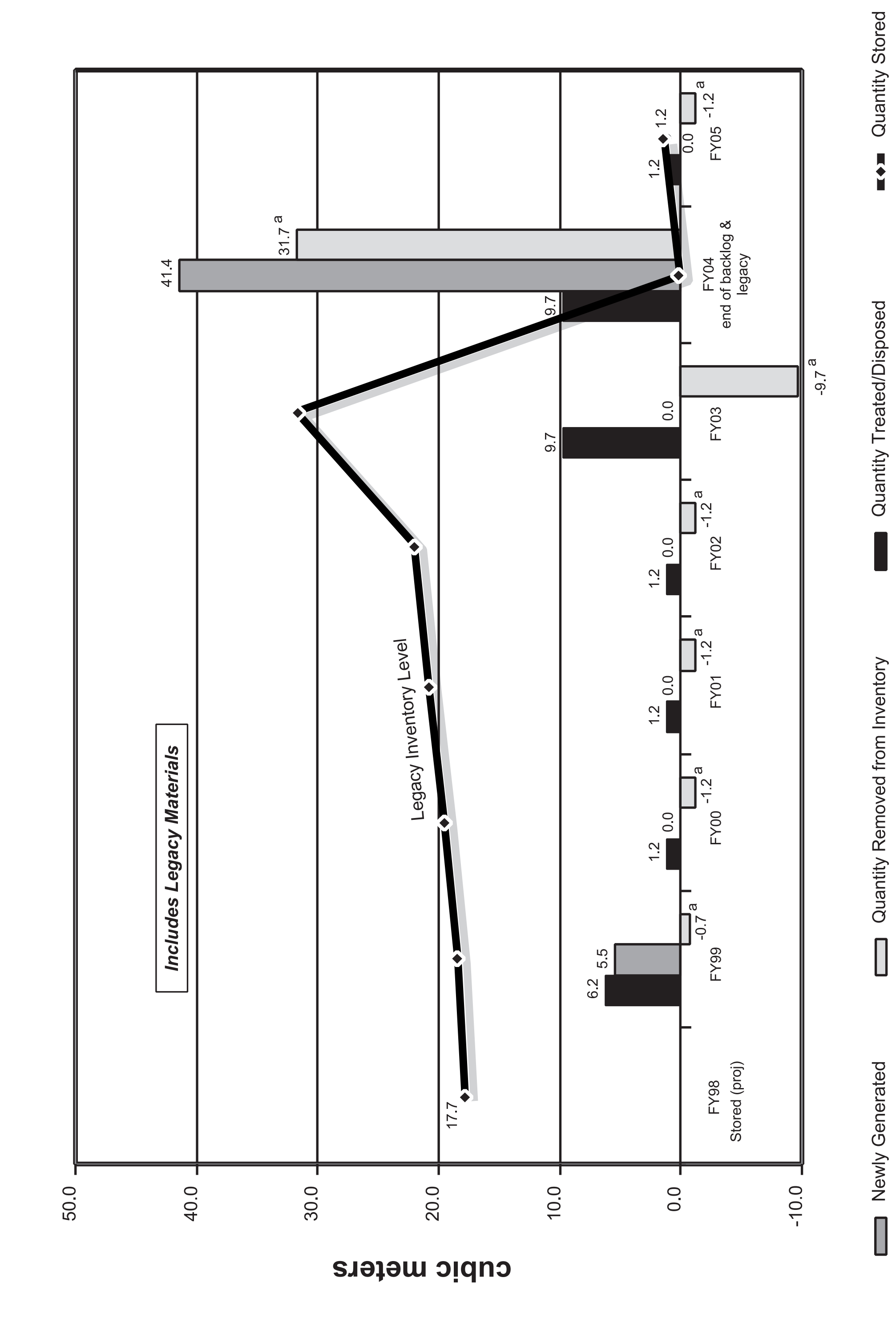
Legacy low-level waste inventory levels are projected to decrease to zero by 2005.



Source: Losi 1998

Figure 4.12–2. Projected Low-Level Mixed Waste Inventory, Fiscal Years 1999 through 2005

Legacy mixed waste inventory levels are projected to decrease to zero by 2002.



Source: Losi 1998

[a] Negative values for Transuranic and Mixed Transuranic indicate waste is placed into storage with no shipments occurring, resulting in an increase in inventory.

Figure 4.12–3. Projected Transuranic and Mixed Transuranic Waste Inventory, Fiscal Years 1999 through 2005

Transuranic waste volume is projected to increase through 2003 and then decrease by 2005.

4.12.3.5 Hazardous Waste

Hazardous waste refers specifically to nonradioactive waste, including RCRA chemical and explosives waste, biohazardous medical waste, and TSCA waste (primarily asbestos and PCBs). The hazardous waste generated at SNL/NM is predominantly chemical laboratory trash generated from experiments, testing, other research and development (R&D) activities, and infrastructure fabrication and maintenance.

Historic Hazardous Waste Generation

SNL/NM disposed of hazardous waste onsite from the start of operations until 1981. After 1981, waste was shipped offsite for disposal. Table 4.12–5 contains a summary of hazardous waste generated during normal operations from 1992 through 1995. Medical waste totals generated in these years are unavailable. Prior to 1996, ER and D&D wastes were included within the RCRA and TSCA waste categories.

Table 4.12–5. Hazardous Waste Generated During Normal Operations from 1992 through 1995[a]

YEAR ACCEPTED AT HWMF	RCRA	TSCA
1992	147,000	5,000
1993	96,000	5,500
1994	86,000	24,000
1995	207,000	133,000

Source: SNL/NM 1997a
HWMF: Hazardous Waste Management Facility
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] Quantities given in kilograms
Note: Large variations may be attributable to startup and closeout of projects and relocation of laboratories from one building to another.

Current Hazardous Waste Generation

Table 4.12–6 presents data on hazardous waste generated by major programs in 1996 and some subgroups of major waste-generating programs or facilities. The programs or facilities listed in the table are the highest contributors. The remainder of RCRA-regulated hazardous waste is generated by approximately 1,000 additional onsite hazardous waste generators.
Figure 4.12–4 shows projected quantities of SNL/NM-generated RCRA hazardous waste declining through 2001.

The PCB waste generation for 1996 was unusually high due to transformer replacement activities. An additional 77,000 kg of other TSCA waste, primarily asbestos, were generated predominantly from D&D asbestos abatement projects. Finally, 1,400 kg of biohazardous waste were also generated by the Medical Department.
Figures 4.12–5 and 4.12–6 show historic asbestos waste generation and PCB waste generation with projections through 2002 (see Section 4.12.3.3 for additional information).

Explosive Waste

Explosive waste is a specific class of hazardous waste, RCRA characteristic code D003, that, due to its inherent danger, is addressed separately. Only one facility at SNL/NM, the TTF, is permitted under RCRA to treat this class of waste onsite. The TTF was specifically designed to treat explosive-contaminated waste, which did not meet DOT requirements for offsite transportation, from the Light Initiated High Explosive Facility. The TTF RCRA permit allows for treatment of up to 300 lb of waste per year. In 1996, 5,634 kg of explosive wastes were also sent to the KAFB Explosives Ordinance Disposal Unit.

4.12.3.6 Solid Waste

Solid waste consists predominantly of office and nonhazardous laboratory trash. It does not include food waste from cafeteria operations, which is managed under a separate contract with the USAF. Nonhazardous building debris generated from D&D activities may also be considered solid waste; however, it is currently managed at KAFB. After nonhazardous trash is transferred to the SWTF, it is screened for improperly disposed of and potentially hazardous materials, which are removed from the trash and disposed of through appropriate processes. All solid waste is currently disposed of at the Rio Rancho Sanitary Landfill in Rio Rancho, New Mexico.

Historic Solid Waste Generation

Before August 1, 1994, solid waste was disposed of at the KAFB Solid Waste Landfill. From August 1, 1994, through May 13, 1996, the SNL/NM Solid Waste Management Program was in transition—the KAFB Landfill closed (except for nonhazardous construction and demolition waste and recyclable landscape debris) and SNL/NM built the SWTF.

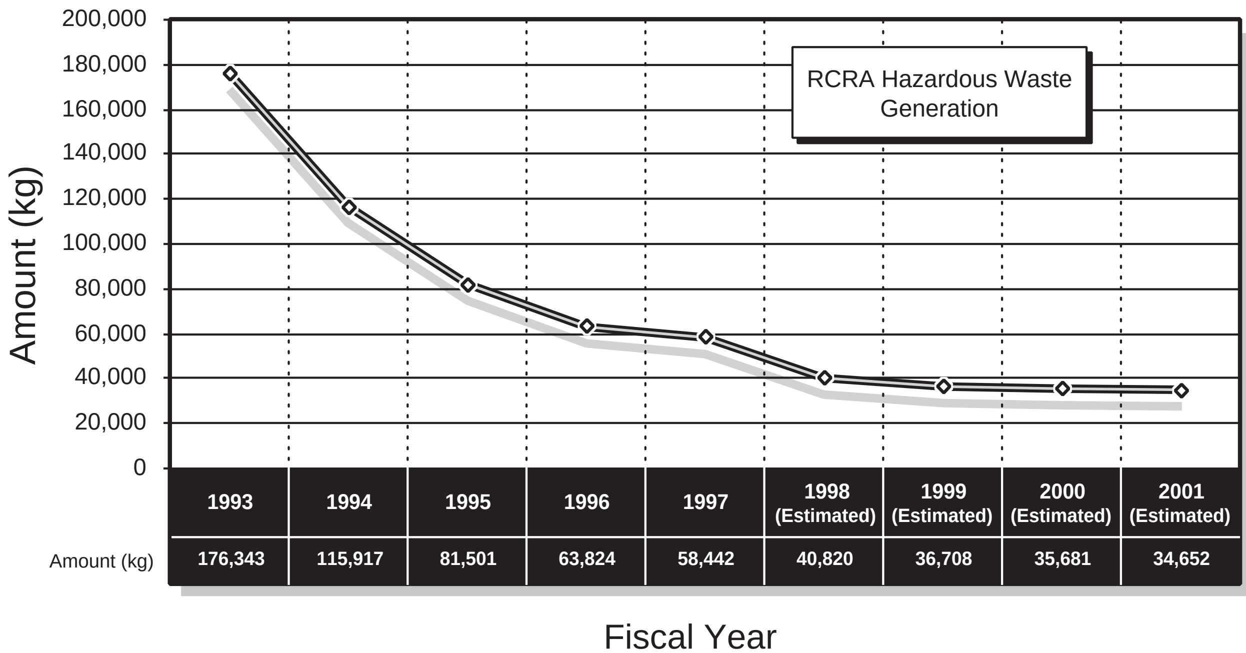
During this transition, solid waste pickup and disposal was under contract to a commercial waste management company that transported from the pickup sites to the city of Albuquerque Cerro Colorado Landfill, initially,

Table 4.12–6. Major Hazardous Waste (RCRA and TSCA) Generators in Calendar Year 1996[a]

GENERATOR	RCRA	TSCA[b]
Environmental Restoration Project[c]	11,000	90
Neutron Generator Facility	220	680
Research Accelerators Facilities, TA-IV	1,100	41
Research Reactors Facilities, TA-V	110	460
Integrated Materials Research Laboratories	2,400	0
Compound Semi-Conductor Research Laboratory	2,000	0
Advanced Material Processing Laboratory	10,000	0
Other Generators	21,170	50,700
TOTALS	**48,000**	**52,000 (PCBs)[d]** **77,000 (Asbestos)[e]**

Source: SNL/NM 1997a
D&D: decontamination and decommissioning
PCBs: polychlorinated biphenyls
RCRA: *Resource Conservation and Recovery Act*
TA: technical area
TSCA: *Toxic Substance Control Act*

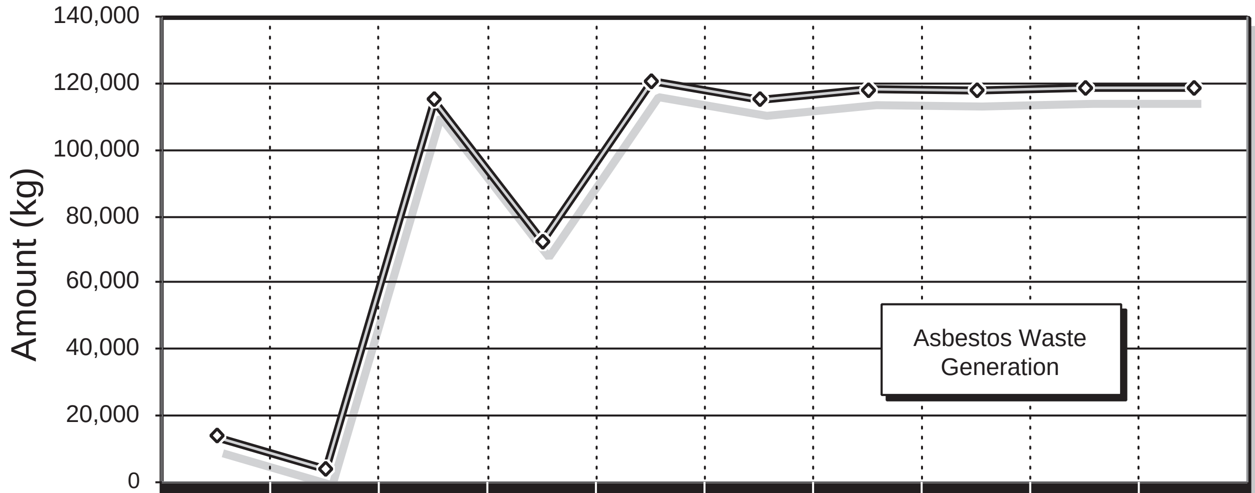
[a] Quantities given in kilograms
[b] PCBs unless otherwise noted
[c] The Environmental Restoration Project is a special program and not considered part of normal operations at SNL/NM.
[d] PCB generation for 1996 was unusually high due to transformer changeout.
[e] Asbestos generation predominantly was from D&D asbestos abatement projects.



Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–4. RCRA Hazardous Waste Generation

RCRA hazardous waste generated at SNL/NM would continue to decline through 2001.



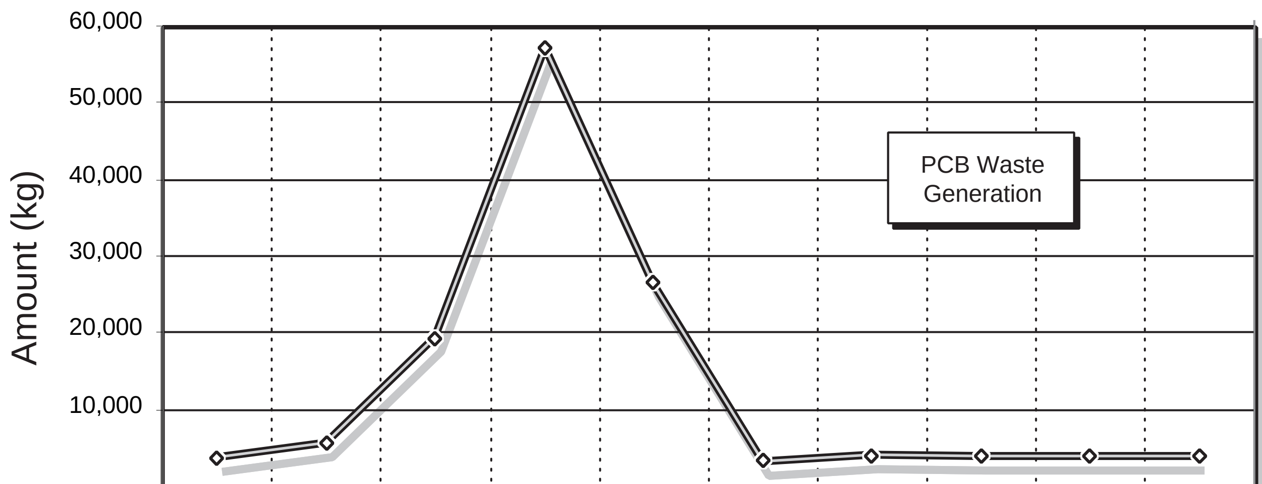
	1993	1994	1995	1996	1997	1998 (Estimated)	1999 (Estimated)	2000 (Estimated)	2001 (Estimated)	2002 (Estimated)
Amount (kg)	14,266	3,890	114,924	72,139	120,482	115,157	117,896	118,090	118,254	118,369

Fiscal Year

Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–5. Asbestos Waste Generation

Volumes of asbestos waste generated at SNL/NM would remain constant through 2002.



	1993	1994	1995	1996	1997	1998 (Estimated)	1999 (Estimated)	2000 (Estimated)	2001 (Estimated)	2002 (Estimated)
Amount (kg)	3,731	5,764	19,386	57,046	26,573	3,316	4,030	4,010	3,992	3,977

Fiscal Year

Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–6. Polychlorinated Biphenyls (PCB) Waste Generation

Volumes of PCB waste generated at SNL/NM would remain constant through 2002.

and then to the Rio Rancho Sanitary Landfill in Rio Rancho, approximately 28 mi from KAFB. On May 13, 1996, SWTF began screening waste. Since 1996, SNL/NM solid waste has been disposed of at local municipal landfills. Detailed records of disposal before August 1, 1994, are limited.

Current Solid Waste Generation

Table 4.12–7 presents information for solid waste generation from normal operations based on the period the SWTF operated from May through December 1996. In 1997, SNL/NM generated 51 solid waste shipments, totaling 1.1M kg or 2,100 m^3 (2,700 yd^3).

Table 4.12–7. 1996 Solid Waste Generation (Partial-Year Information)

DESCRIPTION	WEIGHT (kg)
Dumpster waste generated from May 13, 1996, through December 31, 1996	0.6 M
Average monthly dumpster waste generation	0.1 M
Average annual dumpster waste generation, estimated	1.1 M

Source: SNL/NM 1997a
lb: pound
M: million

4.12.3.7 Pollution Prevention and Waste Minimization

DOE 5400.1 and Executive Order (EO) 12856 implement a pollution prevention program to comply with DOE requirements (58 FR 41981). The SNL/NM Pollution Prevention Program applies to all pollutants generated by routine and nonroutine operations. The scope of the Pollution Prevention Program includes activities that encourage pollution or waste source reduction and recycling, resource and energy conservation, and affirmative procurement of EPA-designated recycled products.

Trends and Requirements

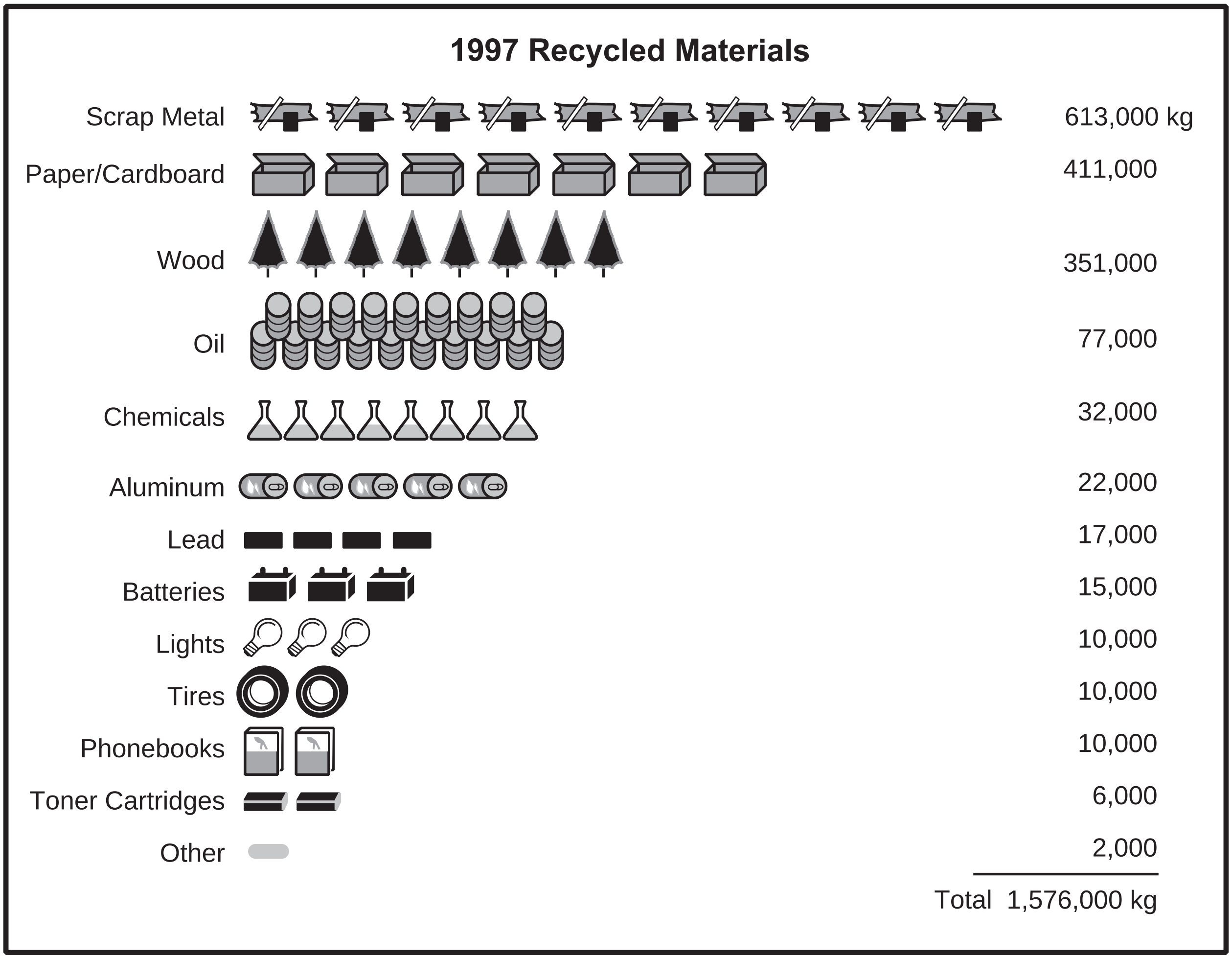
SNL/NM has reduced waste generation, water use, and air emissions and has increased recycling and procurement of recycled material. Figure 4.12–7 presents 1997 recycling information for SNL by material type.

Waste Minimization

Waste minimization activities are not included in the previous descriptions to bound maximum waste projections for any given year. Actual waste trends are shown for RCRA hazardous, TSCA PCB, and TSCA asbestos wastes in Figures 4.12–4, 4.12–5, and 4.12–6. Actual figures for waste recycled are shown in Figures 4.12–7, 4.12–8, and 4.12–9. Prevention and minimization of waste generation and conservation of energy, water, and resources are the overall goals of this program.

The following wastes are tracked to determine SNL/NM's effectiveness in reducing wastes: LLW and LLMW, RCRA, state-regulated, TSCA, and sanitary waste. In addition, reductions of resource, water, and energy use are tracked. Following are the goals to be completed in FY 1999.

- Limit the generation of routine LLW to 20 m^3.
- Limit the generation of routine RCRA hazardous waste to 50 metric tons.
- Limit the generation of routine state-regulated chemical waste to 110 metric tons.
- Limit the generation of routine sanitary waste to 3,650 metric tons.
- Limit the generation of routine LLMW to 2.65 m^3.
- Increase the recycling rate to 33 percent of total sanitary waste generated.
- Increase procurement of EPA-designated recycled products to 100 percent in 1999, except where they are not commercially available competitively at a reasonable price or do not meet performance standards.
- Reduce annual energy use per square foot in regular buildings by 30 percent from FY 1985 to FY 2005. Assume a linear step reduction per year (for example, a 21 percent reduction by FY 1999).
- Reduce annual energy use per square foot in energy-intensive buildings by 20 percent from FY 1990 to FY 2005. Assume a linear step reduction per year (for example, a 12 percent reduction by FY 1999).
- Reduce water use at SNL/NM by 30 percent from 1994 to 2004. Assume a linear step reduction per year (for example, a 15 percent reduction by FY 1999).



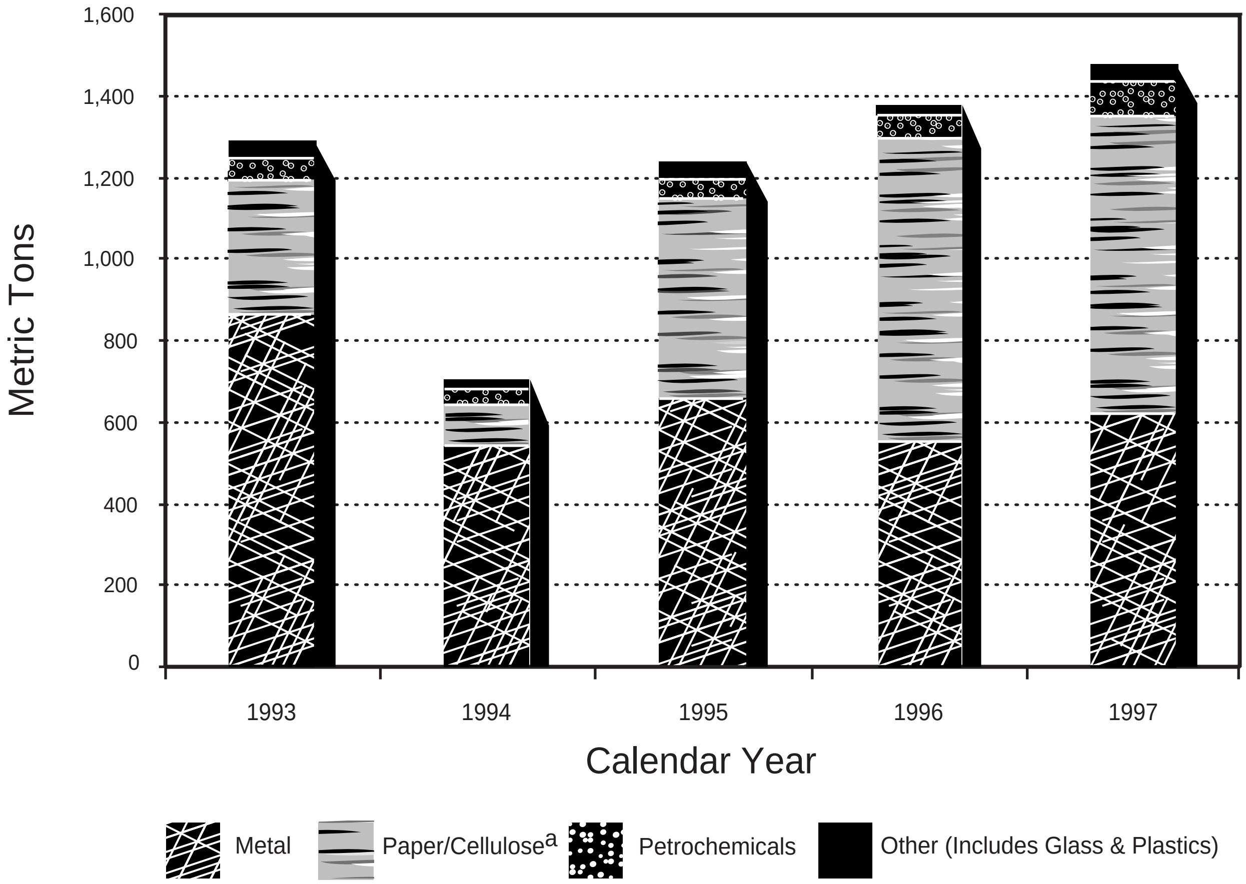
Source: SNL 1998d

Figure 4.12–7. SNL Recycling in 1997

SNL has reduced waste generation through recycling.

Recycling

Recycled paper and cardboard are processed through the SWTF. In 1996, SNL/NM initiated a joint effort with Los Alamos National Laboratory (LANL) to cooperate in collecting, processing, and marketing LANL-generated recyclable paper. After creating a process, the program was expanded to include the Kirtland Area Office (KAO). Over the next few years, efforts to expand cooperation with other Federal and state facilities will continue.

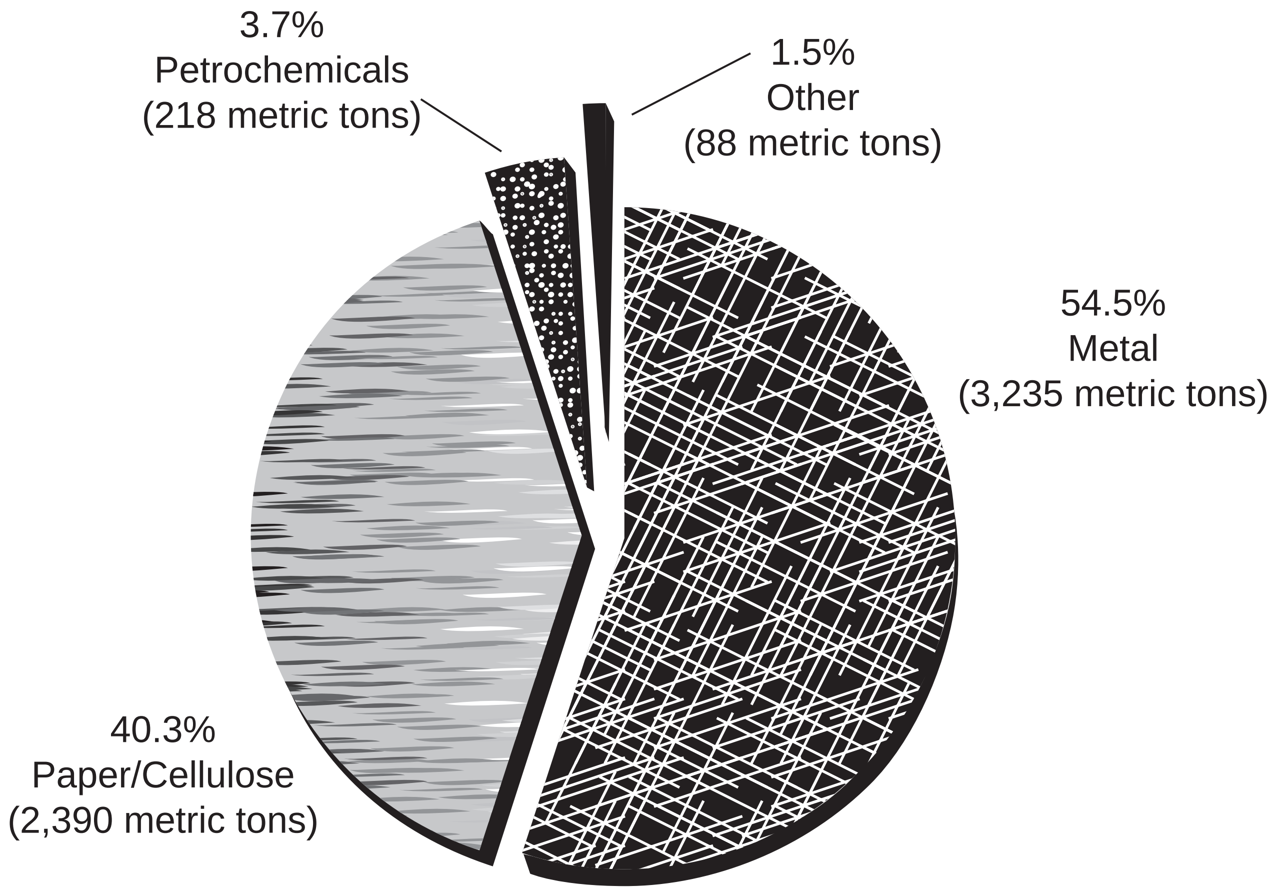


Source: SNL/NM 1998x

[a] Paper/cellulose quantities for 1996 and 1997 include amounts from LANL, the USAF, and other DOE activities at KAFB. For 1997, SNL/NM accounted for 51 percent of the recycled quantity, with LANL, the USAF, and other DOE accounting for 43, 3, and 3 percent, respectively.

Figure 4.12–8. Annual Recycling Trends, 1993 through 1997

SNL/NM annually recycles various material types.



Source: SNL/NM 1998x

Figure 4.12–9. Proportions of Recycled Materials, 1993 through 1997

Paper, cellulose, and metal comprise 95 percent of the material recycled at SNL/NM from 1993 through 1997.

4.13 NOISE AND VIBRATION

4.13.1 Definition of Resource

Noise is sound that is undesirable because it interferes with speech, communication, or hearing; is intense enough to damage hearing; or is otherwise annoying. Airblast noise from the detonation of explosives is impulsive in nature and generally lasts less than 3 seconds. The rapid onset of impulse noise or the vibration of buildings and other structures induced by a noise impulse can be annoying or discomforting to those around it.

Vibration is defined as a motion in which an object moves back and forth from its rest position when it is acted upon by an external force. The maximum ground-borne vibration level recommended by the U.S. Bureau of Mines to prevent threshold damage is 0.5 inches per second. The threshold level at which minor structural damage may begin to occur in 0.01 percent of structures is set at 2.0 inches per second. Noise from explosive detonations can cause buildings to vibrate, which is perceived by the occupants as shaking of the structure and rattling of the windows. These vibrations are perceived by the residents as the cause of existing or potential structural damage. The probability of this shaking causing structural damage is minimal.

4.13.2 Region of Influence

The ROI associated with noise includes the area within the Albuquerque basin. Noise decreases with distance from the source. The sound heard outside KAFB from airblast noise, resulting from the detonation of explosives or sonic booms from sled track activities, resembles a dull thud or short burst of sound. The distance at which this sound can be heard depends on the intensity of the initial airblast, the meteorological conditions, terrain, and background noise levels.

4.13.3 Affected Environment

This section describes the sources of noise resulting from activities conducted at SNL/NM and those associated with activities at KAFB and Albuquerque International Sunport. Although noise from activities at KAFB and the Sunport is not related to SNL/NM activities, it could affect SNL/NM operations.

Quantifying the Effects of Sound

The process of quantifying the effects of sound begins with establishing a unit of measure that accurately compares sound levels. The physical unit most commonly used is the decibel (dB). The decibel represents a relative measure or ratio to a reference pressure. The reference pressure is a sound approximating the weakest sound that a person with very good hearing can hear in an extremely quiet room. The reference pressure is 20 micropascals, which is equal to 0 (zero) dB.

A-weighted sound levels (dBA) are typically used to account for the response of the human ear. A-weighted sound levels represent adjusted sound levels that are made according to the frequency content of the sound.

Baseline sounds at SNL/NM consist of manufactured noise generated in and around the surrounding area, mainly from transportation and stationary sources. Activities at and around SNL/NM affect ambient (background) sound. These include aircraft associated with Albuquerque International Sunport and KAFB, vehicular traffic at KAFB, and industrial sources. SNL/NM test programs, including tests of high explosives, rocket motors, and large-caliber weapons and tests producing sonic booms, contribute to the noise baseline.

Noise effects to the community depend on the loudness of the sound, the intensity of vibrations, the frequency of the events, and the atmospheric conditions transmitting sound during the event. In most cases, the impulse sound heard outside KAFB resembles a dull thud or a short burst (less than 3 seconds). The noise baseline (aircraft, traffic, and industrial sources) would mask the sounds produced by most SNL/NM activities.

Industrial and construction activities are another source of noise. Some of these activities could affect the occupational health of SNL/NM personnel, but measures are in effect through the SNL/NM Hearing Conservation Program to ensure that hearing damage to personnel does not occur.

The regulatory setting that applies to noise at SNL/NM includes the *Noise Control Act of 1972* (42 U.S.C. § 4901), *Contractor Industrial Hygiene Program* (DOE 5480.10), *Occupational Noise Exposure* (29 CFR §1910.95), and *City of Albuquerque Noise Control Ordinance* (Ord. 21-1975, § 9-9-1).

4.13.3.1 SNL/NM Ambient Noise Levels

The ambient noise level is the sound pressure level of the all-encompassing noise associated with a given environment, usually a composite of sounds. Figure 4.13–1 shows a noise scale representing common noise events, the respective decibel (dB) level, and a subjective evaluation of the noise event.

SNL/NM's ambient background sounds will be relatively consistent. Background sounds produced by generators, air conditioning, ventilation systems, vehicles, and employee activities constitute a substantial sound source during the morning, midday, and evening. The range of background noise levels associated with these sources is from 50 to 70 dB (SNL/NM 1997a).

SNL/NM testing produces the most perceptible impulse sound levels at TA-III, Coyote Test Field, and other outdoor test facilities. The 1996 baseline frequency of impulse noise events is 1,059 events. Only a small fraction of these events are loud enough to be heard or felt beyond the site boundary.

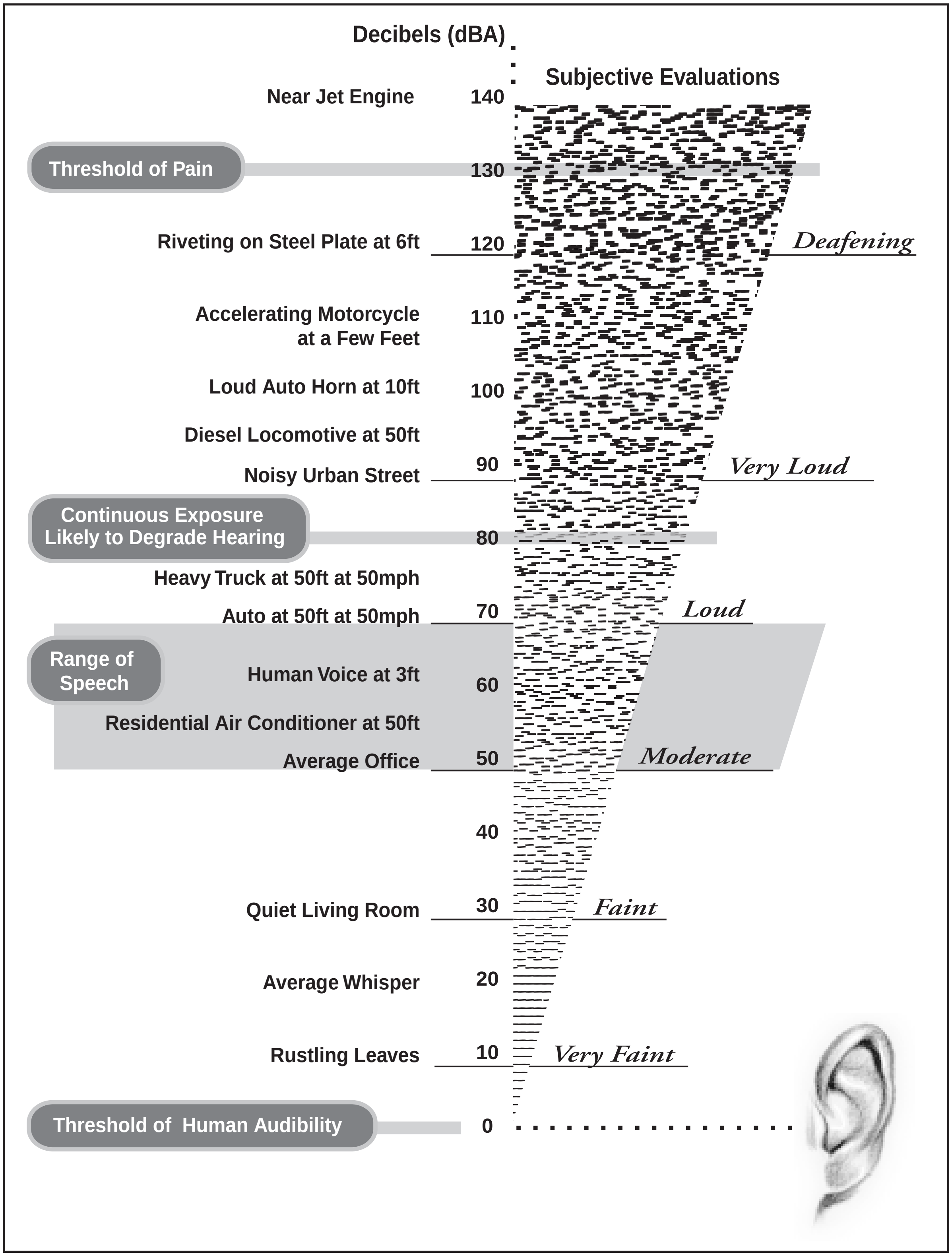
No residential areas on KAFB or in the city of Albuquerque are affected by either the damaging vibration area of 2.0 inches per second or the annoyance vibration area of 0.2 inch per second. SNL/NM facilities within the damage radius for vibrations are designed to withstand the effects of testing; therefore, damage would be unlikely (SNL/NM 1997a).

4.13.3.2 Ambient Noise Levels at Other Locations

SNL/NM is subject to aircraft noise from the Albuquerque International Sunport and KAFB and from vehicular traffic on KAFB. Aircraft noise is the most prevalent sound because Runway 8-26 is the primary runway for the Albuquerque International Sunport. Aircraft take off and land in an easterly direction on this runway about 75 to 80 percent of the time. Aircraft using this runway fly directly over SNL/NM. Noise abatement procedures to decrease aircraft noise in nearby neighborhoods, such as Ridgecrest and Four Hills, affect SNL/NM (SNL/NM 1997a). These procedures direct pilots to avoid these neighborhoods by flying over SNL/NM.

Noise levels at SNL/NM associated with aircraft from the Albuquerque International Sunport are too low to be considered potentially damaging to hearing. The noise is primarily annoying, interrupting conversations, telephone communications, and possibly the ability to concentrate on difficult tasks. Personnel in temporary buildings, such as trailers, are more likely to be affected because of the poor sound absorption qualities of the building materials in comparison to permanent buildings.

Based on Federal Aviation Administration (FAA) land use compatibility guidelines, adverse effects on people are most likely to occur within the 75-dB(A) day-night average noise level (DNL) area.



Source: Original

Figure 4.13–1. Comparing Noise Levels to Events Within Range of Human Hearing

Decibel levels and subjective evaluations are compared for events within range of human hearing.

> **Day-Night Average Sound Level**
>
> The day-night average sound level (DNL) was developed to evaluate the total community noise environment. The DNL is the average A-weighted sound level during a 24-hr period, with 10 dB added to nighttime levels (between 10:00 p.m. and 7:00 a.m.). This adjustment is added to account for the increased human sensitivity to nighttime noise events.

At the Albuquerque International Sunport, the 65-dB(A) and 70-dB(A) noise levels extend beyond the Sunport boundary with KAFB (SNL/NM 1997a), but not the 75-dB(A) noise level.

Motor vehicle noise is prevalent in the more congested areas of KAFB. The fluctuation of traffic noise over long periods is associated with peak traffic periods. In addition, noise levels are influenced by vehicle type, number of tires, road-surface conditions, and exhaust systems. The DNL in a 1995 KAFB traffic study in a 24-hr traffic count at the Gibson gate was 71 dB(A), averaged over a 24-hr period (SNL/NM 1997a).

The Air Force Research Laboratory, USAF/Explosive Ordnance Disposal (EOD), and the Defense Special Weapons Agency detonate explosives on KAFB. Activities that are not SNL/NM's are performed at the Giant Reusable Air Blast Simulator (GRABS) Site, Chestnut Site, High Energy Research Test Facility (HERTF) Site, USAF/EOD areas, and the DOE Live Fire Range.

Harmful noise levels (above 140 dB) from these activities remain within the boundaries of KAFB, with the exception of an 1,800-lb high-explosive detonation at the Chestnut Site, for which the 140-dB noise level extends beyond the KAFB site boundary and into the buffer zone on the Pueblo of Isleta (SNL/NM 1997a). Explosive detonations of this magnitude are expected to be rare.

Future development in the buffer zones on the Pueblo of Isleta and Mesa del Sol will create potential conflicts with respect to land use. Noise levels are projected to affect the buffer zones during high-explosive detonations at the Chestnut Site. Ground vibration may be of sufficient magnitude to generate structural damage if development occurs in the buffer zones. Impulse noise may affect the area, producing annoyance to inhabitants of developed areas should the land-use status change from its current buffer zone designation.

4.14 SOCIOECONOMICS

4.14.1 Definition of Resource

This section describes the demographic and economic variables associated with community growth and development that have the potential to be directly or indirectly affected by changes in operations at SNL/NM. SNL/NM and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services required by SNL/NM operations. SNL/NM operations, in turn, create the demand and pay for the people, goods, and services in the form of wages, salaries, and benefits for jobs and dollar expenditures for goods and services. The measure of the communities' ability to support the demands of SNL/NM depends on their ability to respond to changing environmental, social, economic, and demographic conditions.

For a discussion of DOE operations and socioeconomic effects related to DOE operations at SNL/NM, see Section 6.2.

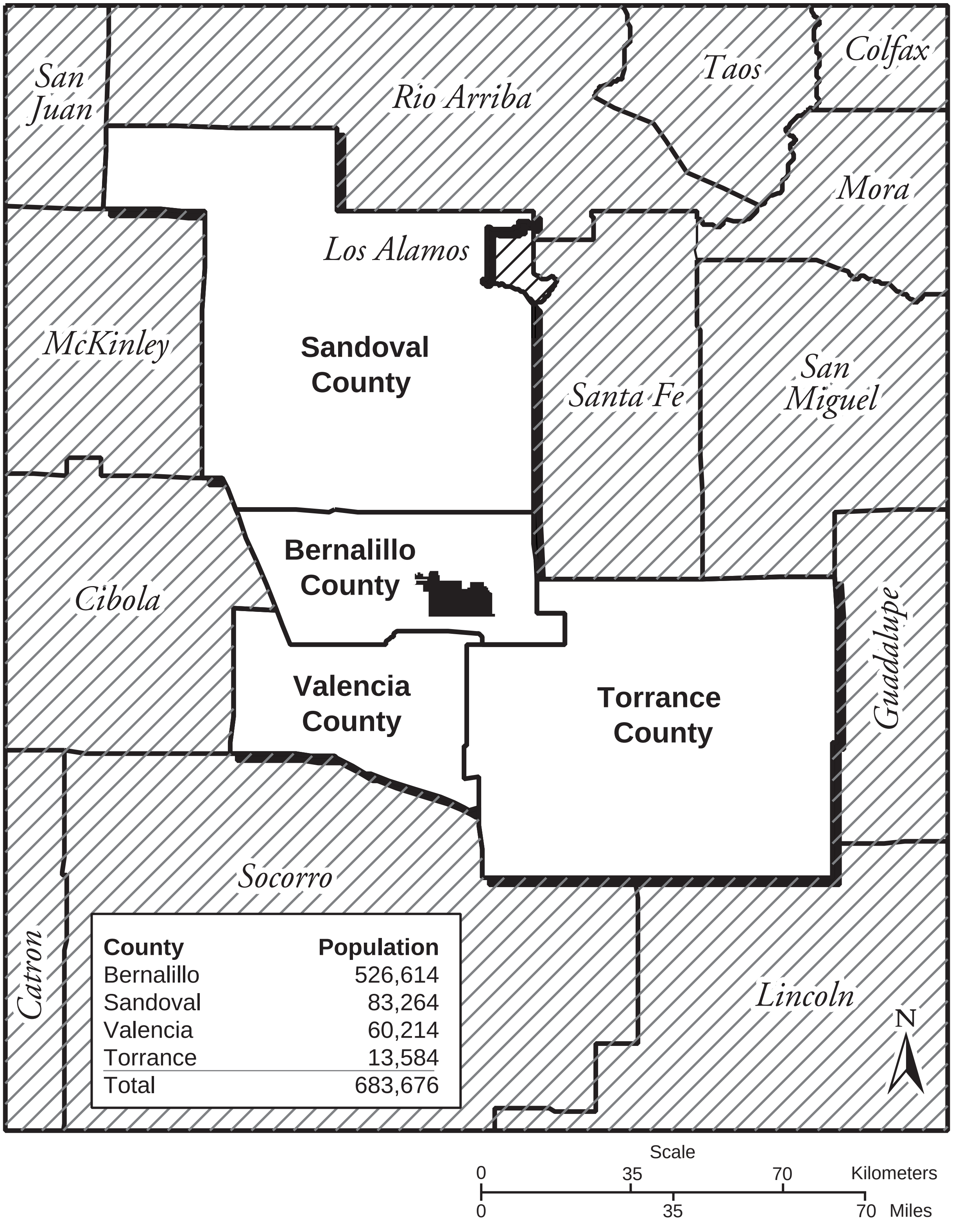
4.14.2 Region of Influence

The socioeconomics ROI is defined by the areas where SNL/NM employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The ROI consists of a four-county area (Bernalillo, Sandoval, Torrance, and Valencia counties) and includes the city of Albuquerque, which is where approximately 97.5 percent of SNL/NM employees reside (Figure 4.14–1). The ROI is also defined in *The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico, Fiscal Year 1996*, prepared by New Mexico State University (NMSU) for the DOE Office of Technology and Site Programs, DOE/AL (DOE 1997j). The FY 1997 report was reviewed; however, FY 1996 remained the year most representative of past operations. FY 1997 data are presented for comparison.

4.14.3 Affected Environment

4.14.3.1 Demographic Characteristics

The estimated population in the four-county ROI in 1990 was approximately 599,416 people, of whom approximately 80 percent (480,577) reside in Bernalillo county. The predominant population in the ROI is white, although 37.1 percent of the total population have a Hispanic ethnic background (Table 4.14–1). Native Americans residing in the ROI account for 5 percent of the



County	Population
Bernalillo	526,614
Sandoval	83,264
Valencia	60,214
Torrance	13,584
Total	683,676

Source: Census 1997a

Figure 4.14–1. Four-County ROI Population

The socioeconomic region of influence encompasses Bernalillo, Sandoval, Torrance, and Valencia counties.

Table 4.14–1. Demographic Profile of the Population in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
POPULATION					
1996 Population (Est.)	526,614	83,264	13,584	60,214	683,676
1990 Population	480,577	63,319	10,285	45,235	599,416
Population Change from 1990 to 1996	46,037	19,945	3,299	14,979	84,260
RACE (1990)					
Percent of Total Population					
White	76.9	68.6	87.0	77.5	76.2
Black	2.7	1.5	0.4	1.1	2.4
Native American	3.4	19.7	1.2	2.9	5.0
Asian/Pacific Islander	1.5	0.8	0.2	0.4	1.4
Other[a]	15.5	9.4	11.1	18.1	14.9
Percent Minority (1990)	44.2	48.8	39.5	54.3	45.4
Ethnicity (1990)					
Hispanic	178,310	17,372	3,892	22,733	222,262
Percent of Total Population	37.1	27.4	37.8	50.3	37.1
AGES (1990)					
Percent Under 18	26.1	32.0	32.1	30.8	27.2
Percent 65 and Over	10.5	10.1	11.4	10.1	10.4
Percent Between 18 and 65	63.4	57.9	56.5	59.1	62.4
EDUCATION (1990) PERSONS 25 YEARS AND OLDER					
Percent High School Graduate or Higher	82.1	79.3	72.6	73.3	81.0
Percent Bachelor s Degree or Higher	26.7	19.1	10.9	12.1	24.5
MONEY INCOME (1989)					
Total Income ($1,000)	6,511,338	686,948	92,051	463,387	7,753,724
Median Household Income ($)	27,382	28,950	19,619	24,312	27,392
Per Capita Income ($)	13,594	10,849	8,950	10,244	12,935
Percent of Persons Below Poverty Line (1989)	14.6	15.6	21.1	19.0	15.1

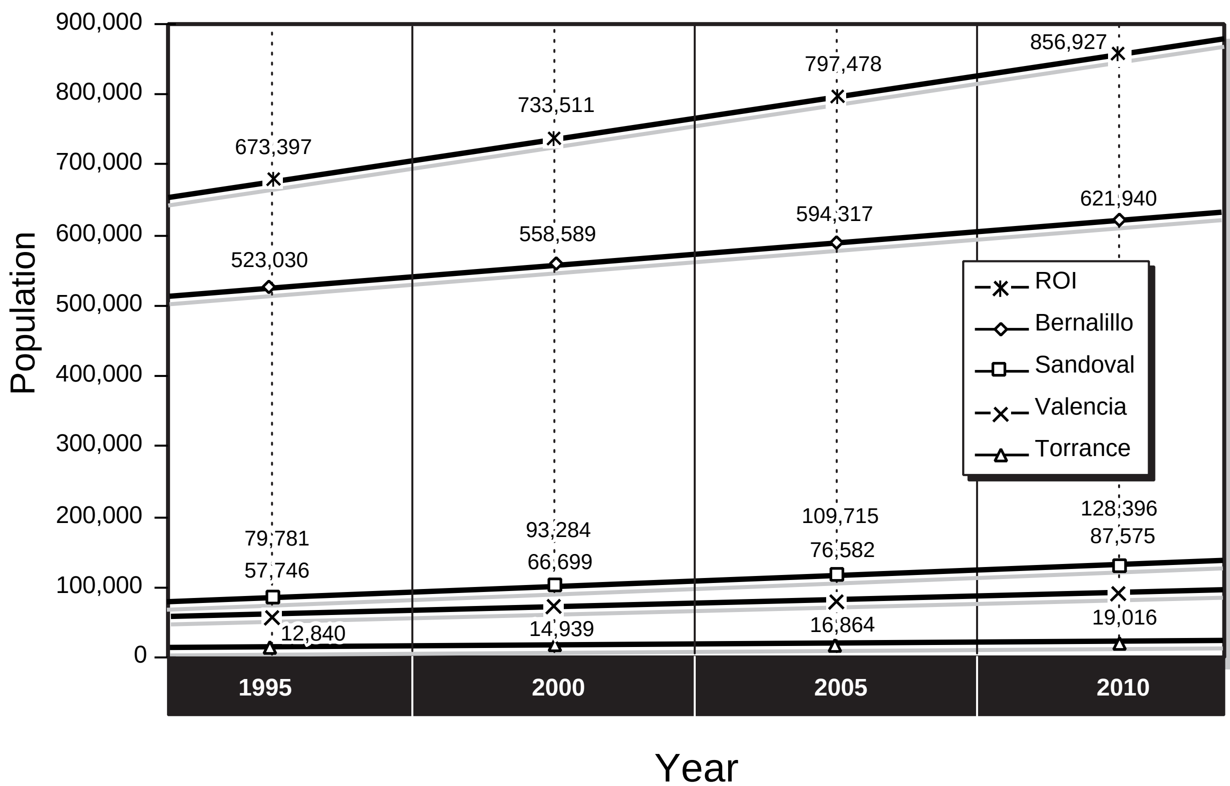
Sources: Census 1995, 1997a; MRGCOG 1997a; UNM 1997a
ROI: region of influence
[a] According to the Bureau of the Census, in the 1990 Census, the "Other" category included persons identifying themselves as multiracial, multiethnic, mixed, interracial, or a Spanish/Hispanic origin group (such as Mexican, Venezuelan, Latino, Cuban, or Puerto Rican).

general population. The Pueblos of Acoma, Cochiti, Isleta, Jemez, Laguna, San Felipe, Sandia, Santa Ana, Santo Domingo, Zia, and Zuni, and the Cañoncito Navajo Reservation are important centers of these Native American populations (Census 1995). In 1990, minorities made up 45.4 percent of the total ROI population and 49.6 percent (not shown in table) of the state population (based on revised 1990 census data). In April 1997, out of a total work force of 6,824 workers, minorities made up 27.4 percent of the SNL/NM work force, including 1,325 Hispanic, 203 Native American, 184 Black, and 155 Asian workers (SNL/NM 1997h).

According to the Bureau of the Census, the ROI population grew from 599,416 in 1990 to 683,676 by July 1, 1996, which is an increase of 83,260 people or 14.1 percent over the 1990 count (Census 1997a) (Table 4.14–1). Figure 4.14–2 shows population projections to 2010. Bernalillo county has attracted the highest population growth, a trend that is likely to continue. Sandoval and Valencia counties, however, have been increasing at faster rates than Bernalillo county, and probably will continue to grow at a faster percentage increase than Bernalillo, with Sandoval doubling in population by 2020. The growth of the Albuquerque area is increasingly affecting a multi-county region. The social and economic activities of Sandoval, Torrance, and Valencia counties are becoming more intertwined with Bernalillo county as urbanization increases. The most concentrated development is expected to be in the Rio Grande valley, but northwest Torrance county will also become increasingly developed (MRGCOG 1997b).

Some 62.4 percent of the population in the ROI is between the ages of 18 and 65. Approximately 81 percent of this population has completed high school, and 24.5 percent has attained a 4-year or higher college degree (Census 1995) (Table 4.14–1).

The 1989 total, median, and per capita income levels of the population in the ROI were approximately $7.8 B, $27,392, and $12,935, respectively (Table 4.14–1). While both the median and per capita income levels of the ROI were close to the respective state averages of $24,087 and $11,246, there are substantial differences in income levels among the counties, especially between Torrance county (at



Source: UNM 1997b

Figure 4.14–2. 1995 Population Estimates and Projections to 2010

Population increases are projected for each of the four counties from 1995 through 2010, with the total region of influence population increasing by 27 percent.

the low end) and Bernalillo county (at the upper end) (Table 4.14–1) (MRGCOG 1997b). At the time of the 1990 Census, an estimated 15.1 percent of the residents in the ROI were living below the official poverty thresholds. Poverty thresholds vary by size of family and number of related children under 18 years of age. In 1989, for example, the official poverty threshold for a family of four was $12,674. In 1989, 21 percent of the state population was identified as in poverty or designated as having low income (Census 1996).

4.14.3.2 Economic Base

SNL/NM is the fifth-largest private employer in New Mexico and the third largest in the ROI. Its direct economic impact on the ROI is substantial even after deducting procurement and wage/salary payments made outside the ROI. For FY 1997, the SNL/NM payroll for the ROI was $417 M for 6,824 full-time personnel (DOE 1997j). During the same year, SNL/NM spent approximately $309 M in procurements (Figure 4.14–3) in the ROI (DOE 1997j). Therefore, $726 M ($417 M + $309 M) in direct income was available for households and businesses to create jobs and make additional purchases of products and services inside or outside the ROI. Table 4.14–2 lists employment and income in the ROI.

The total number of employed civilian workers in the ROI in 1996 was 331,800 (363,192 in 1997 [DOE 1998j]). In 1996, Sandoval, Torrance, and Valencia counties had a combined overall average unemployment rate of 5.8 percent, which was higher than Bernalillo county (5.3 percent) and the ROI as a whole (5.4 percent) (Table 4.14–2) (UNM 1997c). Torrance county had the highest unemployment rate (8.9 percent). Employment changes at SNL/NM could have a greater socioeconomic effect on Bernalillo and Torrance counties (Figure 4.14–3), where members of the SNL/NM workforce comprise a higher percentage of the county population and civilian labor force in comparison to the other counties.

The pattern of employment and income are different from county to county. During 1996, employment and per capita income were highest in Bernalillo county, followed in descending order by Sandoval, Valencia, and Torrance counties (Table 4.14–2).

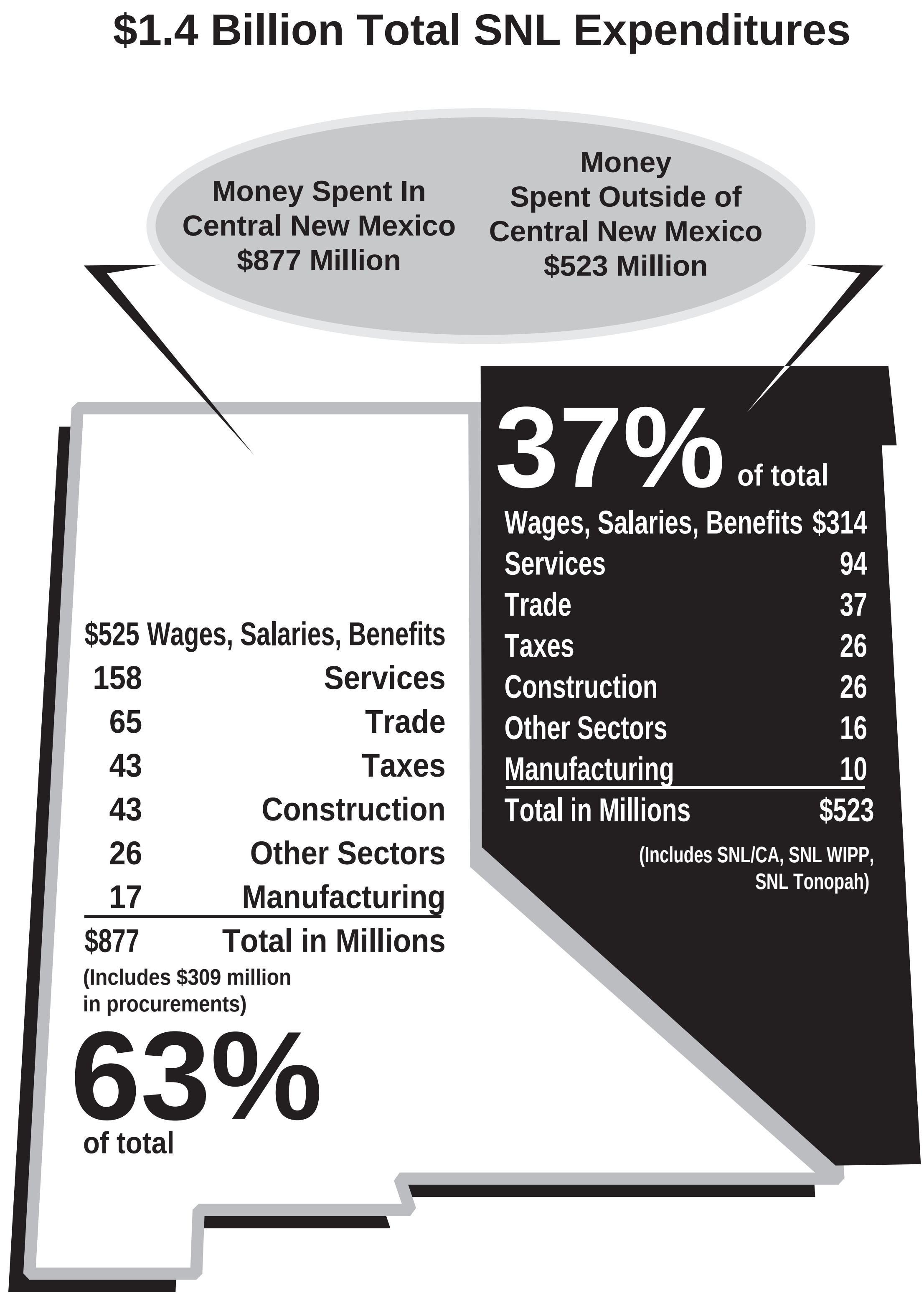
In 1995, service industries comprised the largest employment sector in Bernalillo county (108,172 employees or 40.6 percent), of which the health, engineering, management, and business sectors were the largest contributors. Retail trade accounted for another 21.9 percent, followed by manufacturing (8.9 percent) and construction (8.3 percent) (Figure 4.14–4). Manufacturing was the largest employment sector in Sandoval county in 1995 with 41.6 percent, followed by the retail trade and service industries sectors accounting for 21 percent and 17.2 percent, respectively. The retail trade sector provided the most employment in Torrance county (44.2 percent) and Valencia county (34.6 percent), followed by the service sector in both counties (22.6 percent and 33.2 percent, respectively) (Census 1997b).

The total operating and capital budget for SNL/NM for FY 1996 was approximately $1.4 B ($1.38 B in 1997), of which an estimated $877 M ($840.5 M in 1997) was spent in central New Mexico. SNL/NM expenditures by major sectors for FY 1996 were personnel, including benefits ($525 M); services ($158 M); trade ($65 M); government ($43 M); construction ($43 M); other sectors ($26 M); and manufacturing ($17 M) (Figure 4.14–4). As Figure 4.14–3 illustrates, $523 M of the $1.4 B was spent outside of New Mexico and $314 M was spent on salaries, wages, and benefits. In FY 1996, $94 M of SNL/NM expenditures went for services, $37 M for trade, $26 M for government, $26 M for construction, $16 M for other sectors, and $10 M for manufacturing (DOE 1997j).

The flow of income and expenditures (such as procurements) from SNL/NM also generates direct revenue to state and local governments in the form of taxes, fees, and government services. In 1996, SNL/NM paid $43 M in revenue (mainly state and local taxes, fees, and government services) in New Mexico. An additional $26 M was paid in taxes to other government entities (outside New Mexico).

NMSU prepares an annual analysis of SNL/NM's economic impact on the state of New Mexico and the four-county ROI. In their analysis, NMSU employs an economic model that incorporates buying and selling linkages among regional industries and measures the impact of SNL/NM's expenditure of money in the ROI.

The NMSU model produces three multipliers. The first multiplier is used to calculate overall economic activity, the second calculates income, and the third calculates employment. These multipliers provide information needed to estimate SNL/NM's economic impact. The overall economic activity multiplier identifies the extent to which SNL/NM relies directly and indirectly on the ROI economy to provide materials, services, and labor it requires to conduct its operations. It also identifies the extent to which respending by businesses and industries occurs in the ROI. Income and employment multipliers make



Source: Original

Figure 4.14–3. Total Operating and Capital Budget at SNL

Of the total operating and capital budget for SNL for FY 1996, $877 M was spent in central New Mexico and $523 M was spent outside of central New Mexico.

Table 4.14–2. Employment and Income Profile in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
LABOR FORCE 1996					
Number of Workers	281,408	38,101	5,668	25,587	350,764
Employed	266,434	35,986	5,162	24,218	331,800
Percent Unemployed	5.3	5.6	8.9	5.4	5.4
SNL/NM WORK FORCE 1997					
Number of Workers	5,846	311	160	336	6,653[a]
Percent of Total SNL/NM Work Force[a]	85.7	4.6	2.3	4.9	97.5
Percent of 1996 Population	1.1	0.4	1.2	0.6	1.0
PERSONAL INCOME (BEA)					
Total Personal Income 1995 ($1,000)	11,901,977	1,387,695	183,339	898,055	14,371,066
Per Capita ($)	22,718	17,349	14,229	15,622	69,918
SNL/NM Net Wages and Salaries (FY 1996) ($1,000) (Not Including Benefits)	366,712	19,509	10,037	21,077	417,335

Sources: SNL/NM 1997h; UNM 1997c, d
BEA: Bureau of Economic Analysis
FY: fiscal year
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
[a] Total SNL/NM workforce was 6,824 on April 13, 1997, of which 171 employees lived outside the ROI. Thus, only 6,653 workers are shown on this table.

possible the identification of not only the direct impacts of an activity on income and jobs but also the indirect (business) and induced (household) effects (DOE 1997j).

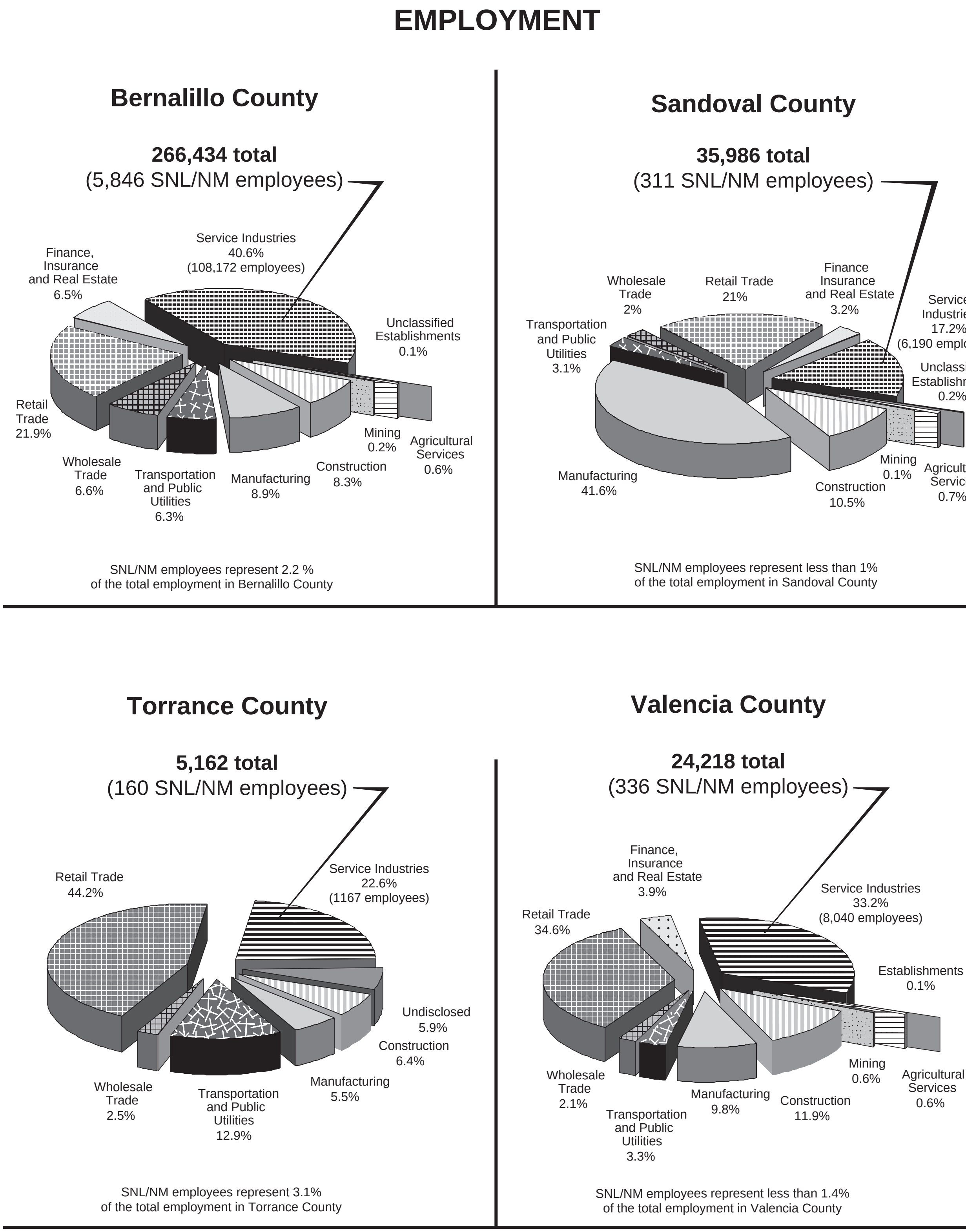
SNL/NM operations in the ROI have substantial influence on the economy. The total funding for SNL was approximately $1.4 B in FY 1996. Using an overall economic activity multiplier of 2.75 (adjusted for central New Mexico) yields a total economic impact of $3.9 B within the ROI. Assuming $486 M net additional personal income ($525 M gross personal income) and using the 2.21 income multiplier, the total personal income was slightly less than $1.1 B in FY 1996, or approximately 8 percent of the personal income generated in the ROI. SNL/NM workers living in the ROI received approximately $417.3 M in net wages and salaries in FY 1996. For every job at SNL/NM, an estimated additional 2.46 jobs were created in the ROI, which means that the 6,653 average employment level in FY 1996 resulted in an additional 16,366 jobs. In effect, nearly 1 out of every 14 jobs in the ROI was created or supported by SNL/NM, or 23,019 out of 331,800 (DOE 1997j).

4.14.3.1 Housing and Community Services

Table 4.14–3 lists the total number of occupied housing units and vacancy rates in the ROI. In 1990, the ROI contained 246,561 housing units, of which 225,289 were occupied. The median value of owner-occupied units was $85,300 in Bernalillo county, which is higher than the other three counties and nearly twice the median value of units in Torrance county. Coincidentally, the vacancy rate was lowest in Bernalillo county (7.8 percent) and highest in Torrance county (24.8 percent). While both Bernalillo and Sandoval counties issued a high number of new housing permits between 1990 to 1992, Sandoval county had the highest percentage of permits in relation to the existing stock in 1990 (Census 1995).

Community services include public education and health care (hospitals, hospital beds, and doctors). In 1990, student enrollment totaled 165,719 in the ROI (Census 1995). Ninety-two percent of these students attended public schools. Community health services and facilities are concentrated in Bernalillo county.

SNL/NM is actively involved in the surrounding communities including the city of Albuquerque, Bernalillo



Source: Census 1997b

Figure 4.14–4. 1995 Employment in Four-County Region of Influence

The largest employment sectors in the four-county region of influence are service (Bernalillo), manufacturing (Sandoval), and retail (Torrance and Valencia).

Table 4.14–3. Housing and Community Services in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
HOUSING (1990)					
Total Units	201,235	23,667	4,878	16,781	246,561
Occupied Housing Units	185,582	20,867	3,670	15,170	225,289
Median Value ($)	85,300	69,600	46,500	72,100	NA
Vacant Units	15,653	2,800	1,208	1,611	21,272
Vacancy Rate	7.8	11.8	24.8	9.6	8.6
New Housing Building Permits (1990-1992)	6,147	1,492	NA	490	NA
Percent of 1990 Housing Stock	3.1	6.3	NA	2.9	NA
PUBLIC EDUCATION (1990)					
Total School Enrollment	133,386	17,092	2,793	12,443	165,719
Elementary or High School	82,555	12,815	2,390	9,325	107,085
Percent Public	91.5	93.4	98.5	95.6	92.1
COMMUNITY HEALTH CARE (1991)					
Hospitals	10	0	0	0	10
Hospital Beds	1,726	0	0	0	1,726
Physicians (1990)	1,585	51	3	21	1,660

Source: Census 1995
NA : not available
ROI: region of influence

county, and neighboring pueblos. SNL/NM is active with the following committees, boards, and/or organizations: Albuquerque Economic Development; Citizens Advisory Board for SNL/DOE; Greater Albuquerque Chamber of Commerce; and the United Way (SNL/NM 1997a). Other activities include work with educational institutions, community associations, and government agencies.

Measuring SNL/NM's Economic Impact on the ROI

A multiplier is a factor used to calculate the incremental effect of changes, in dollars spent or jobs created or lost, at SNL/NM. For example, the overall economic activity multiplier is used to calculate the total economic activity generated in the ROI for each $1 spent by SNL/NM. The income multiplier is used to calculate the total income generated in the ROI for each $1 of income paid to workers at SNL/NM. The employment multiplier is used to calculate the total number of generated jobs in the ROI for each job created at SNL/NM.

NMSU identified the following multipliers in their FY 1996 analysis (FY 1997 is in parentheses):

Overall Economic Activity Multiplier

- $1 spent by SNL/NM generates an additional $1.75 ($1.98), for a total overall economic impact of $2.75 ($2.98) in the ROI.

Income Multiplier

- $1 income from SNL/NM for workers generates another $1.21 ($1.32), for a total impact on income of $2.21 ($2.32) in the ROI.

Employment Multiplier

- 100 jobs created at SNL/NM generates another 246 jobs (264), for a total impact of 346 (364) jobs in the ROI.

Sources: DOE 1997j, 1998j

4.15 ENVIRONMENTAL JUSTICE

4.15.1 Definition of Resource

Presidential EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations. Identifying minority and low-income populations is based on demographic and economic census information presented in *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* 59 FR 7629, (SNL 1997f). The following sections summarize the information presented in that report.

4.15.2 Region of Influence

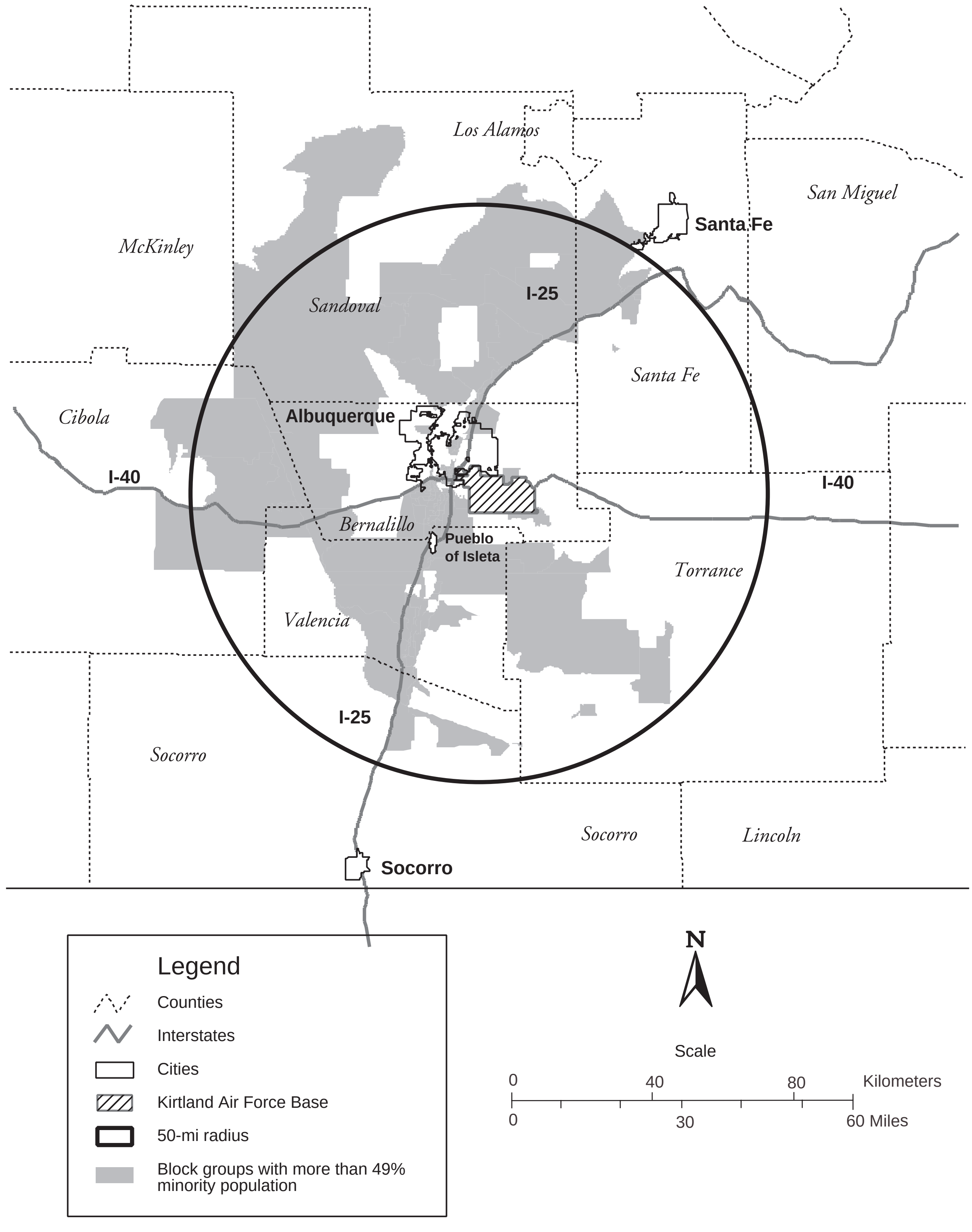
The population within a 50-mi radius around SNL/NM was considered in this evaluation because most resource areas have an ROI with the 50-mi radius, and none of them (with the exception of the four-county region for socioeconomics) has an ROI that extends beyond 50 mi. Minority populations living up to a 50-mi radius of SNL/NM, which exceed 49 percent of the population according to census data (Figure 4.15–1), were evaluated regarding health and environmental effects from activities at SNL/NM . Similarly, where low-income population exceeded 21 percent of the general population (Figure 4.15–2), the effects from activities at SNL/NM were analyzed. Figure 4.15–3 shows areas of environmental justice concern located near KAFB main gates (SNL 1997f). The figure presents a composite assessment of both minority and low income populations as presented in *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* (SNL 1997f).

4.15.3 Affected Environment

4.15.3.1 Identifying Minority and Low-Income Populations

For this SWEIS, minority populations are considered to be all *people of color,* except white people who are not Hispanic. In 1990, 49 percent (51 percent by 1996) of New Mexico's population was minority (Census 1998). Neighborhoods having minority population percentages exceeding the minority population percentage of 49 percent (slightly more conservative than 51 percent) are identified on a block-by-block basis, with clusters of blocks known as block groups.

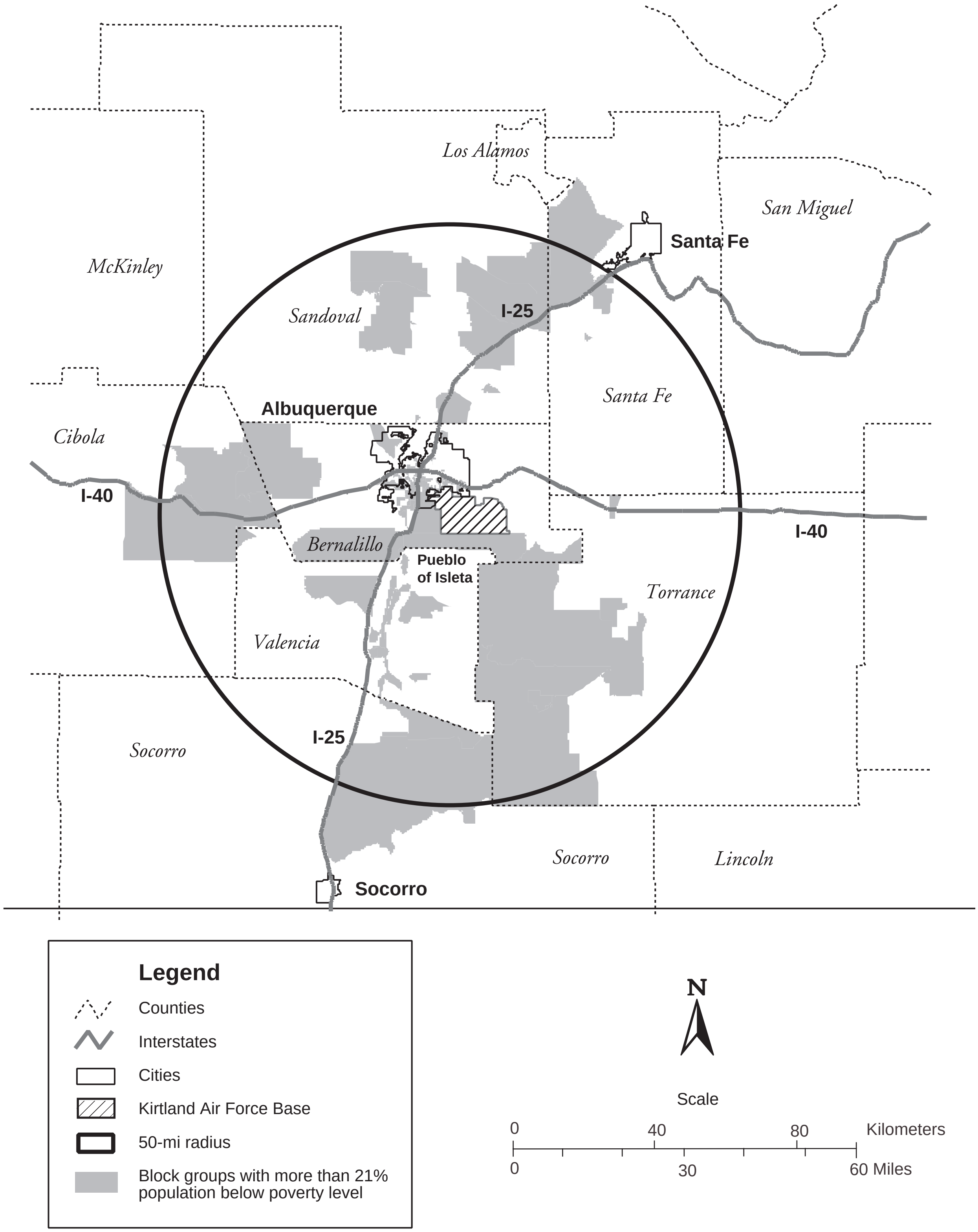
The Bureau of the Census characterizes persons in poverty (low-income persons) as those whose incomes are less than a statistical poverty threshold. The threshold is a weighted average based on family size and age of family members. For instance, the 1990 census threshold for a family of four was based on a 1989 household income of $12,674 (Census 1990). By 1996, the household income threshold rose to $16,036 (Census 1997c). In 1989, 21 percent of New Mexico's population was listed in poverty or designated as having low income (Census 1996). By 1996, the estimated percentage stood at 24 percent (Census 1997c). In this analysis, low-income block groups (same as above) occur where the low-income population percentage in the block group exceeds the poverty percentage for the



Source: SNL/NM 1997j

Figure 4.15–1. Minority Population

Block groups with more than 49 percent minority population were identified within a 50-mi radius of SNL/NM.



Source: SNL/NM 1997j

Figure 4.15–2. Low-Income Population

Block groups with more than 21 percent low-income population were identified within a 50-mi radius of SNL/NM.

Source: SNL/NM 1997f

Figure 4.15–3. Environmental Justice Areas

Five block groups with potential environmental justice concern are located near KAFB.

state of New Mexico. Figures 4.15–1 and 4.15–2 show the percentages of minority populations and low-income individuals, respectively, living within a 50-mi radius of SNL/NM. This area is similar, but not identical to, the four-county socioeconomic ROI discussed in Section 4.14.

4.15.3.2 Minority Populations

Block groups containing fewer than 49 percent minority individuals were not considered minority block groups (SNL 1997f). According to 1990 census data, approximately 280,360 minority individuals from an approximate total population of 609,500 reside in the 50-mi ROI. This represents 46 percent of the total ROI population (SNL 1997f). Figure 4.15–1 shows the census block groups containing minority individuals.

Approximately 228,800 persons identified themselves as being of Hispanic origin, which represent approximately 37.5 percent of the ROI population (SNL 1997f). Areas of Hispanic population lie generally in historic settlement patterns west of Interstate 25, in areas called the North Valley and South Valley. In the North Valley, Los Ranchos de Albuquerque has a higher-than-state-average Hispanic concentration. Old Town, the original center of Albuquerque, also has a higher-than-state-average Hispanic concentration. The highest Hispanic concentration is in the South Valley (SNL 1997f).

Approximately 29,840 persons identified themselves as "American Indians," which represent approximately 5 percent of the ROI population (SNL 1997f). The ROI contains 11 pueblos or reservations and 2 joint-use areas. The Pueblo of Isleta and Isleta Pueblo Trust Lands are adjacent to the southern boundary of KAFB. In addition, the Pueblo of Isleta represents the largest landholding of a minority population adjacent to KAFB (SNL 1997f).

Another 8,025 persons identified themselves as being "Asian or Pacific Islander," and approximately 14,600 persons identified themselves as being "Black," which represent approximately 1 and 2 percent, respectively, of the ROI population. The highest concentrations of both these groups reside in base housing on or near KAFB. Several smaller Black communities also exist west of KAFB, just beyond the city's airport (SNL 1997f).

An estimated 91,600 persons identified themselves as "Other," which represent approximately 15 percent of the ROI population. Statewide, 190,350 persons identified themselves as "Other." Of those people, approximately 186,970 (98 percent) were of Hispanic origin (SNL 1997f). This phenomenon occurs because many Hispanics do not consider themselves to be "White," a category they perceive as designated for European-Americans. According to the Bureau of the Census, the "Other" category includes persons identifying themselves as multiracial, multiethnic, mixed, interracial, or of a Spanish/Hispanic origin group (such as Mexican, Venezuelan, Latino, Cuban, or Puerto Rican). Concentrations of "Other" populations to the west of SNL/NM are in Hispanic neighborhoods. The distribution of "Other" minority individuals near SNL/NM mirrors the distribution of Hispanic individuals (SNL 1997f).

4.15.3.3 Low-Income Populations

Approximately 85,330 persons were identified as being low income, which represent approximately 14 percent of the ROI population (SNL 1997f). Figure 4.15–2 shows the census block groups containing more than 21 percent population below the poverty level.

This distribution of low-income population has a strong correlation to minority populations of Blacks, Native Americans, and Hispanics. For example, the high concentrations of low-income populations west of Albuquerque, shown in Figure 4.15–2 (near the 50-mi radius boundary), indicate the Pueblo of Laguna and its outlying Native American villages. Similarly, portions of the Pueblo of Isleta, south of the city, have high percentages of low-income individuals. To the southeast of SNL/NM, the rural Hispanic villages of Tajique, Torreon, and Escobosa are also low-income. To the north of SNL/NM, high concentrations of low-income populations are located in the Pueblos of Jemez, San Felipe, Santo Domingo, and Cochiti, as well as in the rural Hispanic villages of La Cienega and Jemez Springs (SNL 1997f).

High concentrations of low-income populations occur west of SNL/NM, along the Rio Grande, in the predominantly Hispanic South Valley neighborhoods. In addition, small pockets of low-income populations reflect the locations of Black neighborhoods such as the Kirtland Addition and the South Broadway/East San Jose area (SNL 1997f).

This page was intentionally left blank.