DOE/EA-0945

ENVIRONMENTAL ASSESSMENT

for the

PROCESSING AND ENVIRONMENTAL TECHNOLOGY LABORATORY (PETL)

Sandia National Laboratories/New Mexico

September 1995

U.S. Department of Energy
Albuquerque Operations Office
Albuquerque, New Mexico

DISCLAIMER

U.S. DEPARTMENT OF ENERGY
FINDING OF NO SIGNIFICANT IMPACT

PROCESSING AND ENVIRONMENTAL TECHNOLOGY LABORATORY at SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NEW MEXICO

AGENCY U.S. Department of Energy

ACTION Finding of No Significant Impact

SUMMARY The U.S. Department of Energy (DOE) has prepared an environmental assessment (EA) on the proposed Processing and Environmental Technology Laboratory (PETL) at Sandia National Laboratories/New Mexico (SNL/NM). This facility is needed to integrate, consolidate, and enhance the materials science and materials process research and development (R&D) currently in progress at SNL/NM.

Based on the analyses in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969. Therefore, an environmental impact statement is not required, and DOE is issuing this Finding of No Significant Impact (FONSI).

PROPOSED ACTION

DOE proposes to build and operate the PETL at SNL/NM to provide a centralized and integrated facility for research, development, and testing (RD&T) of materials and materials processes, and to enhance technology transfer and collaborative research. The PETL would be constructed on 1.6 hectares (four acres) of previously disturbed, but currently undeveloped land within SNL/NM boundaries on Kirtland Air Force Base (KAFB). The materials science and materials process RD&T and related activities, which now occur in several separate facilities located within several Technical Areas at SNL/NM, would be relocated to and consolidated in the PETL, in Technical Area I. The PETL would include offices, conference rooms, light laboratories, high bay laboratories, chemical laboratories, and a machine shop.

The occupants of PETL would be relocated from existing facilities. Because of the consolidation of research personnel and equipment into one facility, PETL would allow materials science and materials process RD&T, and related activities to be performed more efficiently than is possible with the currently dispersed facilities. The consolidation of these functions would also allow the reduction of the amounts of hazardous materials stored.

ALTERNATIVES CONSIDERED

The following alternatives to the proposed action were considered: (1) no action - perform the PETL mission in existing facilities; and (2) renovate existing facilities - perform the PETL mission in existing SNL facilities, renovating these facilities to meet technical as well as environmental, safety and health requirements.

Under the no action alternative, the PETL would not be constructed and the existing facilities would continue to be used under the current physical conditions. However, the no action alternative is not a reasonable alternative since some of the buildings in which activities are conducted are scheduled for or are being considered for demolition.

Renovation of the existing facilities would require the complete renovation of buildings in which operations are currently conducted. Environmental impacts associated with the renovation activities would be expected. The mission of the PETL would be negatively affected by the disruption of activities during renovation. Some currently occupied buildings are considered to be at the end of their useful lives, and renovation is not considered to be cost effective for these buildings.

ENVIRONMENTAL IMPACTS

Land use: The PETL would be constructed on land owned by DOE. There would be no known conflicts between the proposed action and Federal, regional, state, local, or Indian land use plans, policies, or controls. No existing land uses would be affected.

Air and Water Quality: No significant impacts to air, noise, or water quality would be expected to occur as a result of the construction and operation of the PETL. Air emissions during normal operations would not increase over the no action alternative since PETL would involve continuing operations. During normal operations, only sanitary sewer, nonhazardous wastewater, and storm sewer effluent would be expected.

Biological Resources: Approximately 1.6 hectares (four acres) of previously disturbed desert grassland habitat would be disturbed as a result of the proposed action. No threatened or endangered species would be affected.

Cultural Resources: The proposed site has been surveyed in accordance with the National Historic Preservation Act; DOE has consulted with the New Mexico State Historic Preservation Officer. Construction and operation of the PETL would have no affect upon historic properties.

Chemical Hazards: Limited quantities of numerous chemicals are used in the materials sciences and materials processes R&D testing activities to be relocated to the PETL. Worker health and safety would be protected in the PETL through designed safety features, such as the separation of corridors ordinarily used by workers from those used to transport chemicals from the storage area to the laboratories; centralized chemical storage, which would reduce the chemical inventory in individual laboratories; and the provision of windows allowing workers to view and monitor laboratories from separate administrative areas. The annual volume of hazardous wastes produced by these activities is expected to decrease as a result of consolidation into the PETL.

Accident Analysis: The PETL has been designed to provide a safe working environment. Four accident scenarios having the potential to affect workers, the public, or the environment were analyzed: a chemical spill in a laboratory; a facility fire; an aircraft crash; and natural phenomena (e.g., earthquake, extreme wind, or tornado). Under the chemical spill scenario, laboratory personnel in the PETL could be exposed to chemicals at levels greater than the normal permissible exposure limits. However, such exposures would not produce irreversible health effects. Under the facility fire scenario, the airborne concentration of most chemicals would be less than one-tenth of the permissible exposure limits set by Occupation Safety and Health Administration for occupational workers. Exposure of members of the public to such concentrations would not be expected to result in irreversible health effects.

In the event of an aircraft crash into the PETL, structural damage would be expected in the area of contact, as well as potential serious injury or death to personnel in the immediate area. The frequency of occurrence of a crash into the facility is estimated at 8.2×10^{-5}.

The proposed PETL would be designed to withstand an earthquake of 0.22g, with an annual probability of exceedance of 1×10^{-3}. The probability that a tornado would occur in the area of the PETL is less that one in one million.

DETERMINATION

In accordance with the Council on Environmental Quality (CEQ) requirements contained in 40 CFR parts 1500-1508, the EA examined the potential environmental impacts of the proposed PETL and discussed potential alternatives. Based on the analyses in the EA, the DOE has determined that the construction and operation of the proposed PETL facility does not constitute a major Federal action that would significantly affect the quality of the human environment, within the meaning of the NEPA and CEQ regulations at 40 CFR 1508.18 and 1508.27. Therefore, an environmental impact statement is not required, and DOE is issuing this Finding of No Significant Impact (FONSI).

For a detailed description of the proposed action and its environmental consequences, refer to the EA. Single copies of the EA may be obtained from:

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Issued this 18th day of Dec, 1995

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Acting Area Manager, Kirtland Area Office

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ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AIA	Albuquerque International Airport
AIHA	American Industrial Hygienists Association
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AQCR	Air Quality Control Regulation
ASHRAE-IES	American Society for Heating, Refrigeration, and Air Conditioning Engineers - International Energy Standards
Btu	British thermal unit
CAA	Clean Air Act
CCHP	Corporate Chemical Hygiene Plan
CDR	Conceptual Design Report
CEQ	Council on Environmental Quality
CFC	Chlorofluorocarbons
CFR	Code of Federal Regulations
CWA	Clean Water Act
dBA	Decibels on the A-weighted scale
DOE	U.S. Department of Energy
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ES&H	Environment, Safety and Health
FY	Fiscal Year
HVAC	Heating, Ventilation, and Air Conditioning
HWMF	Hazardous Waste Management Facility
HWSF	Hazardous Waste Storage Facility
IDLH	Immediately Dangerous to Life or Health
KAFB	Kirtland Air Force Base
L_{eq}	Equivalent sound level
M_L	Maximum probable local magnitude shock
mg	Milligram
MSDS	Material Safety Data Sheet
NEPA	National Environmental Policy Act
NIOSH	National Institute of Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historical Places
OP	Operating Procedure
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PETL	Processing and Environmental Technology Laboratory

ACRONYMS AND ABBREVIATIONS
(Concluded)

PHA	Preliminary Hazard Assessment
PHC	Preliminary Hazard Classification
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
ppm	Parts per million
RCRA	Resource Conservation and Recovery Act
R&D	Research and Development
RF	Radio-Frequency
SARA	Superfund Amendments and Reauthorization Act
SHPO	State Historic Preservation Officer
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SOP	Standard Operating Procedure
STEL	Short-Term Exposure Limit
T&E	Threatened or Endangered species
TLV	Threshold Limit Value
TLV-C	Threshold Limit Value - Ceiling
TWA	Time-Weighted Average
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriter's Laboratory
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service

1.0 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is one of the nation's largest research and development (R&D) facilities and is operated for the U.S. Department of Energy (DOE) under contract with Sandia Corporation. The primary mission of SNL/NM is the application of engineering and scientific capabilities to matters of national importance, including nuclear weapons, arms control and treaty verification, environmental restoration and waste management, energy supply and conservation, advanced conventional military technologies, and other programs in the national interest. SNL/NM is also charged with helping U.S. industry compete effectively in international markets through the transfer of Federally originated technologies.

This environmental assessment (EA) has been prepared pursuant to the National Environmental Policy Act (NEPA) of 1970 (42 United States Code [U.S.C.] 4321 *et seq.*); the Council on Environmental Quality (CEQ) NEPA regulations of 1986 (40 Code of Federal Regulations [CFR] 1500-1508, as amended); Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions* (1979); *DOE Order 5440.1E, National Environmental Policy Act Compliance Program* (1992), which establishes DOE procedures for NEPA compliance; and DOE's NEPA implementing procedures, 10 CFR 1021, *Compliance with the National Environmental Policy Act*, effective 1992. NEPA requires that Federal agencies consider the potential environmental consequences of a proposed action as part of the decision-making process.

This EA describes the purpose and need for action, the proposed action and alternatives, the existing environment, and the potential direct, indirect, and cumulative effects that may result from both the proposed action and alternatives. The discussion of these potential effects includes impacts to the environment, SNL/NM personnel, and the public caused by routine operations or abnormal events. The impacts of actions involving space vacated by relocation of these activities would be assessed at such time as they are proposed, and are not the subject of this document.

1.2 PURPOSE AND NEED FOR ACTION

The purpose and need for action are to provide modern, centralized facilities to improve ongoing R&D in the materials science and materials process programs at SNL/NM. This collocation and consolidation of materials R&D programs is needed to:

- enhance and facilitate the efficiency, collaboration, and synergy of research, development, characterization, and analytical activities;

- promote technology transfer and collaborative research with private industry and education institutions by facilitating interactions with SNL/NM researchers;

- reduce the quantities of hazardous materials stored in centralized storage; reduce the amounts of hazardous waste generated; and reduce the potential for worker exposure to hazardous materials and wastes in these ongoing operations with safety-enhanced laboratories;

- provide modern laboratory facilities and environmental control systems able to meet increasingly stringent environmental requirements;

- meet the requirements of certain vibration-sensitive analytical equipment; and

- maintain necessary security and close interrelations with other R&D activities that take place in SNL/NM Technical Area I.

These requirements are necessary to meet two of DOE's objectives to: (1) utilize an aggressive R&D program to develop processes that will offer significant cost reductions and minimizing the use of toxic materials in DOE activities, and (2) transfer technology to the private sector. The DOE R&D technology base supports many DOE programs, including improved understanding of basic scientific principles; advanced development of design materials and options; design for stockpile maintenance and reduction; stockpile reliability and safety assessment; extended functional lifetimes; and non-proliferation and arms control. Many technologies developed in support of DOE programs also are applicable to industrial problems.

The R&D process requires highly specialized facilities and equipment to achieve programmatic goals. DOE recognizes that the degradation of facilities and equipment over time reduces the ability of the R&D programs to support DOE's objectives. Therefore, DOE needs to assess the adequacy of existing facilities periodically and assure that safe and appropriate facilities are provided for the existing DOE R&D program.

SNL/NM is committed to supporting DOE's programmatic needs for new processes and materials; resolving environmental problems associated with weapon maintenance and dismantlement; conforming with environmental and safety regulations; and transferring new technology to the private sector. DOE R&D programs at SNL/NM include activities carried out by several SNL/NM organizations, including the Materials and Process Sciences Center, the Microelectronics and Photonics Core Competency Center, and the Environmental Programs Center. These organizations currently maintain active R&D programs in the development of ceramic, polymeric, and metallurgical materials. Research and development of materials processes that would be less hazardous, produce less waste, and release fewer regulated emissions are major activities of these organizations. These materials and materials processes have applications in both the DOE and in private industry.

These activities currently are dispersed throughout SNL/NM in more than nine separate facilities, many of which do not meet current best-industry practice. Some of the buildings now occupied by these R&D organizations at SNL/NM are approaching the end of their design life or are scheduled for demolition; therefore, new locations must be identified for these centers. SNL/NM has assessed the need for more modern, environmentally conscious facilities for many of its ongoing R&D programs in its *Site Development Plan* (SNL, 1995b).

Action to provide modern facilities is consistent with DOE's program planning and major assessment processes (DOE, 1992).

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2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The proposed action and the alternatives provide for the continuation of R&D activities currently being performed at several locations within Technical Area I at SNL/NM. The proposed action would provide for collocation of associated, ongoing activities in a modern facility, the Processing and Environmental Technology laboratory (PETL), in Technical Area I to provide maximum efficiency and productivity during a 50-year life span. No action and the renovation of existing facilities are evaluated as alternatives. Alternatives considered but eliminated from further analysis were the following: (1) construct the facility at another SNL/NM location; (2) locate in other existing SNL/NM building(s); (3) lease off-site facilities; and (4) procure services from off-site vendors.

SNL/NM is 4 kilometers (2.5 miles) south of Interstate 40, and about 10.5 kilometers (6.5 miles) east of downtown Albuquerque. Technical Area I consists of land owned by DOE within the boundaries of Kirtland Air Force Base (KAFB) (Figure 2.1). All R&D programs proposed for relocation to the proposed PETL are currently located in buildings at SNL/NM, primarily in Technical Area I.

2.1 NO-ACTION ALTERNATIVE

Under the no-action alternative, the materials science and materials process R&D programs currently performed by the Materials and Process Sciences Center, Microelectronics and Photonics Core Competency Center, and Environmental Programs Center would continue to be performed in the existing buildings, and would continue to operate under the current physical conditions.

The no-action alternative provides an environmental baseline for comparison with the impacts of the proposed action and the alternative of renovating existing facilities. However, the no-action alternative is not a reasonable alternative because it is not feasible (see discussion below, Section 2.1.1). Activities could not continue in the current locations because some of the buildings are scheduled for, or are being considered for, demolition under the SNL/NM *Site Development Plan* (SNL, 1995b). The no-action alternative would not satisfy the purpose and need as discussed in Section 1.2 and restated as follows:

- The R&D programs would not be collocated and consolidated to enhance and facilitate the efficiency, collaboration, and synergy of research, development, characterization, and analytical activities.

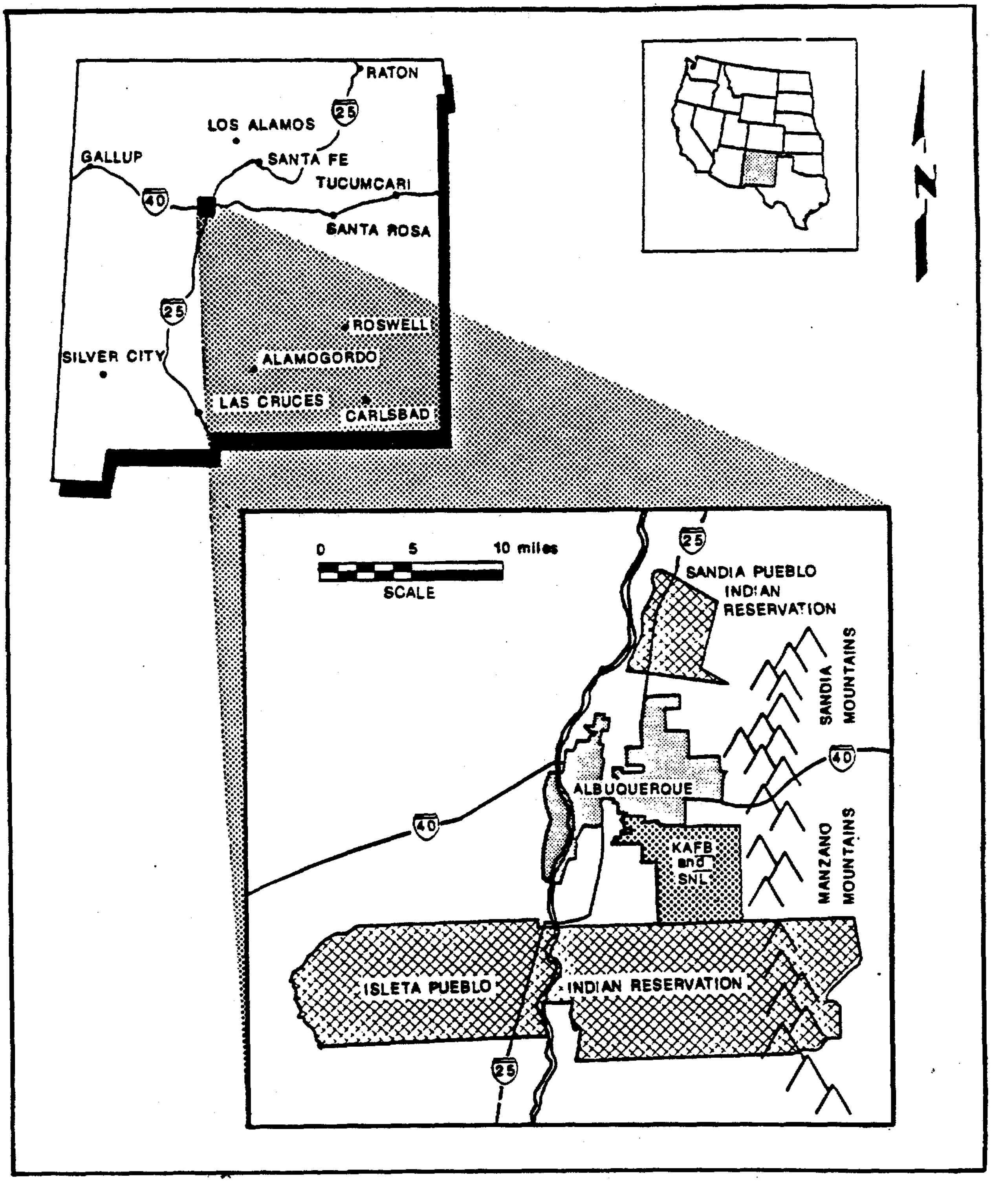


Figure 2.1
Location Map for Kirtland Air Force Base
and Sandia National Laboratories/New Mexico

- Technology transfer and collaborative research with private industry and education institutions would not be promoted because current program locations do not allow efficient interactions with SNL/NM researchers.

- The quantities of hazardous materials stored would not be reduced; the amounts of hazardous waste generated would not be reduced; and the potential for worker exposure to hazardous materials and wastes would not be reduced. These reductions would not happen because there would be no centralized chemical storage and no safety-enhanced laboratories.

- Modern laboratory facilities and engineered controls would not be available to meet increasingly stringent environmental requirements.

- The requirements for a vibration-sensitive location for certain analytical equipment would not be met because current facility construction and location of the existing facilities do not meet these requirements.

2.1.1 Current Occupied Space

The ongoing R&D programs are carried out by more than two dozen Departments in more than 100 standard light laboratories and additional offices. These organizations are located in permanent and transportable buildings. These buildings include 805, 806, 807, 823, 828, 892, 894, 960, and 981 scattered throughout the SNL/NM Technical Areas. Many of these buildings were not originally designed for laboratory needs, but were converted from warehouse, component assembly, and temporary space. All of the buildings have been modified to the maximum extent possible to accommodate current programs and equipment. Many of these buildings have reached their 50-year life spans or will do so in the near future; building 828 is scheduled for demolition (SNL, 1995b). Laboratories with vibration-sensitive equipment are restricted to the ground floors of the permanent buildings. With the current programs, all of the buildings are at maximum capacity and current working conditions are cramped. Laboratory chemicals are often stored adjacent to or within the laboratories. Existing ventilation systems that support the clean rooms, gas cabinets, and fume hoods are operating at capacity.

All laboratories in the existing buildings operate in compliance with: applicable Federal, state, and local regulations; all applicable DOE Orders; the current version of the SNL *Environment, Safety and Health Manual (ES&H Manual)* (SNL, 1995a), which is incorporated here by reference; and applicable SNL/NM operating procedures. The *ES&H Manual* is updated and revised on a regular basis. All SNL/NM operations conform to the current version of this manual. The laboratory operations create physical and chemical hazards inherent to the activities performed. Such hazards are currently controlled by a combination of retrofitted engineered safety controls, administrative controls, and worker training. The proposed PETL would allow more ES&H requirements to be met through the preferred methods of hazard elimination and the use of designed-in engineered controls.

2.1.2 Current Programs

The proposed action would affect only the three Centers described in this section. Of these three Centers, the Materials and Process Sciences Center is the largest, and conducts the majority of the chemical and materials laboratory work. A brief description of the current R&D programs and operations is provided below.

Materials and Process Sciences Center

This Center focuses on the research, development, characterization, and testing of metals, ceramics, and polymeric materials. This Center also provides analytical research and services in materials characterization and compatibility. The Center's programs focus on R&D relating to the nonnuclear components of weapons systems. This Center currently is expanding its efforts to find replacement materials and processes that are less hazardous to the environment and production personnel.

The Materials and Process Sciences Center also coordinates SNL/NM's Materials Science and Technology Program. The goal of the Center is to provide customers with materials and materials processing services ranging from research to development to applications engineering. Teamed with the other Centers conducting materials R&D, this Center develops new programs for agencies of the Federal government and for private industry, program development, and technology transfer.

The Departments in this Center conduct the following programs:

- **Organic Materials Synthesis and Degradation.** This Department supports the development, application, and reliability assessment of organic materials. The synthesis of new polymers includes evaluating physical and chemical properties, and lifetime evaluations using accelerated aging techniques.
- **Properties of Organic Materials.** This Department performs R&D on the structure and properties of polymers and other organic materials, including developing material characterization techniques.
- **Organic Materials Processing.** This Department conducts basic and applied research in advanced cleaning technologies, and on the processing and manufacturing techniques applicable to organic materials, including foams, thin films, millimeter-sized materials, porous membranes, and copolymers.

- **Electron Microscopy/Metallography.** This Department applies electron optical and optical metallographic techniques to analyze and characterize the morphology, structure, and chemical composition of engineering materials and components.

- **Surface/Molecular Spectroscopy and Gas Analysis.** This Department uses molecular spectroscopy, surface analytical techniques, and gas analysis to characterize materials for materials compatibility and reliability studies.

- **Chemical and X-Ray Analysis.** This Department provides analytical chemistry support, including atomic spectroscopy, chromatography, electrochemistry, classical wet chemistry, and x-ray analysis techniques.

- **Physical and Joining Metallurgy.** This Department engages in R&D on the thermal and chemical interactions that control microstructure and properties of metals and alloys, including interpretation of solidification and solid-state transformation in metal alloys, modeling and interpretation of kinetic processes, and development of phase equilibria and thermodynamic information for metallurgically important systems. It also conducts research in joining and welding processes.

- **Mechanical and Corrosion Metallurgy.** This Department conducts R&D to characterize the mechanical and corrosion response of materials on both microscopic and macroscopic scales.

- **Liquid Metal Processing.** This Department conducts R&D to characterize melting and casting processes, including FASTCAST™ technologies, and controls systems required in the production of specialty metals.

- **Ceramic Processing Science.** This Department studies the processing of ceramics and related materials as processing is central to attaining desired material properties.

- **Glass and Electronic Ceramics.** This Department conducts research on the fundamental relationships between the structure and properties of ceramic glass materials, and uses this knowledge to develop technologies related to these materials.

- **Ceramic Synthesis and Inorganic Chemicals.** This Department conducts research into the synthesis of both unique ceramic compositions and unique forms of ceramics by novel methods.

Microelectronics and Photonics Core Competency Center

This Center is responsible for SNL/NM's microelectronics and photonics programs, including semiconductor physics, device and circuit development, integrated circuits, sensors, micromechanics, processing, and fabrication. These programs develop and provide manufacturing processes for custom microelectronics and photonics products for government needs in defense, energy, and environment.

Environmental Programs Center

This Center meets and anticipates the needs of the DOE, its primary customer, as well as other government agencies and industry partners, by developing and applying technology in the following principal areas: (1) Product Quality and Realization, to support defense programs and to enhance economic competitiveness for industry through development of environmentally conscious manufacturing and reliable and quality management tools and information; and (2) Hazardous Materials Management to provide efficient and environmentally acceptable methods for hazardous waste and material characterization, treatment, storage, disposal, and monitoring. These programs are carried out in the Environmentally Conscious Manufacturing Department and Manufacturing Systems Reliability Modeling Department.

2.1.3 Current Operations

The following discussion is a brief overview of current R&D, testing, and analytical operations carried out by the three Centers described above, and does not include every activity. Ongoing research is performed on microsampling techniques, nondestructive testing, and solvent substitution in support of pollution-prevention efforts for the DOE complex and general industry. Materials, processes, and analytical techniques are expected to change with advances in technology and knowledge.

Materials currently synthesized and tested include: glasses, ceramics, metals, alloys, conductors, superconductors, insulators, films, organic materials, fullerenes, polymers, polymeric and aqueous foams, and composites.

Routine specimen preparation includes: chemical precipitation or deposition, sawing, grinding, polishing, drilling, chemical etching, ion beam thinning, welding, cutting, mounting, and cleaning. Samples are tested at ambient temperatures, as well as at high and low temperatures, and in ordinary as well as controlled atmosphere conditions.

Analytical methods include: optical microscopy, analysis of optical and electrical properties, transmission and scanning electron microscopy, x-ray diffraction and fluorescence, electron microprobe analysis, gas chromatography, mass spectrometry, infrared spectrometry, fluorescence analysis, atomic emission spectrometry, inductively- coupled plasma mass spectroscopy, and wet chemical analysis.

Processes include: material synthesis and process development, casting and annealing of glass and ceramic materials,, development of coating techniques (*e.g.*, sol-gel and thermal spray), thermal testing, studying sintering behavior of ceramics, chemical testing (*e.g.,* corrosion tests), and mechanical testing (*e.g.,* tests of adhesion, stressing, cracking, breaking, impact, tension, compression, fatigue, deformation [stress-strain], fracture toughness, friction, and wear).

All laboratory operations are performed in accordance with the procedures established in the SNL *Corporate Chemical Hygiene Plan* (*CCHP*) (SNL, 1991a), which is incorporated here by reference. The *CCHP* complies with Occupational Safety and Health Administration (OSHA) regulations, 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories,* and is administered by the SNL/NM Industrial Hygiene Departments.

Laboratory Equipment

The laboratories, equipment, and chemicals used in the materials and materials process R&D programs are consistent with standard light-laboratory operations found in universities and industrial R&D programs. They meet the OSHA definition of laboratory-scale: a workplace where relatively small quantities of hazardous substances (as defined in 29 CFR 1910, *Occupational Safety and Health Standards*) are used on a non-production basis and in which the containers used for reactions, handling, or transfers are designed to be easily and safely manipulated by one person (29 CFR 1910.1450).

All general chemistry equipment is laboratory-scale and the majority is commercially available. Typical equipment includes, but is not limited to, lasers, high- and low-temperature equipment, electronic and mechanical laboratory equipment, compressed gases, high-pressure equipment, high-voltage equipment, vacuum equipment, and equipment producing x-rays and radio frequency (RF) fields. Some of the larger, specialized instruments (*e.g.,* the scanning electron microscope) produce ionizing radiation. A few analytical instruments (*e.g.,* gas chromatographs) may contain a commercially-purchased sealed radioactive source. These instruments are purchased commercially, are in common use among general industry and other DOE laboratories, and are handled only by specially trained technicians.

All equipment is operated in accordance with the manufacturer's instructions and additional operating procedures, as needed. Repairs and maintenance of the high-technology equipment (*e.g.,* lasers) is performed by trained specialists provided by the commercial manufacturer. All equipment with ionizing radiation components or high-voltage components have manufactured protective safeguards built into the equipment for protection and safety.

A common condition with current operations is the lack of sufficient laboratory space. In one case, a Class IV laser and x-ray machine sometimes must operate simultaneously in adjoining areas. To reach the x-ray area, technicians must pass through the laser area. When the laser is in operation, access to the x-ray area is prohibited, creating delays and inefficiency in completing assignments. This situation currently is addressed by elaborate administrative controls restricting access to the laser, which prevent access to the x-ray machine.

Chemical Inventory and Storage

Approximately 2500 different chemicals and chemical compounds are used to carry out the operations described above. The chemical inventory is similar to those found in any university or noncommercial research laboratory, and includes organics, metals, organometallics, acids, bases, and oxides. SNL/NM maintains a complete chemical inventory, which is on file with the Materials and Process Sciences Center ES&H Coordinator and is incorporated here by reference. The chemical inventory is tracked by individual laboratory and is updated on an annual basis. The chemicals that are considered the most toxic and/or are stored in the greatest quantities are provided in Table 2-1. These chemicals are used in small quantities during laboratory-scale or bench-scale general chemistry experiments and analyses. These chemicals also are needed in small quantities to provide calibration standards and for cleaning equipment. No processing of radioactive materials is involved in carrying out the activities described above. The Materials and Process Sciences Center, with almost 100 laboratories, maintains the largest chemical inventory among the three Centers described above.

The chemicals are used in relatively small quantities (one to three liters) to perform laboratory-scale general chemistry experiments and analyses, prepare calibration standards, and clean laboratory equipment. However, many of the chemicals are available only in minimum quantities (volumes) that greatly exceed the amounts needed to conduct experiments. Each laboratory also maintains its own chemical supplies. These two practices result in both a duplication of chemicals and an increase in the total volume (quantity). Thus, the total chemical inventory required is increased by about 25 percent or more for the no-action alternative when compared to the proposed action (see below).

All chemicals are properly stored and are inspected periodically for deterioration and container integrity, in compliance with policy outlined in the current version of the *ES&H Manual* (SNL, 1995a). The SNL/NM Chemical Exchange Program collects unopened and unexpired excess chemicals for redistribution to other laboratories.

Waste Management

Each laboratory uses a number of chemicals in small quantities (one- to three-liter amounts). The current buildings and their locations in relation to one another do not permit the maintenance of a centralized chemical storage facility; therefore, each laboratory must maintain its own inventory. This results in a duplication of up to 25 percent of the total number of chemicals stored by the laboratories. The total quantity (volume) of chemicals on site during any month also is increased substantially because of inventory duplication. This also increases the overall quantity of hazardous waste generated. Periodically, chemicals must be transported from one building to another. When this occurs, all chemicals are transported in accordance with the current version of the *ES&H Manual* (SNL, 1995a).

Table 2-1 Representative List of Chemicals with Toxicity Data for the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico[a]

Chemical	Maximum Inventory	Toxicity Data (mg/m^3)[b]			
		PEL-TWA[c]	TLV-STEL[d]	TLV-C[e]	IDLH[f]
Acetone	100 liters	590	--	--	6,050
Benzene[g]	3 liters	0.3	3.3	--	1,625
Dioxane[g]	5 gallons	3.6	--	4	1,830
Hexane	20 liters	180	--	--	3,938
Hydrochloric Acid	22 liters	--	--	7	76
Hydrofluoric Acid	4 liters 80 pounds	2.5	--	5	25
Hydrazine	1 liter	1.3	--	0.04	66
Lead	60 pounds	0.05	--	--	100
Mercury	11 pounds	0.05	--	0.1	10
Methanol	70 liters	260	325	--	7,980
Methylene chloride[g]	10 liters	1,765	--	3,530	8,119
Phosphoric Acid	20 liters	1	3	--	4,070
Picric Acid	100 grams	0.1	0.3	--	75
Toluene	35 liters	375	560	1,149	1,915
Trichloroethylene[g]	25 liters	546	--	1,092	5,460

Sources for Toxicity Data: National Institute of Occupational Safety and Health (NIOSH), 1994; Sax, 1984; Merck, 1983; Material Safety Data Sheets.

[a] These chemicals are considered in the most toxic and/or are stored in the greatest quantities. The nature of activities that would be performed in the proposed PETL may necessitate larger or smaller inventories. Quantities would vary depending on individual experiments and would be maintained at the lowest level required to meet demand.

[b] The table lists OSHA permissible exposure limit (PEL) values for some chemicals. If the NIOSH-recommended time-weighted average (TWA) for a chemical is lower than the OSHA PEL (NIOSH 1994), the NIOSH TWA is listed.

[c] Permissible Exposure Limit - Time-Weighted Average (PEL-TWA): The permissible constant exposure concentration that must not be exceeded during any 8-hour work shift of a 40-hour work week.

[d] Threshold Limit Value - Short-Term Exposure Limit (TLV-STEL): The 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV-TWA.

[e] Threshold Limit Value - Ceiling (TLV-C): The maximum concentration that should not be exceeded during any part of the work day. Note that the TLV-C for hydrazine is lower than the PEL. This discrepancy is due to the use of both NIOSH-recommended values and OSHA standards in the table.

[f] Immediately Dangerous to Life and Health (IDLH): The maximum concentration from which one could escape within 30 minutes without a respirator or irreversible effects.

[g] Identified as a human carcinogen or suspected human carcinogen.

The majority of chemical waste generated during laboratory experiments is listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) and must be managed and disposed of in accordance with 40 CFR 262, *Standards Applicable to Generators of Hazardous Waste,* and 40 CFR 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.* Most of the chemicals also become hazardous wastes once they have reached their expiration dates and must be disposed of accordingly. Each laboratory (generator) properly labels and stores the hazardous waste at the generation point in accordance with procedures specified in the current version of the *ES&H Manual* (SNL, 1995a).

The Materials and Process Sciences Center ES&H Coordinator maintains for all affected Departments hazardous waste generation records that are updated regularly and are incorporated here by reference. For the three-month period of October through December 1992, the average total amount of hazardous waste generated per month was 124 kilograms. The single largest substance each month was photoactivator/stop bath.

Hazardous waste is collected, labeled, and properly stored at the generation point, and then removed and sent to an appropriate, permitted treatment, storage, and disposal facility such as the SNL/NM Hazardous Waste Management Facility/Hazardous Waste Storage Facility (HWMF/HWSF). Hazardous waste is handled in accordance with Chapter 19A, *Chemical Waste Management*, in the current version of the *ES&H Manual* (SNL, 1995a) and under the guidance of the Generator Interface and Industrial Hygiene and Toxicology Departments. All SNL/NM requirements are in compliance with the RCRA and applicable state and local laws and regulations.

SNL/NM actively pursues a waste minimization and waste reduction program as described in the SNL/NM *Waste Minimization and Pollution Prevention Awareness Plan* (SNL, 1994). This program also is in keeping with the DOE and SNL/NM as low as reasonably achievable (ALARA) policy for SNL/NM personnel and with reducing harm or potential impacts to the public and the environment. Source reduction and recycling efforts are two ongoing in-house programs to reduce monthly and annual quantities of hazardous waste generated by normal R&D operations. Recycling unused chemicals through the SNL/NM Chemical Exchange Program is one way in which the total chemical inventory and generated hazardous waste is reduced.

Worker Health and Safety

Potential hazards to worker health and safety are addressed by a combination of engineered safety controls, administrative controls, and worker training. Activity-specific procedures have been developed to further reduce potential hazards to worker health and safety.

In accordance with the current version of the *ES&H Manual* (SNL, 1995a), preliminary hazard assessments (PHAs) are required for all SNL/NM facilities and project activities, all new facilities, and before new operations begin. All PHAs are reviewed and updated at least annually. A safety assessment would be prepared and approved prior to the operation of the proposed PETL, as required by DOE Order 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*.

As required by the SNL/NM *Management, Integration, and Implementation Plan* (SNL, 1992), a preliminary hazard classification (PHC) has been completed for every PHA. PHCs include a semiquantitative ranking of the following hazard class categories: radiologic, toxicologic, environmental, property, and industrial (including chemical, electrical, lasers, ionizing radiation, cranes and hoists, thermal, and explosive). A PHC ranking between one (highest hazard) and five (lowest hazard) was assigned to each PHA for each category. The operations described here are ranked between five (most common) and three.

The results of the PHAs and PHCs are incorporated here by reference and are on file with the Materials and Process Sciences Center ES&H Coordinator. Operating procedures that address the hazards identified in the PHAs have been prepared; a representative list is provided in Appendix A.

All laboratory operations are performed in accordance with applicable OSHA (29 CFR 1910.1450) and *CCHP* (SNL, 1991a) requirements for laboratory standards, the current version of the *ES&H Manual* (SNL, 1995a), Standard Operating Procedures (SOPs), and Operating Procedures (OPs). As required by the current version of the *ES&H Manual* (SNL, 1995a), activity-specific OPs are in place for handling chemicals and operating the laboratory equipment. All laser OPs comply with the American National Standards Institute (ANSI) *Standard for the Safe Use of Lasers* (ANSI Z136.1). Appendix A provides a representative list of the SOPs and OPs on file with the Materials and Process Sciences Center ES&H Coordinator, which are incorporated here by reference.

Laboratory hoods are equipped to monitor continuous air flow. However, monitoring employee exposure is not routinely performed in any of the affected laboratories at this time. The OSHA standards (29 CFR 1910.1450) do not require employee monitoring for laboratory-scale use of OSHA-regulated substances if the exposures to these substances do not exceed the permissible exposure limits (PELs) specified in 29 CFR 1910, Subpart Z, *Toxic and Hazardous Substances*, or if there is no reason to believe that the exposure levels routinely exceed the action level or PEL. The Industrial Hygiene and Toxicology Department is conducting an SNL/NM-wide assessment of the need for exposure monitoring in the individual laboratories.

Although workers are not expected to receive radiation doses above background levels, dosimetry badges are worn and records are kept for personnel working with x-rays or equipment containing components that produce ionizing radiation. Periodic monitoring is performed to check for potential leakage; monitoring information is recorded in a permanent log.

Personal protective equipment (PPE) is used to protect workers while they are working with chemicals. Common equipment consists of approved eye protection, laboratory coats, and appropriate gloves. In addition, special transport and storage containers are used to reduce the potential for chemical spills and to contain the chemical in case the original container should break. Chemical handling is detailed in two specific procedures. These procedures follow the OSHA Laboratory Standards (29 CFR 1910.1450) and the *CCHP* (SNL, 1991a). Training and familiarity with the chemicals used is provided to personnel through specialized courses and Material Safety Data Sheets (MSDSs). Safety showers and emergency eyewashes are readily available in case of a chemical splash. Emergency medical services are available on site.

Accidents and injuries are uncommon in the Materials and Process Sciences laboratories. Only six OSHA potential reportable injuries occurred in 1992. One involved a potential chemical exposure to a laboratory worker that was determined to be inconclusive. The other injuries involved strains and sprains consistent with injuries found in office and light laboratory settings. For the period 1989 to 1992, occurrence reports have been generated at a rate of two per year. The majority of these occurrences have involved legacy waste and associated contamination.

2.2 PROPOSED-ACTION ALTERNATIVE

The proposed action is to construct and operate laboratories in a 15,394 gross-square-meter (165,700 gross-square-foot), three-story building designed with light laboratories and office space within a designated vibration-sensitive, secured area of Technical Area I at SNL/NM (Figure 2.2). The proposed PETL facility would occupy approximately four acres of DOE-owned, vacant land inside Technical Area I at SNL/NM, in the southeast corner of Section 32, Township 10N Range 4E. The facility would be located north of Building 858 and inside the perimeter security fence of Technical Area I. The existing security fence would bound the facility to the north and east. K Street is just outside the north security fence. Seventeenth Street would bound the facility on the west side.

Approximately 260 personnel from the three Centers described in Section 2.1.1, and currently working in several buildings, would be collocated in the proposed PETL facility.

The proposed-action alternative would meet the purpose and need for action for the following reasons:

- The proposed PETL would be designed to allow the materials and process science operations described under the no-action alternative to continue to carry out existing

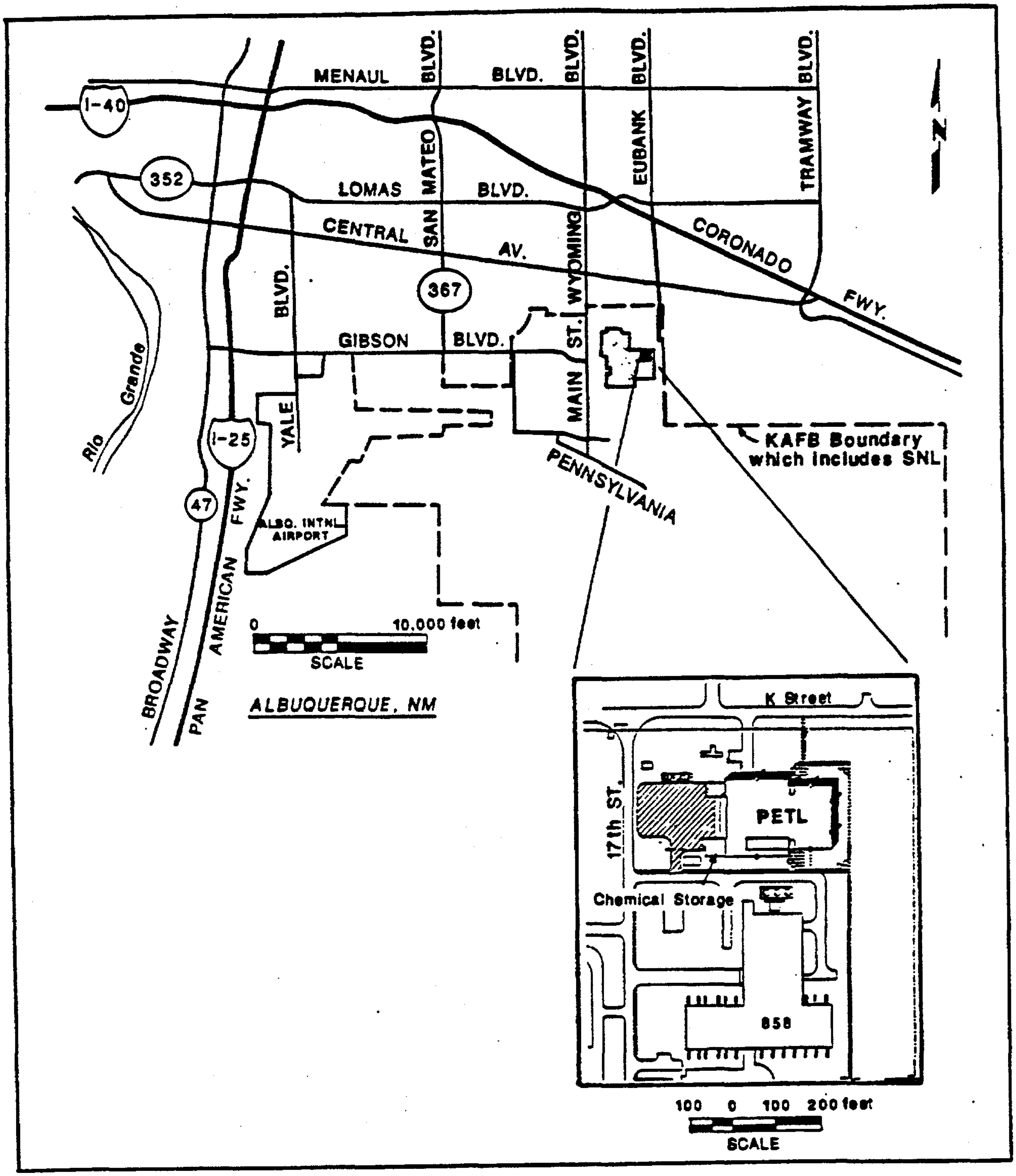


Figure 2.2
Location Map for the Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

R&D programs in a more efficient, effective, centralized facility. The collocation of these Centers would enhance and facilitate the synergy of the research, development, characterization, and analytical activities.

- There is an increasing emphasis on technology transfer with private-sector clients. Collocating and locating the proposed PETL close to the perimeter of the secured area would increase access to the building by private industry and educational institutions. This increased access would facilitate interactions with SNL/NM researchers.
- A centralized chemical storage area with engineered environmental and safety controls would allow the quantities of hazardous materials stored and hazardous wastes generated to be reduced. This would reduce the potential for worker exposure to hazardous materials in these ongoing operations.
- Increasingly stringent environmental requirements demand more modern laboratory facilities and environmental control systems. The proposed PETL would provide safety-enhanced laboratories, consolidated environmental systems, reduced potential worker risk, and improved energy efficiency.
- Ongoing materials science and materials process R&D programs require that the proposed PETL be located in a secured area within easy access of established R&D activities and clients located in Technical Area I, and within an area designated for vibration-sensitive equipment to accommodate special equipment requirements.

2.2.1 Facility Construction

A conceptual design for the proposed PETL was prepared in 1992 (Dekker and Associates, 1992). Preparation of the final engineering design would proceed after the NEPA process is completed; funding to begin this activity is anticipated in 1996. Construction of the facility is currently proposed to begin in Fiscal Year (FY) 97 with full occupancy scheduled for FY2000. The facility would be designed and constructed to be operational for 50 years.

Site development would include exterior utilities; drainage improvements; asphalt paving; concrete curbs, gutters, and walks; fencing; earthwork; and landscaping, including trees and shrubs, consistent with SNL/NM standards. The proposed site is bounded to the north and west by existing roads.

The general design summaries provided below are taken from the final *Conceptual Design Report (CDR)* (Dekker and Associates, 1992). During the final design process, all structural features and systems would be analyzed for specific design needs, permits, and regulatory compliance. Construction of the facility would be performed to the specifications of DOE

Order 6430.1A, the Uniform Fire Code (UFC), and the Uniform Building Code (UBC), which includes earthquake design criteria and other applicable building codes and regulations. The most significant codes, standards, and regulations are provided on page 8 of the Appendix of the final *CDR* (Dekker and Associates, 1992). The final engineering design process would include a detailed list of building codes, permits, and regulations that would be adhered to in the construction of the proposed facility.

2.2.2 General Design Features

The proposed PETL would be a three story building with a full basement (Figure 2.3). It would provide an area of approximately 15,394 gross square meters (165,700 gross square feet). The proposed PETL's two primary functional areas would consist of approximately one-third office space and two-thirds laboratory space. The current design is illustrated in Figure 2.4.

The basement would contain the building's primary mechanical systems, the machine shop, and laboratory facilities for instruments needing high bays. A separate portion of the basement would house the elementary neutralization system and the emergency wastewater holding system (Figure 2.4, Item 7).

The chemical storage facility would be a single-story structure at ground level, outside and adjacent to the first floor. A separate loading dock would be adjacent to this facility (Figure 2.4).

Electrical, HVAC, and special exhaust systems would be provided throughout the proposed PETL to meet testing and research laboratory requirements and SNL/NM ES&H requirements. The current design of the building, offices, and mechanical systems allows for future modification to accommodate changing research needs, while requiring minimal modifications to the building's HVAC and electrical systems.

Existing laboratory equipment and office furniture would be moved into the facility. Additionally, new equipment and furniture would be selected to keep combustible loading to a minimum. Where possible, flame-resistant items would be used; these items would be either fire-marshal approved or have a flame spread rating of 25 or less. Handicapped access would be provided in public and common-use areas, including rest rooms located on each floor.

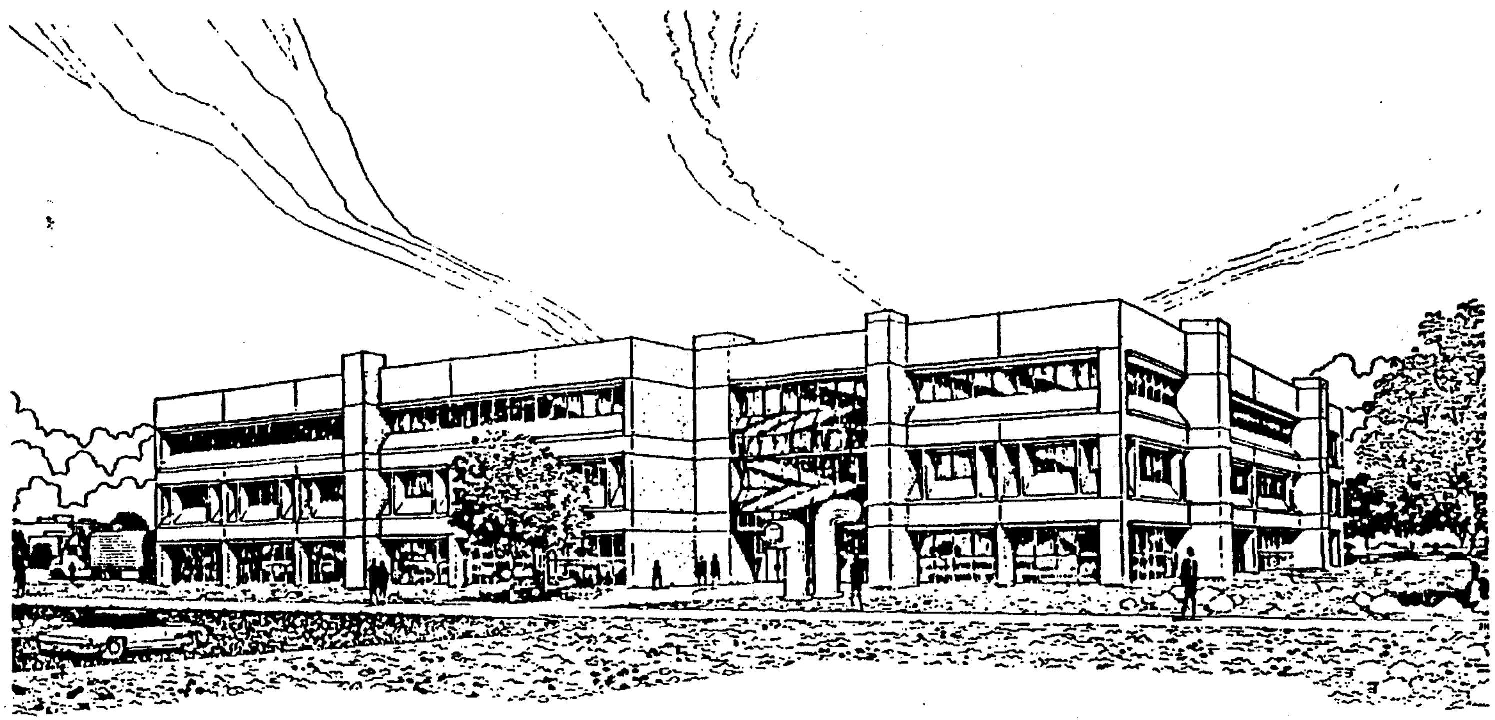


Figure 2.3
Artist's Conception, Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

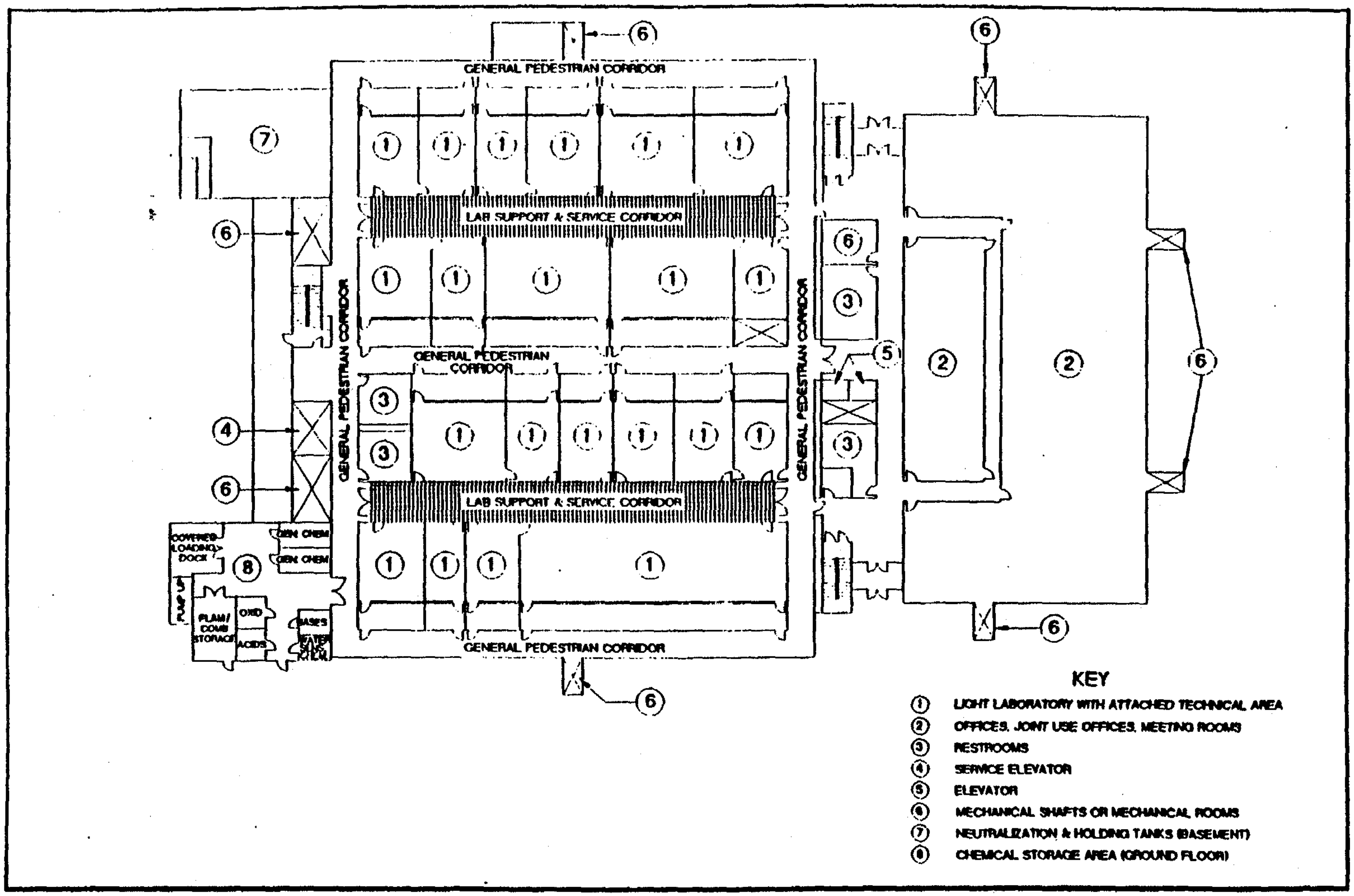


Figure 2.4
Generalized Floor Plan for the Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Energy Usage. The building energy usage profile would be designed to meet the requirements of the American Society for Heating, Refrigeration, and Air Conditioning Engineers-International Energy Standards (ASHRAE-IES) 90.1A and current DOE criteria, including DOE Order 6430.1A, *General Design Criteria.* The current design is expected to yield a 10 percent energy usage reduction over the 1985 operating energy use level of similar buildings at SNL/NM.

The current design calls for an adjacent utility substation. Inverters would be located on each floor inside the building to provide standby power for operation of stairwell, exit, and interior selected corridor lights, and would provide power for the fire alarm system.

Natural Gas Systems. Natural gas would be used in the laboratories. An existing high-pressure natural gas main is located west of the proposed building site. A high-pressure gas line would be extended to the building, and a pressure regulator would be installed outside the building.

Water System. Domestic cold and hot water would be provided throughout the building. Drinking fountains would dispense cold water. All laboratory sinks would be supplied by a separate water system. The current design calls for a deionized water storage tank in the basement for laboratory use.

Laboratory Piping Systems. Current design calls for a system of piping that would serve laboratories on all three floors. The system would include, but not be limited to, risers for the following: vacuum; compressed air; process chilled water supply and process chilled water return; and cold water, hot water, and recirculation hot water.

Sewer System. A sanitary sewer would be extended toward the west from the proposed building. Wastewater from the elementary neutralization system would be discharged into the sewer system by a separate pump. The gravity sanitary sewer line would discharge into a new sewer collector manhole. The sewer system would have a separate sampling manhole provided for routine sampling and testing by SNL/NM ES&H personnel.

Arrangements would be made with the SNL/NM Environmental Restoration (ER) Program Office to have a camera survey of the existing sanitary lines performed at the utility connection locations. If the survey indicates there are no breaks in the line, the new connection would be made without further ER Program involvement.

Storm Sewer. The grade of the proposed building site drops off toward the south and west from the northeast corner of the site. The existing storm sewer piping south of the new building has drop inlets, culverts, and open drain trenches, which currently discharge into a storm sewer extending southward. New storm leaders would be built to accommodate roof drainage and the new building. Small manholes would be located where necessary to accommodate changes in flow direction.

Exhaust Air Systems. The general chemical laboratories would use small amounts of chemicals. The current design calls for three types of ventilation systems to adequately exhaust these chemicals: a general laboratory ventilation system, a designated ventilation system for use with regulated and controlled chemicals, and an explosion-proof system for use with combustible chemicals.

During the final design process, actual specific exhaust needs for each laboratory would be analyzed. At that time, it may be determined that some additional, smaller exhaust systems may also be necessary. The need for a specialized exhaust system for the machine shop also would be evaluated during the final design process.

The three ventilation systems would be ducted separately, with ventilation shafts on the roof. Duct work would be coated as necessary. The exhaust housings, located at the roof level would include variable-volume exhaust fans, heat recovery coils, and sound-attenuating devices, as needed. Exhaust stacks would be of the appropriate height and sufficiently far from the fresh-air intakes to prevent the exhaust from entering the fresh-air intakes.

A backup power system capable of handling emergency shutdowns of the exhaust system would be included in the final building design. The exact power source (*e.g.*, a gasoline generator) and operating specifications would be decided based on the extent of the exhaust system. At that time, ES&H requirements would be identified (*e.g.*, air quality, spill prevention controls and countermeasures).

Fire Protection. A combination evacuation and fire alarm system would be installed at the entrance lobby. The fire alarm system would provide both visual and audible alarms. Bells would be installed on the exterior of the building, and manual pull boxes would be installed throughout the building. Photocells and smoke detectors would be installed in the return air ducts on individual floors and in the outside air intake ducts.

Fire protection would be provided through either a water system or a water/foam system. Water would be provided through the existing SNL/NM infrastructure by extending capped water lines onto the facility site. Two new fire hydrants would be installed to supplement the flow from two existing fire hydrants located near the new building. The current design calls for an ordinary hazard (Group 2) fire protection sprinkler system. In case of a fire, the basement would serve as the containment facility for all of the water.

All fire protection features would be analyzed during the final design process and designed in accordance with the UFC and the SNL/NM fire protection engineering procedures and standard specifications. A Fire Hazard Analysis would be provided in accordance with DOE Order 5480.7a, *Fire Protection*.

Smoke Removal. Three large smoke removal fans would be installed in the proposed PETL that would activate upon receiving a fire alarm signal through the electrical fire alarm system. Fresh air would be delivered as smoke is exhausted. In the event smoke is detected in the fresh-air ducts, the fresh-air ducts would automatically shut down.

Chemical Storage Facility. A separate chemical storage facility would be located outside the proposed PETL adjacent to the first floor, away from the general offices and support facilities. The facility would have a separate receiving area with an exterior loading dock, one set of interior doors, and three separate exterior doors. Blast-resistant, hollow metal doors, and Underwriter's Laboratories (UL) labeled fire doors and frames would be installed where required by fire code. The storage area would be analyzed for specific fire and building code requirements during the final design process. The need for new or amended permits to store hazardous substances would be determined at that time.

Elementary Neutralization System. An elementary neutralization system would be located in the northwest portion of the basement to collect rinsate and soapy water from the laboratories (see Figure 2.4, Item 7). The current design calls for water to be collected in a pH control system consisting of three, 7570-liter (2000-gallon) effluent tanks; a 1135-liter (300-gallon) tank for hydrochloric acid; and a 1135-liter (300-gallon) tank for caustic soda. A sequence of operations would move the water through the tanks. Sensors in the tanks would monitor the pH until the appropriate pH level was reached. The wastewater then would be discharged into the sanitary sewer system. The monitoring and release schedules would be determined during the final design process. The need for discharge permits would be determined at that time.

This system would be designed to handle only laboratory sink water; potentially contaminated water from abnormal events (*e.g.*, chemical spills) would be handled by the emergency wastewater holding system.

Emergency Wastewater Holding System. Two 11,350-liter (3000-gallon) tanks would be located in the northwest portion of the basement in the same area as the elementary neutralization system (see Figure 2.4, Item 7). These tanks would be designed to hold potentially contaminated water from the emergency showers and eyewash stations. The purpose of these tanks is to ensure that hazardous waste is not discharged into the sanitary sewer system. These tanks would be operated, monitored, and tested in accordance with all applicable laws and regulations including appropriate RCRA and Clean Water Act (CWA) regulatory requirements and SNL/NM ES&H requirements, to be determined during the final design process.

Cryogenic Tanks and Gas Cylinder Storage. A tank farm would be located outside of and away from the building with tanks and vaporizers for laboratory use including, but not limited to, liquid oxygen, ultrapure nitrogen, ultrapure argon, and bulk hydrogen. Provisions would be made on each of the three floors in the building for filling self-contained mobile dewars.

The need for an oxygen monitor and other safety and/or fire protection features and permits would be determined during the final design process.

2.2.3 Proposed Space

The proposed new facility would offer the following enhancements to existing operations:

- modern laboratory facilities with enhanced analytical capabilities and safety features;

- a centralized chemical storage area and a centralized area for storing gas cylinders separate from laboratory and office facilities;

- reduction of chemical storage space, substantial reduction (up to 25 percent) of the total monthly chemical inventory, and reduction in the monthly and annual amount of hazardous waste generation;

- improved energy efficiency through modern architectural features and by consolidating the heating, ventilating, and air conditioning (HVAC) systems and electrical design and resources;

- further reduction of potential risks both by eliminating physical and/or chemical hazards, and by using engineered controls rather than administrative controls now in use at the existing facilities;

- pedestrian traffic within the building designed to provide easy, unobstructed access to emergency exits; the service corridors, separate from the pedestrian corridors, would be used to move equipment and chemicals to and from the laboratories, thereby isolating general personnel from these hazards; and

- one materials laboratory designated specifically for conducting short-term analytical laboratory studies with chemicals not routinely used.

The primary purpose of the designated materials laboratory would be to allow the analysis of unknown samples from DOE and SNL/NM clients. This laboratory also would be used to work with chemicals defined by OSHA as particularly hazardous and/or restricted use and other nonroutinely used chemicals (29 CFR 1910). One example of a nonroutinely used chemical class is chlorofluorocarbons (CFCs), which are needed for benchmarking in certain solvent substitution studies. These analyses are performed on a limited basis under existing laboratory conditions; however, current conditions do not permit adequate control to assess the hazard potential (in particular for unknowns) and for worker protection. This laboratory, like all proposed PETL laboratories, would not process radioactive materials.

2.2.4 Relocated Operations

At the proposed PETL, the materials science and materials process R&D programs and operations would continue to be in compliance with applicable Federal, state, and local regulations, DOE Orders, the current version of the *ES&H Manual* (SNL, 1995a), the *CCHP* (SNL, 1991a), and applicable operating procedures (Appendix A). As part of the final design process, all design features and operational activities would be assessed for regulatory compliance, including modifications to existing permits or the acquisition of new permits, if required. The final *Conceptual Design Report (CDR)* (Dekker and Associates, 1992), which is incorporated here by reference, provides a list of pertinent construction codes and statutes. Of particular importance would be to ensure that all laboratory facilities are designed, sited, and constructed in compliance with the Uniform Fire Code (UFC) and in accordance with DOE Order 6430.1A, *General Design Criteria*.

Chemical Inventory and Storage

An integrated chemical storage area would house the inventory of approximately 2500 standard laboratory chemicals. This storage facility would store all of the chemicals used by all laboratories in the proposed PETL in one location, thereby reducing the total chemical inventory and volume. Chemicals would be separated by compatibility group (*e.g.*, acids, bases, flammables/combustibles) and stored in separate walled areas within the facility. Quantities of each chemical would be maintained at the lowest level required to meet demand. This would eliminate the need for individual laboratories to maintain separate chemical inventories. The reduction in inventory and volume also would decrease the total amount of hazardous waste generated.

Waste Management

An elementary neutralization system would collect rinsate water from laboratory sinks. Sensors in the tank would monitor the pH prior to release into the sewer system. This would control the pH of wastewater discharged to the sewer system.

An emergency wastewater holding system would collect potentially contaminated wastewater from the emergency showers or eyewash stations in the event of an accidental chemical spill. The purpose of this system is to ensure that hazardous waste is not discharged into the sewer system.

Both the elementary neutralization system and the emergency wastewater holding system are located in the northwest corner of the basement in an area that is separate from, but adjacent to, the main basement. This space provides a separate area for secondary containment while providing easy access to the tanks for sampling, testing, inspection, and maintenance.

Worker Health and Safety

The proposed PETL would feature laboratories specifically designed to minimize potential worker hazards. Each laboratory would have an adjoining chemical-free technician area furnished with a window that would allow laboratory personnel to complete nonlaboratory tasks while maintaining visual access to the laboratories to monitor experiments and operations without having to enter the laboratories. This would increase laboratory personnel safety by separating the worker from the chemical area and lower the potential for chemical exposure. Other features would include: exhaust systems located away from exits, multiple exits from the laboratories, visual access throughout the building, equipment and chemical transport corridors separate from pedestrian corridors, and collocated associated activities to eliminate the need for moving hazardous materials between buildings.

2.3 RENOVATE-EXISTING-FACILITIES ALTERNATIVE

The renovate-existing-facilities alternative would require the complete renovation of the currently occupied permanent buildings in which materials and process science operations are conducted. Activities could not continue in the current locations because some of the buildings are scheduled for demolition under the *Site Development Plan* (SNL, 1995b). The renovate-existing-facilities alternative would not meet the stated purpose and need for the following reasons:

- The R&D programs would not be collocated and consolidated to enhance and to facilitate the efficiency, collaboration, and synergy of the research, development, characterization, and analytical activities.

- The quantities of hazardous materials stored would not be reduced, the amounts of hazardous waste generated would not be reduced, and the potential for worker exposure to hazardous materials and wastes would not be reduced. These reductions would not happen because there would be no centralized chemical storage and no safety-enhanced laboratories.

- Technology transfer and collaborative research with private industry and education institutions would not be promoted because current program locations do not allow efficient interactions with SNL/NM researchers.

The chemistry laboratories require specialized venting and power systems, engineered systems for removing waste, and vibration-sensitive structures. Complete renovation of the current facilities required to provide these special systems would extend over 12 years. Costs associated with renovating older buildings would be greater than for the proposed PETL due to extensive safety upgrades, specialized electrical and ventilation systems, and specialized laboratory equipment. An additional cost would be incurred for asbestos removal and removal of legacy waste contamination in some of the buildings.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

Additional alternatives were identified, but were eliminated from further analysis. These alternatives and the reasons for their elimination are discussed in the subsections that follow.

2.4.1 Construct-the-Facility-at-Another-SNL/NM-Location Alternative

This alternative would require the selection of an alternative location at SNL/NM for the proposed PETL. Alternative locations would not satisfy stated needs and objectives to the extent that the proposed location would. Also, the impacts of construction and operation of the PETL at an alternative site in or near SNL/NM Area I would be similar to those analyzed for the proposed action. Reasons that other locations were not considered include the following:

- Other appropriately located areas are not available. The proposed site within Technical Area I is one of the few vacant lots adjacent to the secured area with sufficient area to accommodate a building the size of the proposed PETL.

- The operations conducted by the materials organizations require location within a secured area. Although Technical Areas II through V contain secured areas, a remote location would not fulfill the purpose of locating the proposed PETL close to other R&D programs in Technical Area I.

- Other areas would not provide an effective or efficient corridor for private-sector organizations participating in the technology transfer program because these areas are remotely located and do not allow efficient interactions with SNL/NM researchers, most of whom work in Technical Area I.

2.4.2 Locate-in-Other-Existing-SNL/NM-Building(s) Alternative

This alternative would require the search for and selection of vacant or underutilized SNL/NM space for the proposed PETL operations. This alternative is not feasible because there is no vacant or available space within any of the SNL/NM technical areas (Dekker and Associates, 1992). The locate-in-other-existing-SNL/NM-building(s) alternative would not meet the purpose and need for the following reasons:

- The R&D programs would not be collocated and consolidated to enhance and to facilitate the efficiency, collaboration, and synergy of the research, development, characterization, and analytical activities.
- The quantities of hazardous materials stored would not be reduced; the amounts of hazardous waste generated would not be reduced; and the potential for worker exposure to hazardous materials and wastes would not be reduced. These reductions would not happen because there would be no centralized chemical storage and no safety-enhanced laboratories.
- Technology transfer and collaborative research with private industry and education institutions would not be promoted because current program locations do not allow efficient interactions with SNL/NM researchers.

This alternative is similar to the renovate-existing-facilities alternative; the costs and programmatic impacts associated with this alternative would be similar to those incurred for renovation of any existing building (see Section 2.3). Costs associated with renovating older buildings would be greater than for the proposed PETL due to extensive safety upgrades, specialized electrical and ventilation systems, and specialized laboratory equipment. An additional cost would be incurred for asbestos removal and removal of legacy waste contamination in some of the buildings.

2.4.3 Lease-Off-Site-Facilities Alternative

This alternative would require the procurement of leased space outside of KAFB, DOE, or SNL/NM property to conduct the proposed PETL operations. This alternative is not feasible because no commercial space is available with the amount of space needed for the laboratories and staff of these three organizations. It is unlikely that the specific building requirements of the chemical storage laboratory and tank farms could be met in the Albuquerque area. The lease-off-site-facilities alternative would not meet the purpose and need for the following reasons:

- The current R&D programs must be located in Technical Area I to enhance and to facilitate the efficiency, collaboration, and synergy of the research, development, characterization, and analytical activities of other researchers and on-site customers.

- It is necessary to maintain security and close interrelations with other R&D activities that take place in SNL/NM Technical Area I. An off-site facility would pose security problems.

- The need for vibration-sensitive structures is of particular concern.

Additional administrative problems would be associated with the regulatory requirements and costs associated with transporting hazardous materials and hazardous wastes. These concerns would increase the cost of doing business.

2.4.4 Procure-Services-from-Off-Site-Vendors Alternative

This alternative would require the search for and selection of vendors that could duplicate the R&D activities of the proposed PETL. The procure-services-from-off-site-vendors alternative is not considered feasible or reasonable; it would not meet the purpose and need for the following reasons:

- SNL/NM has not proposed to discontinue conducting these R&D programs on-site with SNL/NM employees.

- Certain SNL/NM operations have attempted to use off-site analytical services in the past. This strategy failed because the off-site laboratories did not provide sufficient analytical techniques or correct results.

- Security issues could not be met.

3.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

Except where site-specific environmental descriptions are provided, it may be assumed that environmental conditions at the proposed PETL site are consistent with conditions that prevail for the entire Albuquerque area. The geographical, meteorological, geological, seismological, and hydrological characteristics of SNL/NM, including the proposed PETL site and surrounding vicinity, are described in previous reports (IT *et al.* 1993; ERDA, 1977), which are incorporated here by reference.

3.1 GEOGRAPHIC SETTING

3.1.1 Location

SNL/NM is situated in the eastern portion of the Albuquerque-Belen Basin in the foothills of the Manzano Mountains. Tijeras Arroyo and Arroyo del Coyote, the major drainages for the East Mesa, originate in the Manzano Mountains and travel southwestward from the Manzano Mountains joining the Rio Grande, the major drainage for the Albuquerque-Belen Basin, about eight miles west of the proposed PETL site area.

SNL/NM is located within the boundaries of KAFB. KAFB is bordered on the north and east by the City of Albuquerque, on the east-southeast by the Cibola National Forest, and on the south by the Isleta Pueblo Indian Reservation. The Albuquerque International Airport (AIA) adjoins KAFB immediately to the west. KAFB and AIA share the two runways operated by the AIA. The southern portion of the western boundary of KAFB is bordered by vacant land owned by the state of New Mexico and held in trust by the University of New Mexico (Figure 3.1).

SNL/NM operations occur within five technical areas which are owned by DOE and on additional land used under agreements with other Federal or state agencies and the Isleta Pueblo Indian Tribe (Figure 3.1). The proposed PETL site is located in the northeast corner of SNL/NM Technical Area I at the intersection of K and Seventeenth Streets (Figure 2.2).

Civilian and military residential areas are located to the east, north, and west of the proposed PETL facility. These residential areas include single-family dwellings, high-density multifamily dwellings, and mobile home parks. Military housing is located as close as 500 meters (1900 feet) to the north, and a mobile home park is about 1463 meters (4800 feet) to the east of the proposed PETL (Figure 3.2).

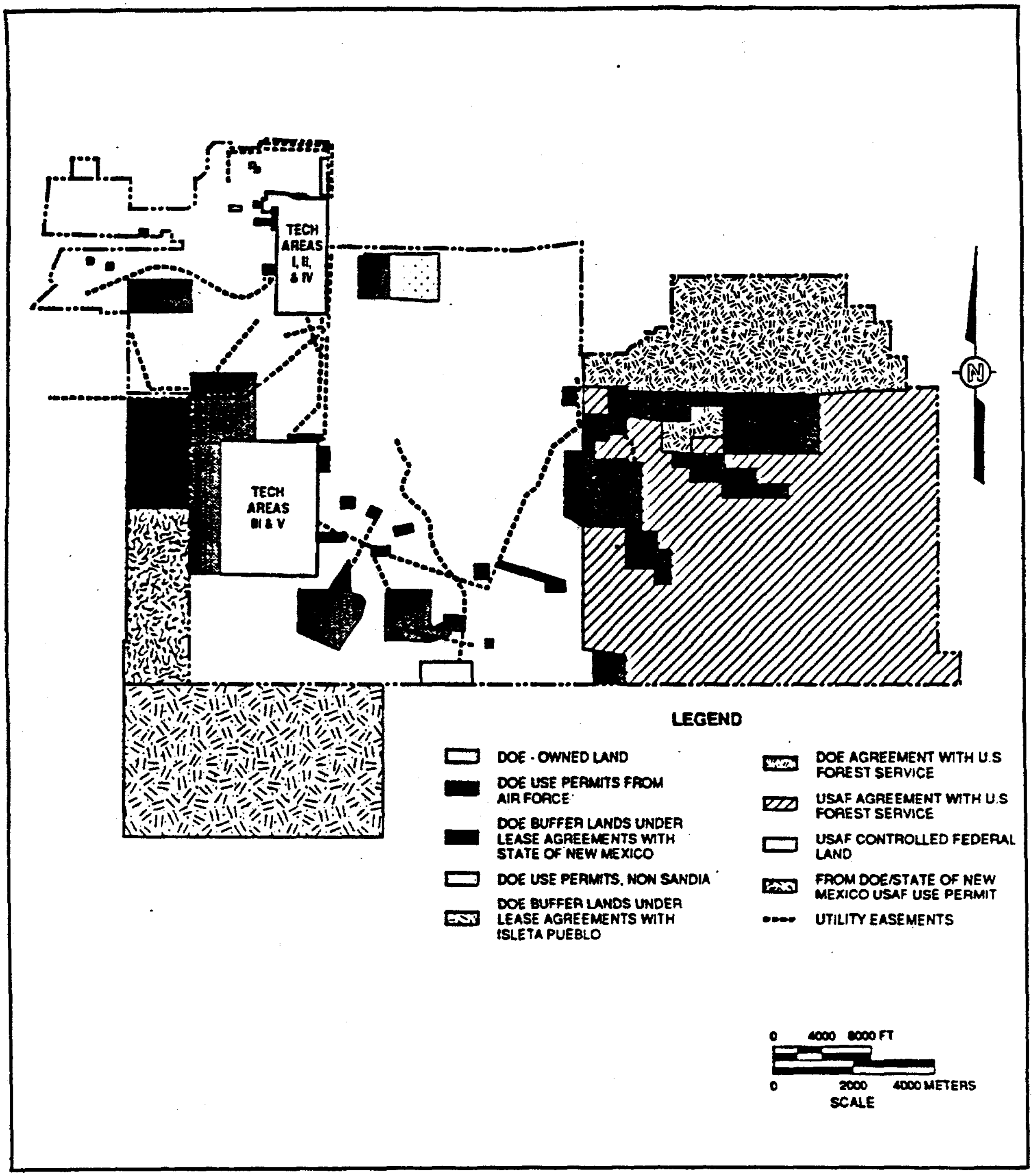


Figure 3.1

Land Use Agreements within Kirtland Air Force Base (including Sandia National Laboratories), Albuquerque, New Mexico

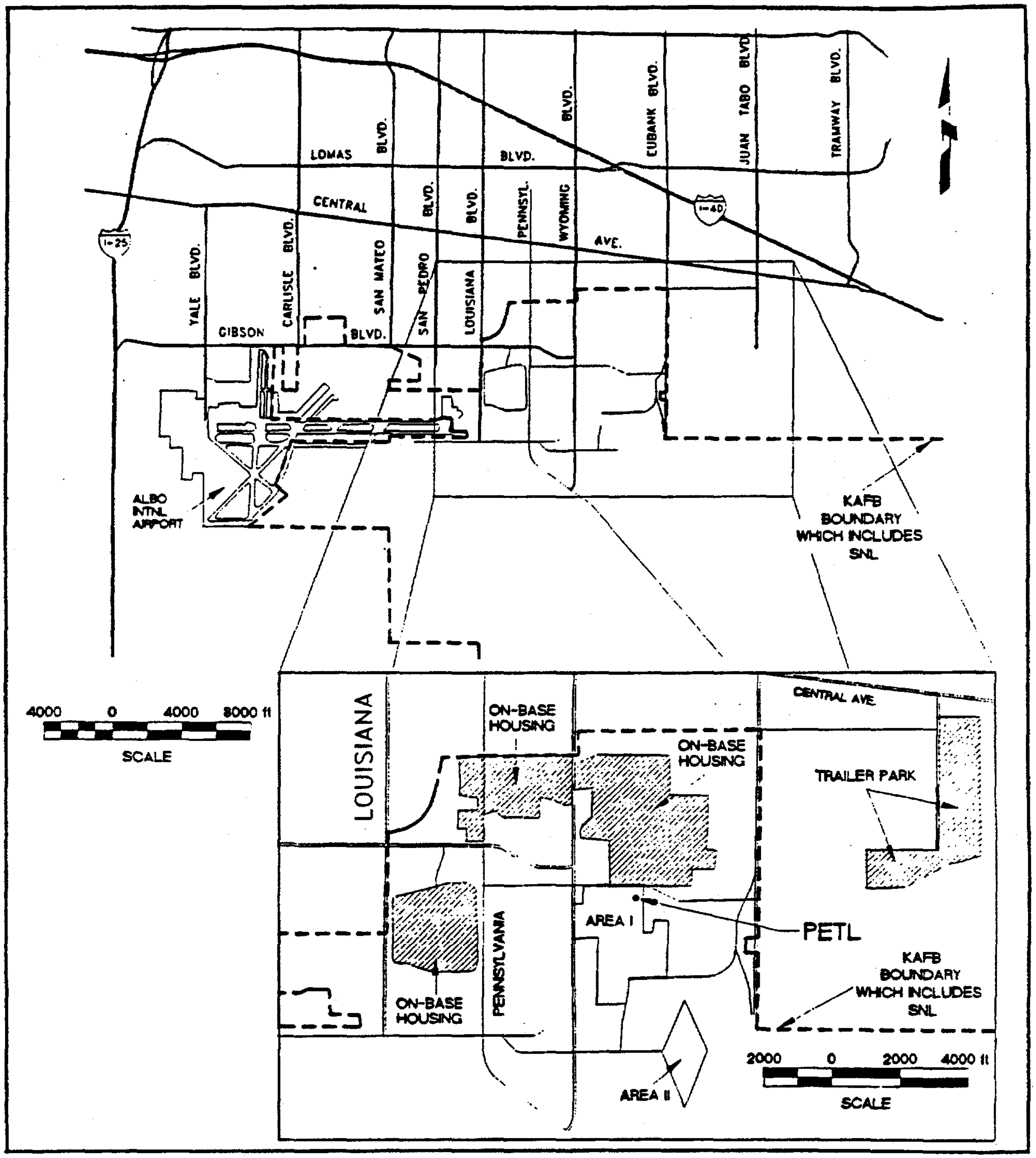


Figure 3.2
Residential Areas in the Immediate Vicinity of the Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

3.1.2 Geology, Soils, and Seismology

The Rio Grande Valley, formed within the Albuquerque-Belen Basin, is bounded by uplifted fault blocks: the Sandia, Manzanita, and Manzano Mountains (east); the Lucero Uplift (west); and Nacimiento Uplift (northwest) (Figure 3.3). The basin is filled with up to 3600 meters (12,000 feet) of sand, gravel, and fluvial deposits (Figure 3.4) (IT *et al.*, 1993; Lozinsky *et al.*, 1991). In the proposed PETL site area, the Embudo gravely, fine, sandy loam and the Wink fine, sandy loam, are deep, moderately alkaline, well-drained soils formed on old alluvial fans (SNL, 1989; Hacker, 1977). Runoff from these soils is medium with moderate water erosion hazard; the shrink-swell potential for both is low (SNL, 1989).

The Rio Grande Rift between Albuquerque and Socorro is the most seismically active area in New Mexico. SNL/NM is located in Seismic Risk Zone 2B, which corresponds to a Modified Mercalli Intensity VII (or about 6 on the Richter scale). Instrumental data since 1960 indicate that a maximum probable local magnitude shock (M_L) of 4.2 to 4.9 on the Richter scale could occur within a 100-year period (Sanford *et al.*, 1972).

3.1.3 Climate

The climate in the Albuquerque area is characterized by low precipitation, wide temperature extremes, frequent drying winds, heavy rain showers (usually of short duration and often with erosive effects), and erratic, seasonal distribution of precipitation.

Winds blow most frequently from the north in winter and from the south along the river valley in summer. At SNL/NM, winds are almost equally probable from all directions under normal conditions, and are particularly subject to orographic effects (DOE, 1987, as reported in IT *et al.*, 1993). Based on climatological records, Albuquerque is classified as a region of low tornado occurrence, with an annual probability of less than 10^{-6} (one in one million).

3.2 AIR QUALITY

Ambient air quality for SNL/NM is regulated by the City of Albuquerque/ Bernalillo County Air Pollution Control Division (APCD). The APCD has established several ambient air sampling stations throughout the city to monitor particulates, ozone, carbon monoxide, and nitrogen dioxide. No continuous ambient air monitoring systems are in place at SNL/NM. To date, no exceedance of the monitored pollutants has been recorded at the station nearest to SNL/NM (Culp *et al.*, 1993; Hwang *et al.*, 1991).

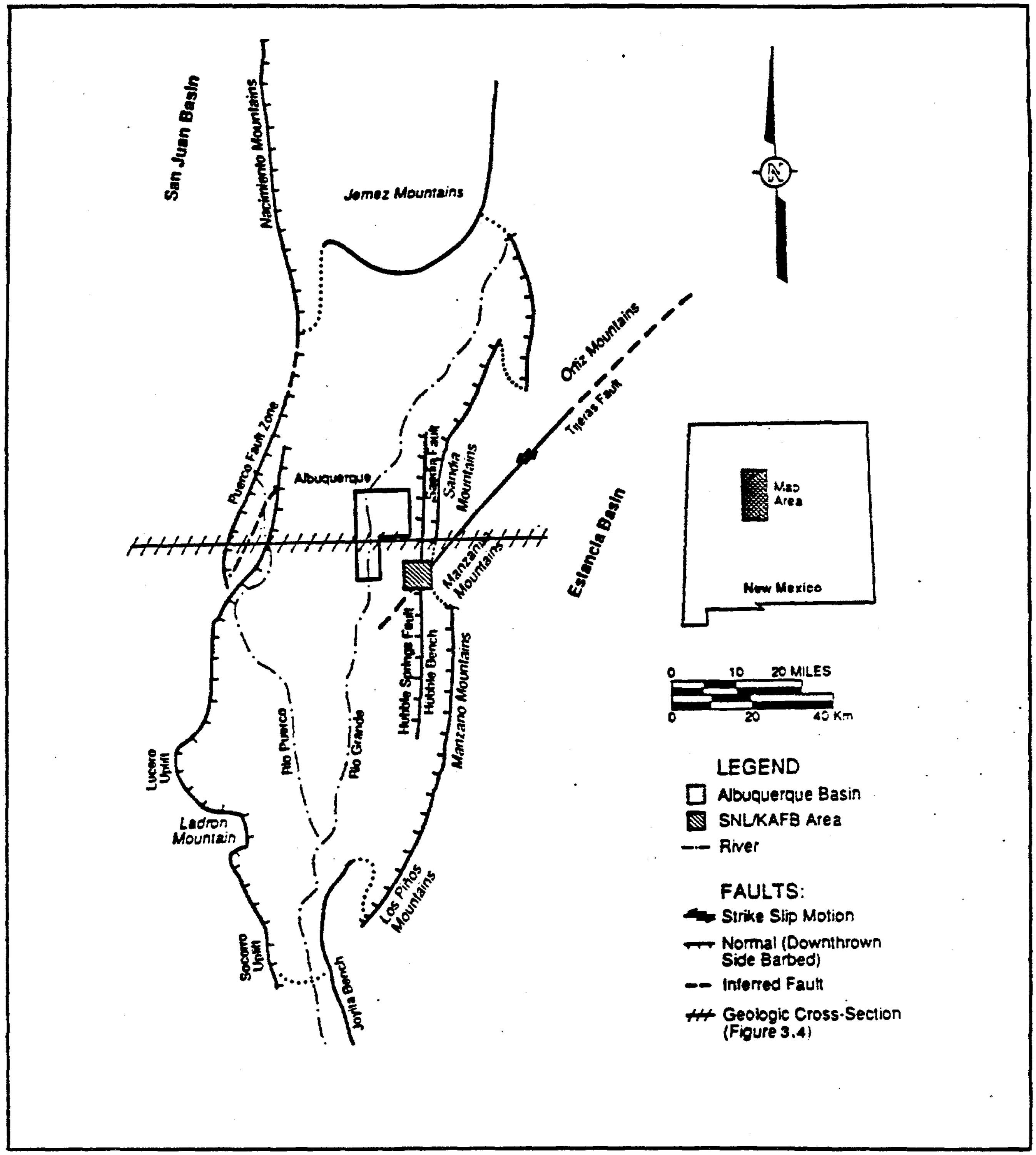


Figure 3.3
Structural Geologic Map of the Albuquerque-Belen Basin, New Mexico

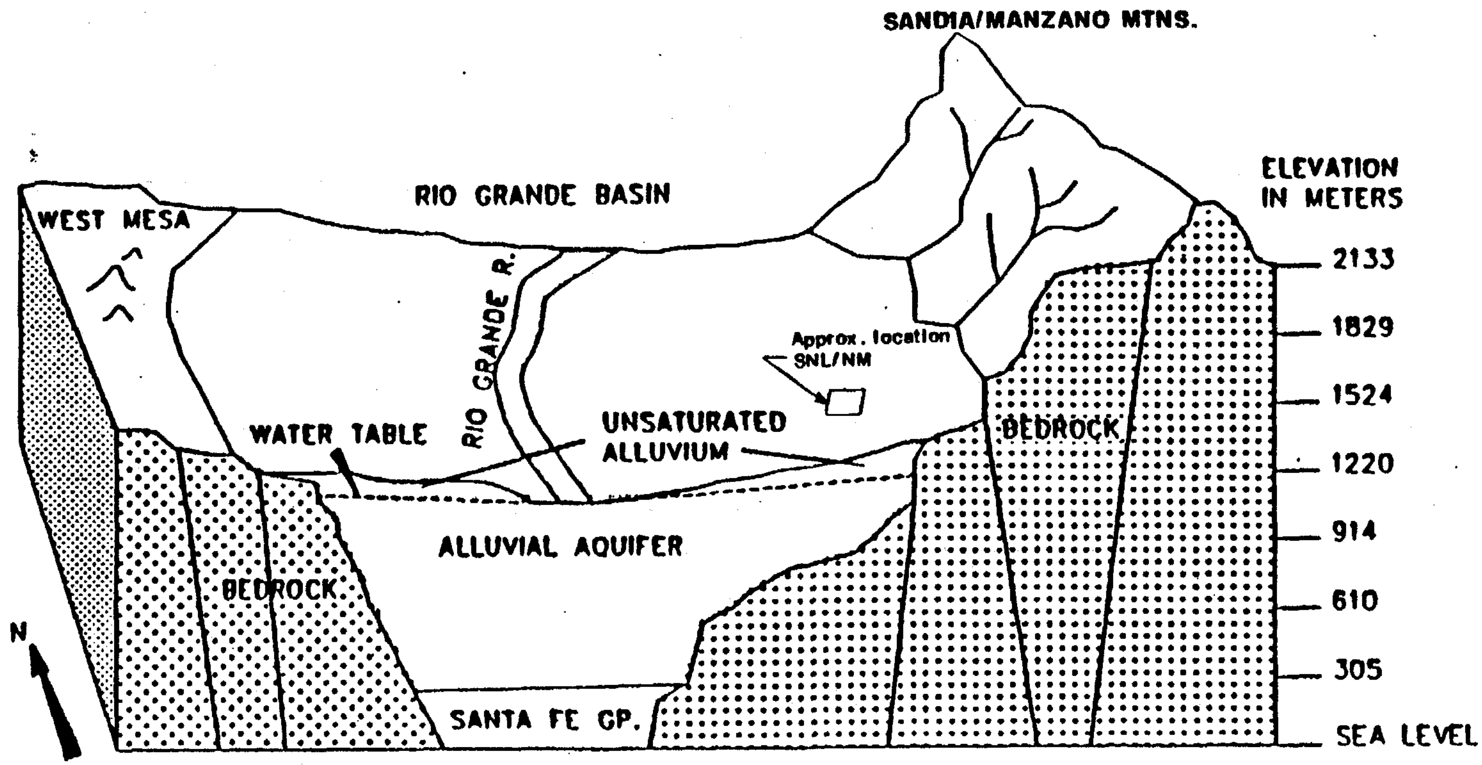


Figure 3.4
Block Diagram Showing Generalized Geologic Cross Section, Albuquerque-Belen Basin, New Mexico

Several sources at SNL/NM emit pollutants that are regulated by the APCD: topsoil disturbances, open burning, various chemical operations, vehicle exhaust, and steam plant operations. Permits have been obtained from the City of Albuquerque when required (Culp *et al.*, 1993; Hwang *et al.*, 1991).

Bernalillo County meets National Ambient Air Quality Standards for designated pollutants with the exception of carbon monoxide. Recent changes to the Clean Air Act found in 40 CFR Parts 6, 51, and 93, *Determining Conformity of Federal Actions to State or Federal Implementation Plans*, require that if the area impacted is a nonattainment area for a designated pollutant, then the Federal agency must determine if the project is in conformity with the applicable implementation plan, or if the project qualifies for an exemption. The City of Albuquerque has issued *Air Quality Control Regulation 43*, entitled *General Conformity*, in response to *Federal Clean Air Act Regulations for Non-Attainment and Maintenance Areas*. Section 43.02, paragraph B.1, establishes the emission threshold of 100 tons per year for carbon monoxide. Current R&D activities are in conformity with the State Implementation Plan for the Albuquerque/Bernalillo County Air Quality Control Board.

In response to the Environmental Protection Agency's final rule, *Inspection/Maintenance Program Requirements* (57 FR 52950-53014), which describes the requirements for Inspection/Maintenance programs in ozone and carbon monoxide nonattainment areas, KAFB requires all employee vehicles traveling on base comply with the provisions of this final rule.

A preliminary inventory showed that SNL/NM, as a whole, has used 107 of the 189 chemicals listed in the Clean Air Act (CAA) Amendments of 1990 (IT *et al.*, 1993). In 1990 only 30 chemicals listed under 40 CFR 372, Subpart D, *Specific Toxic Chemical Listings*, were used in quantities exceeding 100-pounds per year (Hwang *et al.*, 1991). In 1992 only 16 chemicals used laboratory-wide exceeded 1000 pounds per year (Culp *et al.*, 1993). SNL/NM has more than 1000 emission sources (hood/vent), and more than 300 individual emission points (Hwang *et al.*, 1991). Nonradiological regulated air pollutants emitted at SNL/NM include nitrogen dioxide, carbon monoxide, sulfur dioxide, volatile organic compounds, and particulate matter (IT *et al.*, 1993).

An inventory and assessment for all hazardous air pollutants listed in 40 CFR 61, *National Emission Standards for Hazardous Pollutants*, and the Superfund Amendments and Reauthorization Act (SARA) Title III, Section 313, *Toxic Chemical Release Reporting*, was completed for all SNL/NM organizations in 1991 and 1992. This report has been submitted to the U.S. Environmental Protection Agency (EPA) annually since 1991. For the facilities moving to the proposed PETL, 350 listed compounds were identified. For the majority of the 350 compounds, the annual usage is less than 11 kilograms (5 pounds) (see also discussion, Section 2.1.3).

A hazardous emission inventory was conducted in 1991 for 44 chemicals used in Technical Area I. These data, along with meteorological data from the AIA, were used as input to the

Industrial Source Complex Short Term Atmospheric Dispersion Model, Version 90346, a model approved by the EPA at that time. Results of the modeling indicate that the ambient impacts of all the chemicals in the inventory data base are in compliance with the New Mexico Air Quality Standards (Culp *et al.*, 1993; Hwang *et al.*, 1991).

3.3 WATER RESOURCES

3.3.1 Surface Water

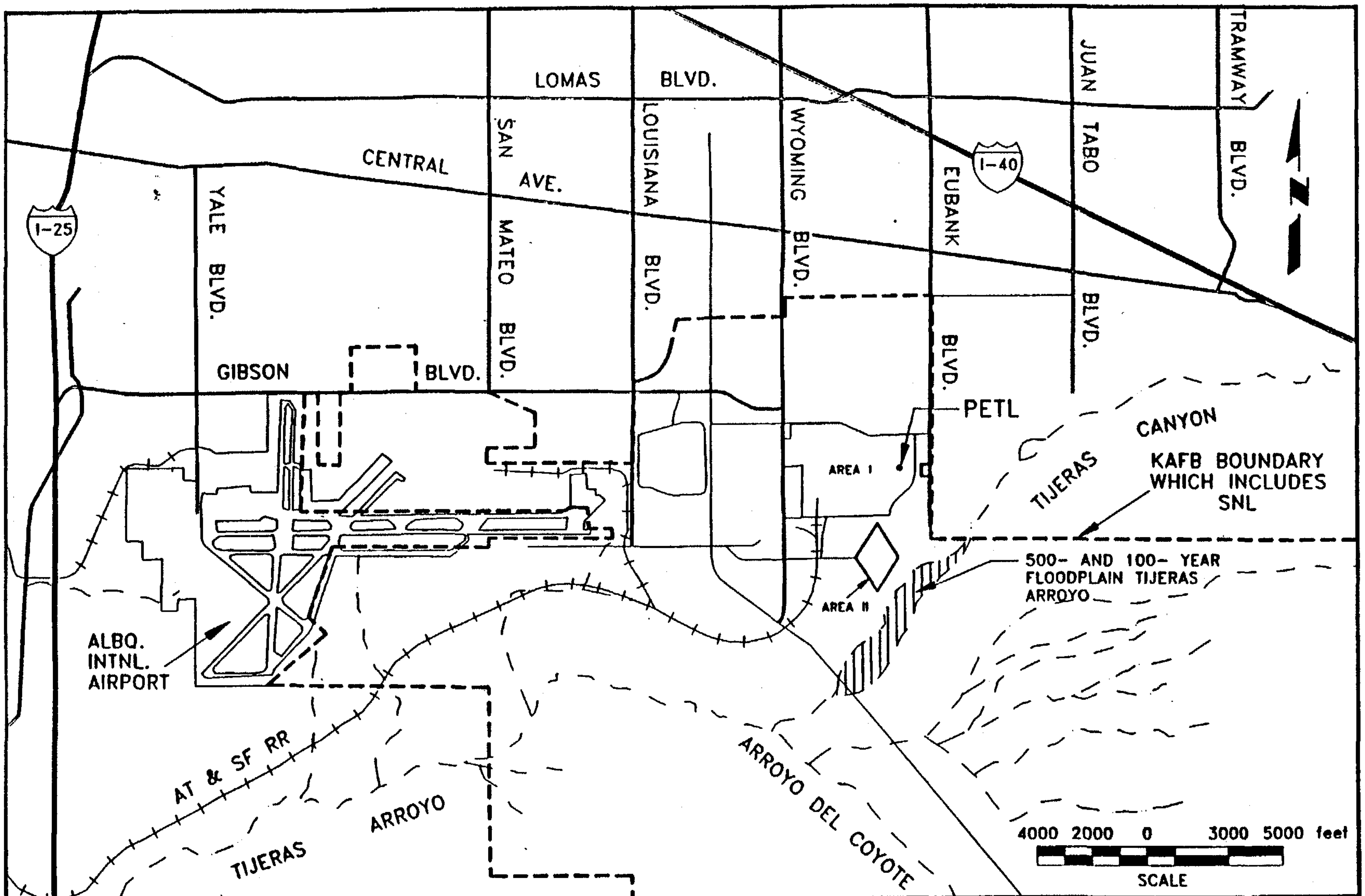
Tijeras Arroyo and Arroyo del Coyote (Figure 3.5) flow intermittently during heavy thunderstorms and during spring snowmelt (USACE, 1979a). Tijeras Arroyo cuts across the eastern portion of KAFB, 0.9 kilometer (0.5 mile) southeast of the proposed PETL. The U.S. Army Corps of Engineers (USACE) has defined the 100- and 500-year floodplains for Tijeras Arroyo and Arroyo del Coyote as shown in Figure 3.5 (USACE, 1979b). The proposed PETL site lies north and outside of both floodplains. During heavy storms, precipitation runoff flows into an unsurfaced ditch north of the proposed PETL site along K Street.

SNL/NM has maintained an environmental monitoring program since 1959. Current surface water monitoring programs include wastewater, storm water, and surface discharge (Culp *et al.*, 1993; IT *et al.*, 1993; Hwang *et al.*, 1991). SNL/NM has five categorical pretreatment operations and three general wastewater streams discharging to Albuquerque's publicly owned treatment works (POTW). SNL/NM performs periodic monitoring of its wastewater discharges to Albuquerque's POTW as required by the City of Albuquerque. Results for 1992 show that no pH excursions above the permitted limits occurred, and that the analytical results for all analytes were less than the concentration limits set by the permits. Further details pertaining to the wastewater discharge permits and the wastewater sampling program are found in Culp *et al.* (1993), IT *et al.* (1993), and Hwang *et al.* (1991), and are incorporated here by reference.

Technical Area I also operates under a general wastewater permit for wastewater discharges issued by the Albuquerque Public Works Departments under the City of Albuquerque's Sewer Use and Wastewater Control Ordinance.

3.3.2 Groundwater

Groundwater is the source of drinking water in this and the surrounding area. A large, unconfined aquifer occupies the Albuquerque-Belen Basin and is present under SNL/NM



SOURCE: ACE, 1979b.

Figure 3.5
Major Surface Drainages, Sandia National Laboratories/New Mexico

(Figure 3.4). The depth to saturated groundwater underlying SNL/NM varies from 15 to 30 meters (50 to 100 feet) (Hwang *et al.*, 1991).

Groundwater monitoring is required under DOE Order 5400.1, *Environmental Monitoring Program*. Background groundwater quality conditions and water-level elevations have been determined for all monitoring wells monitored under RCRA, and can be found in Culp *et al.* (1993) and Hwang *et al.* (1991).

3.3.3 Water Use

Albuquerque and KAFB obtain all drinking water from groundwater. Economic growth in the past 30 years and consequent increased pumping from KAFB and the City of Albuquerque's deep municipal supply wells have significantly altered the saturated groundwater level and flow direction in the vicinity of SNL/NM. For all of KAFB, which includes the U.S. Air Force, SNL/NM, and other tenants, over 1.6 billion gallons of water are pumped from the KAFB production wells annually (Hwang *et al.*, 1991). Over the last 30 years, the water table has declined and is expected to continue to decline (USACE, 1979a).

3.4 BIOLOGICAL RESOURCES

A biological resource survey was conducted at the proposed PETL site area in March 1993 (Cox, 1993). The four-acre area was inventoried for vegetation, wildlife, habitat, and Federal and state species of concern. The proposed site area has been heavily disturbed from past grading and hauling activities. The degrees of development and disturbance are reflected by the flora, fauna, and general condition of the habitat.

3.4.1 Vegetation and Wildlife

Plant species from the surrounding area primarily are representative of the Great Basin Grassland Biome (Fischer, 1990). The diversity of vegetation on site is limited to a few weedy herbaceous species: Russian thistle (*Salsola kali*), summer cypress (*Kochia scoparia*), and snakeweed (*Gutierrezia sarothrae*).

In addition to the herbaceous species, a few grasses are found on the site, including three-awn (*Aristida spp.*) and galleta (*Hilaria jamesii*).

The proposed PETL site's limited vegetation would provide habitat for a correspondingly limited number of animal species and numbers. The only mammal species observed was a prairie dog (*Cynomys gunnisonii*). Common species of mammals that may likely venture onto the site include the blacktailed jackrabbit (*Lepus californicus*) and desert cottontail (*Sylvilagus auduboni*). Common bird species include the western meadowlark (*Sturnella neglecta*), roadrunner (*Geococcyx californianus*), mourning dove (*Zenaida macroura*), scaled quail (*Callipepla squamata*), and several sparrow species. Common reptiles that also could be present include the side-blotched lizard (*Uta stansburiana*) and whiptail lizard (*Cnemidophorus spp.*).

Evidence of burrowing owls (*Athene cunicularia*) was not observed during surveys. Burrowing owls are migratory birds that nest in central New Mexico from April to early October and are commonly found on KAFB and in the surrounding Albuquerque Metropolitan area. Burrowing owls are neither threatened nor endangered; however, they are protected by the Migratory Bird Treaty Act, which prohibits disturbing the owls while they are nesting.

3.4.2 Threatened or Endangered Species and Species of Concern

In consultation with the U.S. Fish and Wildlife Service (USFWS), a field survey determined that no Federal threatened or endangered (T&E) species were observed or expected to occur at the proposed PETL site (Fowler-Propst, 1993).

The New Mexico Energy, Minerals, and Natural Resources Department identified three plant species of concern that potentially could be found in the area (Lightfoot, 1993). The biological resource survey did not observe any of these species (Cox, 1993) (Appendix B).

3.4.3 Wetlands

A field survey by the USFWS indicated that no wetlands are present at the proposed PETL site (Fowler-Propst, 1993).

3.5 CULTURAL RESOURCES

In 1990 a cultural resources survey of Technical Area I identified no prehistoric sites or historic properties at the site of the proposed action. No evidence was found to suggest that any subsurface cultural deposits are likely to be present at the site of the proposed action (Hoagland, 1990).

3.6 NOISE

Commercial and military aircraft operations at AIA, daily operations, and operational functions are the major sources of noise at SNL/NM. Noise baseline data for the AIA operations indicate that the proposed PETL site area falls within the equivalent sound level (L_{eq}) range of 65 to 70 decibels on the A-weighted scale (dBA) (Gill, 1990). Exterior noise levels of 54 dBA were recorded in Technical Area I (Greiser, Inc., 1990, as reported in IT *et al.*, 1993).

3.7 SOCIOECONOMICS

SNL/NM is one of the three largest employers in Albuquerque. Approximately 7670 people are directly employed in New Mexico by SNL/NM. SNL/NM is the fifth largest employer in New Mexico (IT *et al.*, 1993).

3.8 TRANSPORTATION

There are existing streets in the immediate vicinity of the proposed PETL (Figure 2.2) and a large parking lot north of K Street outside the secured fence. There are three entrances to KAFB and SNL/NM at Louisiana, Wyoming, and Eubank Boulevards (Figures 2.2 and 3.2). The Eubank entrance is the closest KAFB entrance to the proposed PETL.

4.0 EVALUATION OF ENVIRONMENTAL IMPACTS

In this section, impacts for the no-action alternative, the proposed action, and the renovate-existing-facilities alternatives are considered. Impacts are considered for construction, normal operation, and abnormal events and cumulative effects.

4.1 CONSTRUCTION

No-Action Alternative

For the no-action alternative, the R&D programs and operations would not be relocated, but remain in their existing buildings at their existing locations. There would be no construction; therefore, there would be no change in the existing conditions for the following: air quality, water resources (surface water and groundwater), biological resources (including T&E species), cultural resources, noise, socioeconomic conditions, or transportation (see Section 2.1 for description of the no-action alternative).

Proposed-Action Alternative

The total length of time for construction of the proposed PETL is planned to be three years. All applicable and relevant construction codes and regulations would be followed during the proposed construction effort. The construction of the proposed PETL represents a standard construction project and the potential for construction-related accidents would be within normal limits for this type of building.

Short-term, construction-related activities would increase the level of airborne particulates. Prior to any soil disturbance, a Topsoil Disturbance Permit required by the City of Albuquerque/Bernalillo County APCD would be obtained, and an implementation plan would be made for controlling dust emissions during construction. Carbon monoxide generated as a consequence of direct and indirect effects of project construction would be far below the emission threshold of 100 tons per year and would be in conformance with the State Implementation Plan.

The total proposed site area is less than 2 hectares (five acres). Under recent amendments to the CWA, construction activities that disturb more than 2 hectares (5 acres) are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for storm-water discharge. This permit would not be required for construction of the proposed PETL.

During the construction phase, the use of heavy equipment would create noise in the area typical of building activities of this type. The background noise level at Technical Area I is typical of light commercial areas with frequent elevations in noise caused by overflights from aircraft using the AIA. All buildings at SNL/NM are designed and constructed to reduce interior noise levels.

The proposed PETL would cause the loss of approximately four acres of heavily disturbed desert grasslands. A small number of small mammals, primarily rodents, could be lost as a result of constructions activities. There would also be a small loss of habitat for those animals that use this area as part of their overall habitat requirements. Surveys would be accomplished prior to construction to reaffirm the presence of prairie dogs or their absence. If prairie dogs are still present, they would be relocated and their burrows filled. The filling of burrows would be accomplished during the seasonal absence of burrowing owls to prevent any adverse effects to this species and to prevent reuse. These measures would preclude any significant adverse effects on prairie dogs and burrowing owls. The anticipated number of prairie dogs that may have to be relocated, if any, would be very small. No Federal T&E or state-listed species would be affected by the construction (Cox, 1993; Fowler-Propst, 1993) (Appendix B).

No properties listed on or eligible to the National Register of Historic Places (NRHP) or State Register of Cultural Properties are located on or near the site of the proposed action (Hoagland, 1990). The DOE has consulted with the New Mexico State Historic Preservation Officer (SHPO) under Section 106 of the National Historic Preservation Act. Based on the findings of the resource survey and report, the SHPO has concurred with the finding that the undertaking (the proposed action) would have no effect on historic properties (Sebastian, 1992) (Appendix B). If any buried cultural resources are found during construction, construction would be halted and consultation with the SHPO would be initiated.

An increase in heavy equipment and construction-worker traffic would occur during the construction phase. However, only temporary and minor traffic delays would be expected for personnel traveling on KAFB or for the public traveling near KAFB. Travel along K Street could be temporarily restricted over the three-year construction phase. No new thoroughfares are proposed for the new facility. After construction, minor shifts in traffic patterns could occur with the relocation of 260 personnel.

Construction of the proposed PETL would create employment for an estimated 50 construction workers. Most of these workers already reside and/or work in the Albuquerque area. Additional revenues would be available for local contractors and suppliers with slight benefits to the local tax base and economy.

The proposed PETL would collocate 260 SNL/NM personnel from existing R&D programs; little change in personnel would be expected.

Natural gas, electricity, and water consumption for the proposed PETL is provided in the final *CDR* (Dekker and Associates, 1992). The proposed PETL is designed for energy efficiency over the long-term. However, because the proposed PETL would collocate activities currently in progress, overall energy consumption is expected to remain similar to the total energy needs of the nine individual buildings currently in use. Based on current energy usage of existing, energy-efficient SNL/NM laboratory buildings, the goals of the proposed PETL would be to operate at lower energy requirements than buildings of similar size.

Renovate-Existing-Facilities Alternative

The impacts associated with renovation could be assessed only after a renovation plan was completed. It is anticipated that this alternative would require that operations be rotated in and out of temporary space for a period of 12 years during the renovation of existing facilities.

Temporary space would be needed during renovation, which would affect the Centers' operations, as well as the occupants of the temporary space. The time and cost for relocating sensitive laboratory equipment could result in an additional loss of up to three months operating time during the moves.

Renovation of the existing facilities also would require asbestos removal, which could result in an increased hazard to building personnel. Decontamination of areas with existing legacy waste contamination also could pose an increased hazard to building personnel.

Because of the increased time to complete renovations to a minimum of four permanent buildings, greater indirect or cumulative effects could be expected than for the proposed action.

4.2 NORMAL OPERATION

4.2.1 Air Quality

No-Action Alternative

Modeling of the current hazardous emissions inventory for all of SNL/NM indicated that the impacts on air quality are within New Mexico Air Quality Standards (Culp *et al.*, 1993). For the no-action alternative, there would be no change in the hazardous emissions inventory, and the effect on Albuquerque's air quality would not change.

Proposed-Action Alternative

Approximately 2500 chemicals would be used and stored at the proposed PETL. Some of these chemicals are regulated by the CAA regulations, 40 CFR 61, *National Emission Standards for Hazardous Air Pollutants*. However, it is expected that any emissions of these chemicals would continue to be below the established standards because of the extremely small quantities used. The proposed PETL laboratories would be designed to isolate these regulated chemicals and process any emissions through filters, if required. Three separate exhaust systems are planned to minimize exposure and maximize safety considerations.

Existing operations at SNL/NM are in compliance with New Mexico Air Quality Standards. The relocation of ongoing operations at the proposed PETL would not be expected to change or degrade existing air quality.

Carbon monoxide produced from the relocation of these R&D activities would be far below the emission threshold of 100 tons per year and would be in conformity with the State Implementation Plan.

Renovate-Existing-Facilities Alternative

Renovation of existing facilities would not be expected to change impacts to air quality with respect to the no-action alternative.

4.2.2 Water Resources

No-Action Alternative

Under the no-action alternative, laboratory facilities would remain in their present locations. The existing R&D programs and buildings in Technical Area I currently operate in compliance with several wastewater discharge permits issued by the City of Albuquerque (Culp *et al.*, 1992; Hwang *et al.*, 1991). No change in current operations would occur, and impacts to water resources would not be expected to change. The existing facilities, while operating within regulatory standards, would not offer the increase in water resource protection that the proposed action would offer.

Proposed-Action Alternative

No impacts to surface water or groundwater are expected from accidental spills.

The proposed PETL would include a new building drain system and an elementary neutralization system to further protect water resources. Under normal operating conditions, laboratory sink rinsate would be discharged directly into the elementary neutralization system located in the basement. Sensors in the tanks would monitor the pH prior to release into the sewer system. This elementary neutralization system would control the pH of the wastewater discharge.

The emergency wastewater holding system would collect water generated by emergency showers or eyewash stations in the event of accidental spills, personnel injuries, or other minor emergency events. This feature would further reduce the potential for contaminated wastewater to enter the sewer system. These tanks would be monitored and tested to determine proper disposal in accordance with DOE Order 5400.1, RCRA, and the City of Albuquerque Sewer Use and Wastewater Control Ordinance.

Renovate-Existing-Facilities Alternative

Renovation of the existing facilities would not be able to achieve the level of water resource protection that would be achieved in the proposed PETL. It would not be feasible or cost-effective to install either an elementary neutralization system or an emergency wastewater holding system in each of the existing locations. This would not achieve the increased reduction of potential contamination offered by the proposed action.

4.2.3 Biological Resources

No-Action Alternative

No change in impacts to biological resources including Federal T&E or state-listed species would occur from the no-action alternative.

Proposed-Action Alternative

An increase in human activity, including pedestrian traffic, and a small amount of service vehicle traffic in the immediate area of the proposed PETL would occur. Because the proposed PETL would be located on a vacant site within the existing perimeter security fence for Technical Area I, minimal disturbance to the flora and fauna in the adjacent grassland would be expected.

No Federal T&E or state-listed plant or animal species were observed at the proposed site (Cox, 1993; Fowler-Propst, 1993) (Appendix B). Therefore, no effects would be expected.

Renovate-Existing-Facilities Alternative

No change in impacts to biological resources would occur from the renovate-existing-facilities alternative with respect to current conditions.

4.2.4 Cultural Resources

No-Action Alternative

The no-action alternative would have no effect on cultural resources.

Proposed-Action Alternative

No properties listed on or eligible to the NRHP or State Register of Cultural Properties are located on or near the site of the proposed action (Hoagland, 1990). The DOE has consulted with the New Mexico SHPO under Section 106 of the National Historic Preservation Act. Based on the findings of the resource survey and report, the SHPO has concurred with the finding that the undertaking (the proposed action) would have no effect on historic properties (Sebastian, 1992) (Appendix B). If any buried cultural resources are found during construction, construction would be halted and consultation with the SHPO would be initiated.

Renovate-Existing-Facilities Alternative

Renovation of existing facilities would have no effect on cultural resources.

4.2.5 Chemical Inventory and Storage

No-Action Alternative

No change in current laboratory operations would occur if no action is taken. This alternative would not be consistent with the need for collocation and consolidation to reduce potential hazards associated with the chemical inventory and storage. This alternative would not implement additional features of the proposed PETL designed to increase protection of worker health and safety.

Proposed-Action Alternative

The proposed PETL is designed to allow R&D operations involving hazardous substances to be carried out in as environmentally and occupationally safe a manner as possible. Service corridors for transport of equipment and chemicals and for access to laboratories would serve to isolate chemical areas from pedestrian traffic. Areas that would be chemical-free zones would allow personnel to perform administrative tasks without potential exposure to hazardous chemicals. The laboratories would be designed to permit handling and usage of hazardous materials with reduced potential exposure to personnel compared to the no-action alternative.

Consolidation of the chemicals used now at many locations into one central facility would reduce chemical inventory, and more fully address environmental and safety issues. The proposed chemical storage area, located on the first floor adjacent to the building, would be designed with a concrete slab roof and epoxy-coated hardened concrete floor. This area would house the proposed PETL chemical inventory; individual laboratories in the building would have only a minimum amount for working use. This would minimize both potential exposures to laboratory personnel and the likelihood of large chemical spills.

The tank farm would be located outside of and away from the building and contain bulk tank storage of gaseous and liquid nitrogen, argon, and gaseous oxygen. Gaseous and liquid hydrogen would be stored in a separate concrete blast enclosure with dual containment and would be monitored for leakage at critical points.

Gaseous oxygen, nitrogen, argon, and various other gases would be provided to the laboratories from the tank farm. This handling method eliminates the need for and danger of compressed cylinders in the work area. Each of the three floors would have provisions for filling self-contained dewars of liquid nitrogen.

Renovate-Existing-Facilities Alternative

Renovation of existing facilities would not achieve the minimization of chemical inventories or result in the improved and consolidated purchasing, storage, and handling of chemicals.

4.2.6 Waste Management

No-Action Alternative

Under the no-action alternative, there would be no change in the kinds or quantities of hazardous waste generated by the three organizations. This would not be consistent with DOE's and SNL/NM's commitment to waste minimization, particularly through source reduction.

Proposed-Action Alternative

The annual volume of hazardous waste generated is expected to decrease under the proposed action. A significant portion of the hazardous waste generated on an annual basis is from partially used or expired chemicals. With a centralized chemical storage facility, laboratories would not maintain individual chemical inventories, thereby reducing the potential for waste generation. Because of reduction in chemical inventory anticipated for the proposed PETL operations, combined with the additional engineered controls and established SNL/NM SOPs and OPs for hazardous materials, impacts to operating personnel, the public, or the environment are expected to be equal to or less than the no-action alternative.

Hazardous waste would be labeled, properly stored, and removed from the generation site according to SNL/NM's policies and procedures. It would continue to be SNL/NM's policy to contain, label, store, and dispose of hazardous chemical waste in accordance with applicable Federal, state, and local laws and regulations to minimize their impact on personnel and the environment. RCRA-regulated hazardous waste would continue to be collected at the generation point and also managed according to SNL/NM's policies and procedures. In accordance with the SNL/NM *Waste Minimization and Pollution Prevention Awareness Plan* (SNL, 1994), laboratory personnel would actively pursue waste minimization through source reduction and recycling efforts.

The consolidation of the total chemical inventory into one central storage facility called for in the proposed action would reduce one source of hazardous waste (i.e., chemicals that have reached their expiration date and must be disposed of as regulated waste).

Renovate-Existing-Facilities Alternative

Operations in renovated facilities would be expected to have the same effects as the no-action alternative.

4.2.7 Worker Health and Safety

No-Action Alternative

Under the no-action alternative, there would be no change in current health and safety conditions. The no-action alternative would eliminate the opportunity to utilize the specially designed laboratories with separate areas for performance of non-laboratory work to enhance worker health and safety. It would also mean continued reliance on administrative controls in many areas instead of replacement by improved engineered controls.

Proposed-Action Alternative

Because of the changes proposed for the proposed PETL with respect to current operations (*e.g.*, more adequate space, specially designed laboratories, larger corridors, separation of worker desks from laboratories, visual access to laboratories, and improved engineered controls), personnel protection would be expected to be as good as current operations, possibly better.

A combination of laboratory design features (*e.g.*, engineered controls such as local exhaust ventilation) and administrative controls (*e.g.*, training, surveillance, and monitoring) would minimize potential personnel exposure to laboratory chemicals. The well-designed and properly balanced exhaust ventilation system will achieve a control level of less than 0.10 part per million when the supply air distribution is good. An auxiliary power source (*e.g.*, a diesel- or gasoline-powered generator) would provide a backup system for operation of local exhaust ventilation in the event of primary power failure (Industrial Ventilation, 1988).

Periodic testing and certification of local exhaust ventilation would be administered by the SNL/NM Industrial Hygiene and Toxicology Department to ensure optimum performance of the fume hoods and continued compliance with all regulatory and industry standards. The fume hoods would be designed to meet the criteria established by the American Conference of Government Industrial Hygienists (ACGIH) Committee on Industrial Ventilation for local exhaust ventilation (ACGIH, 1991).

The laboratory activities that would be conducted at the proposed PETL would involve one or two persons per laboratory using small numbers of chemicals in small quantities (one to three liters) performing operations in fume hoods. This type of laboratory operation, in conjunction with the separation of laboratory and office space, would allow some improvement in achieving exposures that are ALARA.

Renovate-Existing-Facilities Alternative

Renovation of existing facilities could allow some improvement in worker health and safety. However, it is not economically or programmatically feasible for all of the improved engineered controls to be installed in all locations.

4.3 RISKS AND CONSEQUENCES OF SELECTED ACCIDENT SCENARIOS AND ABNORMAL EVENTS FOR THE PROPOSED ACTION

This section considers the potential effects of the following selected accident scenarios and abnormal events to personnel in the proposed PETL and to the general public and environment:

- chemical spill in a laboratory environment;
- fire;
- aircraft crash; and
- natural phenomena (earthquake, extreme wind, or tornado).

The probability of an aircraft crash, earthquake, extreme wind, or tornado taking place was defined quantitatively. Appendices C through E provide detailed information about the data and methodologies used to calculate the potential effects for the chemical spill, fire, and aircraft crash accident scenarios.

Standard dispersion models were used to calculate personnel exposures for the chemical spill and fire accident scenarios. The results then were compared to four OSHA and ACGIH health standards for personnel exposure. These health standards are defined as follows:

- The Permissible Exposure Limit (PEL) is the maximum concentration that must not be exceeded.

- The Permissible Exposure Limit - Time-Weighted Average (PEL-TWA) is the permissible constant exposure concentration that must not be exceeded during any 8-hour work shift of a 40-hour work week.

- The Short-Term Exposure Limit (STEL) is based on a 15-minute time-weighted average exposure, which must not be exceeded at any time during a work day.

- The Threshold Limit Value - Ceiling (TLV-C) is the maximum concentration that must not be exceeded during any part of the work day.

- The Immediately Dangerous to Life or Health (IDLH) limit represents the maximum concentration from which one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.

Any impacts from a chemical spill would be limited to the workers in the immediate vicinity of the on-site facility. A large fire or a large chemical spill would be expected to have only minimal impacts to the public. An aircraft crash, earthquake, or tornado were considered as bounding case accidents.

4.3.1 Chemical Spill in a Laboratory Environment

For the chemical-spill scenario, the indoor dispersion of seven chemicals was calculated using two models. First, the U.S. Army Evaporation Rate Model (Kunkel, 1993) was used to calculate the evaporation rate of seven spilled chemicals. Using the calculated evaporation rate, the airborne steady-state concentrations of the spilled chemicals were then calculated from an equation developed by the American Industrial Hygienists Association (AIHA) (Caravanos, 1991).

Using the AIHA equation, the amount of time needed to reach a steady-state concentration was calculated using the volume of the room to obtain the necessary mass release. The time needed is a function of the mass release divided by the evaporation rate (Appendix C). Seven chemicals were selected based on their frequency of use and/or toxicity (Table 2-1): acetone, benzene, hydrochloric acid (38 percent), hydrofluoric acid (53 percent), methanol, methylene chloride, and trichloroethylene. Lead was not modeled because it does not vaporize at normal laboratory temperatures. Mercury also was not modeled because its vaporization rate is extremely slow. This accident scenario models effects associated with short-term (less than one hour) inhalation of air contaminated by chemicals released as the result of the spill. Adverse effects associated with mercury exposure are generally limited to cases in which the vapor has been inhaled chronically over time periods of months or years as a result of unmitigated spills or incorrectly stored materials, or when the material has been absorbed through direct physical contact or ingested through contaminated food or water.

Two different spill scenarios were modeled. Both assume that a 500-milliliter glass container of a chemical is spilled. Also, it is assumed that the resulting spill is an instantaneous release. Other assumptions common to both scenarios and details of the modeling results are described in Appendix C. The calculated steady-state concentrations for both spill scenarios are shown in Table 4-1. The PEL, STEL, TLV-C, and IDLH values also are shown for comparison.

Spill Scenario 1: Ventilation Functioning

In this first scenario, it is assumed that the laboratory ventilation system is working and there are four complete air changes per hour (the normal air change rate is four to six air changes per hour). Based on the results of the calculations:

- benzene concentrations would exceed both the PEL and the STEL limits;
- hydrochloric acid concentrations would exceed the TLV-C; and
- hydrofluoric acid concentrations would exceed all the limits.

The TLV-C limit would be reached at three minutes for hydrochloric acid, and at 1.5 minutes for hydrofluoric acid. However, the most critical concentration limit, the IDLH level, would govern evacuation time constraints. This concentration limit would be reached at seven minutes for hydrofluoric acid.

Spill Scenario 2: Ventilation Malfunction

In this second scenario, it is assumed that the laboratory ventilation system is malfunctioning or effectively disabled and there is only one-tenth of one complete air change per hour. Based on the results of the calculations:

- benzene concentrations would exceed both the PEL and the STEL limits;
- hydrochloric acid concentrations would exceed the TLV-C limit; and
- hydrofluoric acid concentrations would exceed all the limits.

The TLV-C limit would be reached in 57 minutes for hydrochloric acid and in 24 minutes for hydrofluoric acid. However, the most critical concentration limit, the IDLH level, would govern evacuation time constraints. This concentration limit would be reached at 119 minutes for hydrofluoric acid.

Table 4-1 Estimated Maximum Indoor Air Concentrations of Spilled Chemicals for the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Material	Concentrations[a] in mg/m^3					
	Calculated Steady-State Concentration					
	Scenario 1: Ventilation Functioning	Scenario 2: Ventilation Malfunction	PEL-TWA[b]	TLV-STEL[c]	TLV-C[d]	IDLH[e]
Acetone	36	78	590	--	--	6,050
Benzene	19	40	0.3	3.3	--	1,625
Hydrochloric Acid (38%)	33	68	--	--	7	76
Hydrofluoric Acid (53%)	56	141	2.5	--	5	25
Methanol	13	28	260	325	--	7,986
Methylene chloride	107	223	1,765	--	3,530	8,119
Trichloro-ethylene	41	86	546	--	1,092	5,460

[a] The table lists OSHA PEL values for some chemicals. If the NIOSH-recommended TWA for a chemical is lower than the OSHA PEL (NIOSH 1994), the NIOSH TWA is listed.
[b] PEL-TWA: Permissible Exposure Limit - Time Weighted Average.
[c] TLV-STEL: Threshold Limit Value - Short-Term Exposure Limit.
[d] TLV-C: Threshold Limit Value - Ceiling.
[e] IDLH: Immediately Dangerous to Life and Health.

Consequences

By comparing the two chemical-spill scenarios, it is apparent that the lack of ventilation (Scenario 2) slows the evaporation rate of the spilled chemical. This results in the longer time period for the concentrations to reach steady-state and a longer time before evacuation is necessary. However, the lack of ventilation also results in higher steady-state concentrations due to the decreased air exchange in the room.

In both scenarios, the concentrations of all of the solvents would be below the IDLH limit. In both scenarios, the hydrochloric acid and the hydrofluoric acid spills could result in airborne concentrations greater than the TLV-C values; only hydrofluoric acid would exceed the IDLH limits. When the IDLH concentration limit is reached, a person theoretically would have 30 minutes to leave the area without experiencing any escape-impairing or irreversible health effects.

Exposure to hydrochloric acid vapor through inhalation can produce inflammation of the nose, throat, and larynx resulting in coughing and choking. Hydrofluoric acid vapor, through inhalation, acts as an irritant to the eyes, nose, and throat and can produce nasal congestion and pulmonary edema. Both hydrochloric and hydrofluoric acid will burn the eyes and skin.

For a spill to occur in the laboratory and result in injury to personnel from inhalation, the following multiple failures would have to occur:

- Laboratory personnel violate SOPs and OPs for handling chemicals.
- Laboratory personnel fail to evacuate the laboratory before steady-state concentration limits are reached that could result in potential cause injury.
- Spill response personnel are not notified of the spill.
- Cleanup of the spill does not occur.

Proper use and storage of all chemicals should reduce the risk of a spill and consequent employee exposure. The appropriate notification, cleanup, and evacuation procedures, specified by the SOPs and OPs, would be taken once a spill was discovered.

In addition to the potential inhalation exposure, personnel may be splashed during a chemical spill. Skin contact with chemicals can cause a range of symptoms from no response to irritation or burns. Safety showers and emergency eyewashes are available to remove any contamination. Personnel would be further protected by the PPE used while working with chemicals, as previously discussed in Section 2.1.3. In addition to eye protection and laboratory coats worn by personnel working with chemicals, special transport and storage containers are used to reduce the potential for chemical spills and to contain the chemical in case the original container should break. Personnel are trained in the proper use of PPE and refer to the MSDSs to determine appropriate protective equipment and emergency procedures. The SNL/NM Medical Department is available to provide immediate emergency treatment for injuries in the event there is contact with any chemicals.

4.3.2 Fire

Approximately 2500 different chemicals and chemical compounds are used in relatively small quantities (one to three liters) to perform laboratory-scale general chemistry experiments and analyses. In order to be conservative in calculating the potential effects from a fire at the proposed PETL, eight representative chemicals were selected for modeling. These chemicals are those that are considered either the most toxic and/or are stored in the largest quantities. These eight chemicals and their maximum expected inventory were described previously in Table 2-1 in Section 2.1.3. These chemical quantities were input into the EPA atmospheric dispersion model, TSCREEN, Version 1.0 (EPA, 1990).

The results of the dispersion modeling are detailed in Appendix D and summarized in Table 4-2, along with the OSHA PEL-TWAs for comparison. The results indicate that the release and dispersion of these materials from a one-hour duration fire in the proposed PETL would result in concentrations that are lower than the cited recommended limits. Occupational limits are not applicable to the public; therefore, the PEL-TWAs were divided by 10 to provide a benchmark for the public and to allow for sensitivities that may be present in the general population; these values then were compared to the calculated maximum concentrations. AIHA emergency response planning guidelines for public exposure have been established for some chemicals; however, none have been published for the modeled chemicals.

Mercury is the only material with a calculated downwind concentration that exceeds the benchmark. Exposure to mercury can produce cough, chest pain, dyspnea, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, gastrointestinal disturbance, anorexia, low weight, and irritated eyes and skin. These symptoms are more characteristic of an occupational industrial poisoning than of a brief one-time, one-hour accidental exposure to a low concentration of airborne mercury. The relatively low mercury release concentration, coupled with the conservativeness of the analysis (the assumption that the entire inventory of mercury would be released and assuming worst-case meteorological conditions), makes it unlikely that the public would be affected by an actual facility fire.

Construction would include noncombustible or fire-resistant features. The design features of the proposed PETL chemical storage facility would incorporate modern fire prevention elements. Administrative controls and approved flammable liquid storage cabinets, and noncombustible laboratory material and furniture would be used to limit the fuel loading of a facility fire. Fire protection features include a facility fire detection and alarm system, a fire alarm transmission to the KAFB fire Departments and SNL/NM security alarm rooms, and wet-pipe sprinkler systems. Containment for potentially-contaminated fire suppression water would be addressed in the final design.

Table 4-2 Estimated Maximum Downwind Air Concentrations of Released Materials during a Fire at the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Material	Concentrations in mg/m^3		
	Maximum Release Concentration[a]	PEL-TWA (Occupational Worker)	PEL (Public)[b]
Acetone	0.1	590	59
Benzene	0.004	0.3	0.03
Hydrochloric Acid	0.02	7[c]	0.7[c]
Hydrofluoric Acid	0.06	2.5	0.25
Mercury	0.008	0.05	0.005
Methanol	0.08	260	26
Methylene Chloride	0.02	1,765	177
Trichloroethylene	0.06	546	55

PEL: Permissible Exposure Limit; PEL-TWA: Permissible Exposure Limit - Time-Weighted Average.

[a] Calculated concentrations are for a 15-minute averaged interval (see Appendix D for explanation). The maximum 15-minute averaged concentrations occurred at 695 meters from the proposed PETL

[b] The PEL-TWA is divided by 10 to provide a benchmark to allow for sensitivities that may be present in the general population (EPA *et al.*, 1987).

[c] There is no recommended PEL for hydrochloric acid. The presented value is a ceiling limit.

4.3.3 Aircraft Crash

The east end of the AIA east-west runway is approximately 3.2 kilometers (two miles) southwest of the proposed PETL. The methodology of Smith (1983) was used to estimate the probability of a commercial carrier or a large and/or high-performance military aircraft crash into the proposed PETL, which could result in extensive damage or loss of life (Appendix E). The probability of a crash occurring is calculated based on: (1) the size of the building, (2) the distance from the runway, and (3) the total number of aircraft operations per year at a runway. Crash probability constants were derived using aircraft operations data compiled from several airport sources (Smith, 1983) (Appendix E). For the AIA, the total number of aircraft operations is based on statistics available from the City of Albuquerque Aviation Departments (AIA, 1992). Data on the types and number of aircraft operations per year at the AIA include the annual operations at all runways. Out of the total number of aircraft, the proportion of large or high-performance aircraft represents the best judgment of the AIA air traffic controllers (Slatt, 1990).

According to these calculations, the probability of a major aircraft crash for the proposed PETL is 8.2 x 10^{-5} per year. This is considered a credible event; therefore, the impacts associated with an aircraft crash are discussed below.

The likelihood of an aircraft crash into any particular building within Technical Area I is a function of building size and the location of the building. The probability of an aircraft crash for other buildings in Technical Area I is about 10^{-4} (SNL, 1993). The probability of a crash into the proposed PETL is similar to other locations in Technical Area I. Therefore, the relocation of personnel to the PETL would not substantially change the probability of workers being affected by an aircraft crash.

In the event of an aircraft crash, the fire and explosion from the aircraft's fuel supply and the structural damage to the facility would outweigh any effects to the building personnel as a result of exposure to the chemicals contained in the proposed facility. The potential effects to the public from the burning of the most toxic chemicals would be similar to the scenario described in Section 4.3.2.

4.3.4 Natural Phenomena (Earthquake, Extreme Wind, or Tornado)

Earthquake

The proposed PETL would be designed to withstand earthquakes expected in the Albuquerque area. At a minimum, the proposed PETL (a Performance Category 2 facility) would be designed to withstand an earthquake with an acceleration of 0.22g, with an annual probability of exceedance of 1 x 10^{-3} (DOE, 1993). This ground surface acceleration exceeds the design basis earthquake acceleration of 0.20g as specified in the 1988 UBC (UBC, 1988). The risk to the public and/or proposed PETL operating personnel from a fire or laboratory chemical spill as the result of an earthquake would be similar to scenarios described in Sections 4.3.1 and 4.3.2.

Wind

At a minimum, the proposed PETL would be designed to withstand an extreme straight wind of 78 miles per hour, with an annual probability of exceedance of 2 x 10^{-2} (DOE, 1993). The impact to the public and/or proposed PETL operating personnel from a fire or laboratory chemical spill in the event of an extreme straight wind would be similar to scenarios described in Sections 4.3.1 and 4.3.2.

Tornado

Because the probability that a tornado would occur in the area of the proposed PETL is less than 10^{-6} (one in one million), it is not considered a likely event. Therefore, there are no tornado design criteria and no windborne missile design criteria for the proposed PETL structure (DOE, 1993).

The impact to the public and/or proposed PETL operating personnel from a fire or laboratory chemical spill caused by a tornado would be similar to scenarios described in Sections 4.3.1 and 4.3.2.

4.4 ACCIDENTS AND ABNORMAL EVENTS FOR THE ALTERNATIVES

The accidents and abnormal events considered in Section 4.3 are a fire, a laboratory chemical spill, an aircraft crash, and the natural phenomena of earthquake, wind, and tornado. The chemical spill accident scenario is a relatively high-probability/low-consequence event, and both the probability and consequences of a chemical spill would be reduced in the proposed action. The no-action alternative would result in higher probability and greater consequences in the event of a chemical spill. The renovate-existing-facilities alternative would result in reduced probability and consequences as compared to the no-action alternative, but not as greatly reduced as the proposed-action alternative.

The facility fire, aircraft crash, tornado, wind, and earthquake scenarios represent low-probability/high-consequence events. The probability of an occurrence would not change appreciably when considering the proposed-action, no-action, and renovation alternatives. However, the consequences associated with these abnormal events would be different. The proposed-action alternative would be expected to reduce the consequences, with respect to the alternatives, because of better technical design and application in the areas of fire protection, building codes for seismic risk zones, and chemical storage and handling.

The renovate-existing-facilities alternative would achieve some level of reduced consequences as compared to the no-action alternative, but not as greatly reduced as the proposed-action alternative.

4.5 ENVIRONMENTAL JUSTICE

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629, February 11, 1994) requires Federal agencies to identify and address the possibility of disproportionately high and adverse health and environmental impacts of programs and activities on minority and low-income populations.

Ongoing R&D activities are conducted in strict compliance with applicable Federal, state, and local laws and regulations to protect air, water, and other environmental resources and utilize measures that maximize conditions that promote worker health and safety. The proposed action would continue to maintain these conditions and would enhance environmental and health safety in many areas. Minority and low-income populations in the Albuquerque area and its surroundings, particularly communities located along the Rio Grande downstream of Albuquerque, would continue to benefit from the environmental and health protection measures provided to the region population. No foreseeable disproportionate or adverse health and environmental impacts would occur as a consequence of implementing the proposed action. Also, no adverse effects on social or economic conditions are foreseen.

4.6 CUMULATIVE EFFECTS

Cumulative effects are those impacts on the environment that potentially could result from the incremental effect of the proposed action when considered with interrelated past, present, and reasonably foreseeable future projects.

In the case of the proposed PETL, the cumulative effects are associated predominantly with land disturbance from present and future construction activities, and potential effects on human health and the environment from chemical emissions.

Under the no-action and renovate-existing-facilities alternatives, there would be no change in the cumulative impacts to the four acres of unoccupied land where the proposed PETL would be constructed and operated. The cumulative effect of the proposed action would be the loss of these four acres for future SNL/NM use.

Under the no-action and renovate-existing-facilities alternatives, there would be no expected change in the cumulative impacts associated with the use of chemicals. However, DOE (1992) and SNL (1994) are actively pursuing an overall policy of pollution prevention and waste minimization throughout the complex. Therefore, some net decrease in cumulative impacts could be expected as a result of these efforts.

Currently, all R&D programs operate within regulatory requirements. Because the proposed action is the continuation of existing programs, it is expected that the cumulative effects would be commensurate with existing effects. DOE and SNL/NM are pursuing an active program of reducing potential health risk through an ALARA policy for all personnel. DOE (1992) and SNL (1994) also are actively pursuing an overall policy of pollution prevention and waste minimization throughout the complex. Therefore, in addition to the reduction of cumulative effects afforded by the proposed action, additional reduction is anticipated through the ALARA, pollution prevention, and waste minimization efforts.

By consolidating and centralizing laboratory facilities currently scattered over the SNL/NM complex, the proposed action would decrease the overall cumulative risks associated with the use of hazardous materials and reduce the total quantity of hazardous waste generated at SNL/NM.

5.0 LIST OF AGENCIES AND PERSONS CONSULTED

The following Federal and state agencies were consulted during the preparation of this EA:

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APPENDIX A

REGULATORY REQUIREMENTS, DOE ORDERS, AND OPERATING PROCEDURES

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LIST OF TABLES

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REGULATORY REQUIREMENTS, DOE ORDERS, AND OPERATING PROCEDURES

Table A-1 provides a representative list of legislation, executive orders, and regulations that may be required by Federal, state, and local regulatory agencies for the proposed construction and operation of the proposed Processing and Environmental Technology Laboratory (PETL) at Sandia National Laboratories/New Mexico (SNL/NM). This list includes air, water, hazardous waste, biological and cultural resources, and emergency planning regulations as well as worker protection standards.

Applicable building codes are listed on page 8 of the Appendix of the final *Conceptual Design Report, Processing and Environmental Technology Laboratory* (Dekker and Associates, 1992).
A representative list of the applicable U.S. Department of Energy (DOE) Orders is provided in Table A-2.

All Federal and state environmental and worker protection issues would be addressed by the SNL/NM Safety and Health and Environmental Operations Centers. Table A-3 lists representative procedures applicable to the proposed PETL. These procedures are consistent with the requirements of the current version of the Sandia National Laboratories *Environment, Safety and Health Manual* (SNL, 1995) and *Corporate Chemical Hygiene Plan* (SNL, 1991). These procedures are on file with the Materials and Process Sciences Center Environment, Safety and Health (ES&H) Coordinator.

Table A-1
Representative List of Consultations or Permits That May Be Applicable to the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Consultation or Permit	Granting or Approving Agency	Statute or Regulation	Activity
Construction permit	New Mexico (NM) Construction Industries Division	NM Construction Industries Act, rules and regulations, and permit requirements	No permit is needed because construction will occur on Federal land; fugitive dust regulations apply.
Emissions of regulated air contaminants or pollutants	Albuquerque, New Mexico, Environmental Health Department, Air Pollution Control Division	City of Albuquerque/ Bernalillo County, New Mexico, Air Quality Control Regulations (AQCRs)	Construction permit needed for potential emission of hazardous air pollutants or contaminants; control of particulate emissions required, or demonstration through modeling and analysis that emissions will not violate air standards. A Topsoil Disturbance Permit will be obtained; monitoring (as required by AQCRs) will be performed during the construction phase, and dust suppression measures can be utilized if monitoring indicates that such measures are necessary.
Wastewater Discharge Permits	City of Albuquerque	City of Albuquerque Sewer Use and Wastewater Control Ordinance	Review of Notification of Increased Flow Rate.
NPDES permit for stormwater runoff/ discharge	EPA, Region VI	Clean Water Act and implementing regulations	Notice of Intent for construction activities resulting in disturbance of five acres or more of total land area.
Threatened or Endangered Species consultation	U.S. Department of the Interior, Fish and Wildlife Service (USFWS)	Endangered Species Act	Consult with the USFWS Regional Director to determine impacts (if any) on proposed or listed threatened or endangered species or their critical habitats; prepare a biological assessment if any protected species will be affected.

Table A-1, continued
Representative List of Consultations or Permits That May Be Applicable to the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Consultation or Permit	Granting or Approving Agency	Statute or Regulation	Activity
Migratory bird protection	USFWS	Migratory Bird Treaty Act	Consult with the USFWS regional office and state wildlife management agency required for actions that could affect migratory birds.
Cultural resource protection	New Mexico State Historic Preservation Office (SHPO) and Advisory Council of Historic Preservation	National Historic Preservation Act; Archaeological and Historic Preservation Act; Archaeological Resources Protection Act; Native American Grave Protection and Repatriation Act; Executive Order 11593, *Protection and Enhancement of the Cultural Environment*; and all applicable implementing regulations	Perform cultural resource survey, consult and coordinate with the SHPO to eliminate impacts or develop appropriate mitigation.
Notification and reporting reportable quantities of hazardous substances	New Mexico Environment Department, Superfund Amendments and Reauthorization Act (SARA) Bureau, and designated local emergency response authorities	SARA Title III, Emergency Planning and Community Right-to-Know Act (EPCRA), and implementing regulations	Maintenance of Material Safety Data Sheets in new facility; continued compliance with SARA Title III and EPCRA.

Table A-1, concluded

Representative List of Consultations or Permits That May Be Applicable to the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Consultation or Permit	Granting or Approving Agency	Statute or Regulation	Activity
Notification and reporting of oil and chemical spills	New Mexico Environment Department, SARA Bureau, National Response Center, designated local emergency response authorities	SARA Title III, EPCRA, and implementing regulations	Notification of appropriate authorities when a spill of a reportable quantity has occurred; documentation of cleanup in accordance with internal operating procedures and in conformance with Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)/SARA requirements, as appropriate.
Provision for worker health and safety	Occupational Safety and Health Administration (OSHA); National Institute of Occupational Safety and Health (NIOSH); U.S. Department of Energy (DOE)	OSHA and implementing regulations; industry standards; NIOSH guidance; DOE Order 5482.1B, *Environment, Safety, and Health Appraisal Program* (see also Table A-2)	Documentation of compliance with DOE Orders, SNL/NM policy, the SNL/NM *Environment Safety and Health Manual*, and safe operating procedures for construction and operational health and safety during facility construction and operations.

Table A-2
Representative List of DOE Orders That May Be Applicable to the Proposed Processing and Environmental Technology Laboratory(PETL), Sandia National Laboratories/New Mexico

DOE Order	Title
1324.5	*Records Management*
AL 1540.1	*Materials Transportation and Traffic Management*
AL 1540.2	*Hazardous Material Packaging for Transportation - Administration Procedures*
5000.3A	*Unusual Occurrence Reporting System*
5380.3A	*Personnel Hazardous Waste Training and Qualifications*
5400.1	*General Environmental Protection Program*
5400.3	*Hazardous and Radioactive Mixed Waste Program*
5400.4	*Integration of Environmental Compliance Process*
5440.1E	*National Environmental Policy Act*
5480.1	*Prevention, Control, and Abatement of Environmental Pollution*
5480.1B	*Environment, Safety, and Health Program for U.S. Department of Energy Operations*
5480.3	*Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Waste*
5480.4	*Environmental Protection, Safety, and Health Protection Program Standards*
5480.7A	*Fire Protection*
5481.1A	*Safety Analysis and Review System*
5482.1B	*Environment, Safety and Health Appraisal Program*
5483.1A	*Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned, Contractor-Operated Facilities*
5484.1	*Health Protection Information Reporting Requirements*
5500.1B	*Emergency Management System*
5630.3	*Protection of Departmental Facilities Against Radiological and Toxicological Sabotage*
5700.6C	*Quality Assurance Program*[a]
6430.1A	*General Design Criteria*
SEN-37-92	*Waste Minimization Crosscut Plan Implementation*

[a] See also 10 CFR 830.120, *Nuclear Safety Management* (1994).

APPENDIX B

AGENCY CONCURRENCE LETTERS

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UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
Suite D, 3530 Pan American Highway, NE
Albuquerque, New Mexico 87107

February 16, 1993

Cons. #2-22-93-I-156

Mr. Steve Cox
Jacobs Engineering Group, Inc.
Albuquerque Operations
5301 Central Avenue NE, Suite 1700
Albuquerque, New Mexico 87108

Dear Mr. Cox:

This responds to your letter dated January 28, 1993, requesting information on federally listed and candidate species, or wetlands, that could be affected by the construction of the Processing and Environmental Technology Laboratory (PETL) by Sandia National Laboratories. The proposed site lies within the SE 1/4 of Section 32, T10N, R4E, Bernalillo County, New Mexico.

A site inspection of the anticipated PETL location was conducted by Clent Bailey of my staff on February 11, 1993, and it was determined that no federally sensitive species will be affected by the proposed project. Also, the site lacks the hydrology, hydric soils, and vegetation necessary for it to be considered a wetland.

We suggest you contact the New Mexico Department of Game and Fish and the New Mexico Energy, Minerals and Natural Resources Department for information concerning fish, wildlife, and plants of State concern. If we can be of further assistance, please call Clent Bailey at (505) 883-7877.

Sincerely,

Jennifer Fowler-Propst
Field Supervisor

ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT
Santa Fe, New Mexico 87505

New Mexico DRUG FREE It's a State of Mind!

BRUCE KING
GOVERNOR

ANITA LOCKWOOD
CABINET SECRETARY

6 March, 1993

Steve Cox
Jacobs Engineering Group Inc.
5301 Central Avenue NE
Suite 1700
Albuquerque, NM 87108

Dear Mr. Cox,

There are three plants of concern, the gramagrass cactus (Toumeya papyracantha), white visnagita (Neolloydia intertexta), and the Wright's fishhook cactus (Mammillaria wrightii), State of New Mexico Endangered Species that are known to occur in the area near the proposed Processing and Environmental Technology Laboratory in SNL/NM Technical Area 1. We recommend that you conduct an endangered species biological clearance survey before proceeding with any new construction. If during your survey, you encounter any of these plants, we would appreciate knowing their exact locations.

If you have any questions, please do not hesitate to call Karen Lightfoot or Bob Sivinski, Endangered Species Botanists for the State of New Mexico.

Sincerely,

Raymond R. Gallegos
State Forester

By:
Karen S. Lightfoot

VILLAGRA BUILDING - 408 Galisteo
Forestry and Resources Conservation Division
P.O. Box 1948 87504-1948
827-5830
Park and Recreation Division
P.O. Box 1147 87504-1147
827-7465

2040 South Pacheco
Office of the Secretary
827-5950
Administrative Services
827-5925
Energy Conservation & Management
827-5900
Mining and Minerals
827-5970

LAND OFFICE BUILDING - 310 Old Santa Fe Trail
Oil Conservation Division
P.O. Box 2088 87504-2088
827-5800

JE JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS
5301 CENTRAL AVENUE N E — SUITE 1700, ALBUQUERQUE, NEW MEXICO 87108
TELEPHONE (505) 262-1505

March 17, 1993

Bess Campbell-Domme
Processing and Environmental
Technology Laboratory
Sandia National Laboratories
Albuquerque, NM 87106

Subject: Biological resources survey of the proposed Processing and Environmental Technology Laboratory (PETL).

Dear Ms. Campbell-Domme

On March 15, 1993 Mr. Steven Cox and Ms. Caroline Persson-Reeves visited the Sandia National Laboratories proposed PETL site to survey the flora and fauna. The proposed PETL location is inside the security area of Technical Area I at Sandia National Laboratories, New Mexico. The area surveyed is approximately four acres in the southeast corner of Section 32, Township 10 north, Range 4 east. Except for the east side, the property around the proposed location has been developed. There is a multistory building to the south and adjacent to the proposed location, and the west and north sides are flanked with paved roads with other structures nearby. The east boundary is fenced and beyond the fence is a relatively open area of moderately disturbed desert grassland.

Through requests for information with the New Mexico Energy, Minerals and Natural Resources Department, the New Mexico State Game and Fish, and the US Fish and Wildlife Service we learned which threatened or endangered species might conceivably occur in or around the proposed PETL location. The New Mexico Energy, Minerals and Natural Resources Department has stated that there are three plants of concern that are known to occur in the area near the proposed PETL site (see attached). These plants are the gramagrass cactus (*Toumeya papyracantha*), white visnagita (*Neolloydia intertexta*) and the Wright's fishhook cactus (*Mammillaria wrightii*). The U.S. Fish and Wildlife Service stated that after conducting a site inspection of the proposed PETL location, no federally sensitive species will be affected (see attached).

The proposed PETL location is a relatively flat area that has been heavily disturbed due to past grading and or other earth moving activities. The soil consist of a gravelly sand loam.

The plant species found in the undeveloped areas to the east outside of and around the proposed site, are primarily representative of the Great Basin Grasslands Biome (Brown, 1982, as described in Fischer, 1990) which basically consists of desert grasses mixed with scattered shrub and forb species.

During our survey it was noted that the vegetation at the proposed PETL location is typical of areas that have been disturbed. This area is dominated by the herbaceous species of Russian thistle (*Salsola kali*), summer cypress (*Kochia scoparia*), along with snakeweed (*Gutierrezia sarothrae*). This site has some scattered grasses primarily three-awn grass (*Aristida spp*) and galleta (*Hilaria jamesii*). There were no species of cactus of any kind found on the proposed site.

This site would be expected to support a limited number of small mammals, birds and reptiles. At the time of this survey, there were 24 prairie dog (*Cynomys gunnisonii*) burrows found scattered over the site with one single sighting of a prairie dog. Other indications of wildlife were small rodent burrows and rabbit droppings

Considering the highly disturbed state of the proposed location and the close proximity to other developed properties, the area is less than favorable as habitat for wildlife. The limited number of species that might utilize this area includes:

black-tailed jack rabbit	(*Lepus californicus*)
desert cottontail	(*Sylvilagus audubonii*)
side blotched lizard	(*Uta stansburiana*)
greater roadrunner	(*Geococcyx californianus*)
common crow	(*Corvus brachyrhyncos*)
western meadowlark	(*Sturnella neglecta*)

No species of flora or fauna listed as endangered or threatened were identified as occurring at the proposed PETL location. While it is possible that migrating threatened species of birds may pass over the site, it would not be expected that the development of this site would cause any impacts to these species that do not already exist in the area.

Very truly yours,
JACOBS ENGINEERING GROUP INC.

Steven Cox
Steven Cox
Project Manager

SC:sc
Enclosure (2)

GOVERNOR
Bruce King

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH
Villagra Building
P.O. Box 25112
Santa Fe, N.M. 87504

DIRECTOR AND SECRETARY
TO THE COMMISSION
Bill Montoya

April 7, 1993

Mr. Steve Cox, Project Manager
Jacobs Engineering Group Inc.
5301 Central Avenue N.E., Suite 1700
Albuquerque, New Mexico 87108

Dear Mr. Cox:

The Department of Game and Fish (Department) has received your request for information regarding the construction of a Processing and Environmental Technology Laboratory at Sandia National Laboratories in Albuquerque. Based on the location information provided with your request regarding threatened or endangered wildlife species, state-listed endangered species are not likely to occur in the project area. We suggest you contact the U. S. Fish and Wildlife Service for information concerning federally listed species.

If you have any questions or require further information please feel free to contact Lisa Fisher (275-3904) of this Department.

Sincerely,

Bill Montoya
Director

BM/LF/bes

cc: Jennifer Fowler-Propst (Ecological Services Supervisor, USFWS)
Wain Evans (Assistant Director, NMGF)
Andrew Sandoval (HEP Division Chief, NMGF)
Robert Jenks (HEP Assistant Division Chief, NMGF)

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Rev

STATE OF NEW MEXICO
OFFICE OF CULTURAL AFFAIRS
HISTORIC PRESERVATION DIVISION
VILLA RIVERA, ROOM 101
228 EAST PALACE AVENUE
SANTA FE NEW MEXICO 87503
(505) 827-6320

BRUCE KING
GOVERNOR

HELMUTH J. NAUMER
CULTURAL AFFAIRS OFFICER

THOMAS W. MERLAN
DIRECTOR

July 12, 1991

Mr. Albert R. Chernoff
Director
Management Support Division
Albuquerque Operations Office
Department of Energy
Post Office Box 1500
Albuquerque, New Mexico 87115

Re: Cultural Resources Inventory, Area I, SNL

Attn: Mr. R. F. Gonzales

Dear Mr. Chernoff:

At your request, I have reviewed the results of an intensive cultural resources inventory survey of approximately 365 acres located within Area I at Sandia National Laboratories (SNL). The results of this survey are described in *A Cultural Resources Survey and Review for Sandia National Laboratories, Area I, North of O Street, Kirtland Air Force Base, New Mexico* (CGI Report #8067Z) by Steven R. Hoagland, Chambers Group, Inc.

No potentially significant prehistoric or historic archaeological resources were located by the pedestrian survey of approximately 87 acres of undisturbed or moderately disturbed land in Area I. It is possible that buried archaeological manifestations may be encountered during future construction activities in Area I, but I consider the discovery of significant properties to be unlikely. No other properties currently entered in or determined eligible for inclusion in the National Register of Historic Places are located within Area I.

As discussed in the survey report, several existing structures within Area I may be eligible for inclusion in the National Register because of the architectural and historical values they possess. This office, in consultation with Kirtland Air Force Base, is currently reconsidering the eligibility of the four structures remaining from the original Albuquerque Airport/Oxnard Field that are located adjacent to Area I. The report also briefly describes six buildings (Buildings 824, 828, 838, 839, and two others) within Area I constructed in 1945-46 for the production, stockpiling, and surveillance of the first atomic weapons.

I believe these six buildings may possess historical values sufficient to be considered eligible for inclusion in the National Register. However, it cannot be determined from the information contained in the survey report if these structures retain sufficient integrity to be determined eligible. The report states that the buildings have undergone numerous modifications, but it fails to discuss the modifications in any detail. The report does not include any photographs or survey forms that would permit further evaluation of the remaining integrity.

As recommended in the report, further evaluation by a qualified architectural historian will be necessary to establish the architectural integrity of the identified buildings. Depending on the findings of this evaluation, it is possible that one or more of the structures may be of such exceptional significance that the 50 year guideline for National Register eligibility will not apply. Documentation necessary to conduct an architectural review should include photographs, both current and historical, building plans, a history of modifications since the buildings achieved their significance, and any other pertinent records and documents that may be readily available. This evaluation will inform SNL that potentially significant structures that must be considered in any plans with the potential to damage or alter the structures are present in Area I, or that the buildings are not considered to be eligible properties and not worthy of further consideration.

I recommend that this evaluation be conducted as soon as the necessary documentation can be gathered, since the six identified buildings are approaching 50 years of age. A determination that a property is eligible or potentially eligible for inclusion in the National Register should not preclude SNL for proceeding with plans for construction and modernization projects within Area I. It will mean that SNL must consider alternatives to a proposed action that will reduce adverse effect on an eligible property. The preservation and compatible reuse of historic properties whenever possible is the preferred action whenever possible.

Thank you for the opportunity to consult with you on the results of the cultural resources inventory of SNL Area I. Any questions you may have regarding appropriate documentation for evaluating the significance of the structures in question should be directed to Dr. Mary Ann Anders, at this address and telephone number.

Sincerely,

Lynne Sebastian

Lynne Sebastian, Deputy
State Historic Preservation Officer

LS:DER:bc/Log 27310

Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque New Mexico 87185-5400

RECEIVED IN DEPT. 7731

OCT 28 1992

OCT 27 1992

Mr. Thomas W. Merlan
State of New Mexico
Office of Cultural Affairs
228 East Palace Avenue
Santa Fe, New Mexico 87503

Dear Mr. Merlan:

This letter is in reference to the proposed siting of the Processing and Environmental Technology Laboratory (PETL) located in Technical Area I at Sandia National Laboratories, Albuquerque. Enclosed is a description of the referenced project, and a Cultural Resources Survey and Review for SNL Technical Area I, North of O Street, Kirtland Air Force Base, New Mexico (CGI Report No. 8067Z, dated August 25, 1990). The PETL siting is located inside the surveyed area. Also enclosed is the State Historic Preservation Officer approval for Report No. 8067Z, dated July 12, 1991.

The Kirtland Area Office is requesting SHPO consultation for the subject proposed project. Please return all authorizations and written comments to this office. If you have any questions, contact Susan Lacy of my staff at 845-5542.

Thomas Bodyla
for Kathleen A. Carlson
Area Manager
Kirtland Area Office

Enclosures

cc w/o enclosures:
H. C. Bohannon, KAO, AL
C. L. Soden, EPD, AL
C. M. Tapp, 4300, SNL
T. A. Wolff, 7731, SNL
[illegible] McHarris, 7731, SNL

STATE OF NEW MEXICO
OFFICE OF CULTURAL AFFAIRS
HISTORIC PRESERVATION DIVISION

BRUCE KING
GOVERNOR

VILLA RIVERA BUILDING
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HELMUTH J. NAUMER
CULTURAL AFFAIRS OFFICER

THOMAS W. MERLAN
DIRECTOR

November 10, 1992

Ms. Kathleen A. Carlson
Area Manager
Kirtland Area Office
Department of Energy
Field Office, Albuquerque
P.O. Box 5400
Albuquerque, NM 87185-5400

Dear Ms. Carlson:

We have received a request from your office to review the proposed siting of the Processing and Environmental Technology Laboratory (PETL) in Technical Area I at Sandia National Laboratory, Albuquerque, New Mexico.

Based upon the findings of the Cultural Resources Survey report of Tech Area 1 prepared Chambers Group, Inc. in 1990, no properties listed on or eligible for inclusion to the National Register of Historic Places are located within Area 1. Our letter to the DOE dated July 12, 1991, notes that six buildings may be National Register eligible pending a formal review of their attributes. These buildings, however, will not be affected by the proposed PETL.

Therefore, we concur with a finding of no effect for this undertaking pursuant to 36 CFR 9 800.5. Please be advised that intact buried cultural deposits may exist in this area. Should cultural resources be encountered during construction, stop construction immediately, and contact our office.

Thank you.

Sincerely,

Lynne Sebastian

Lynne Sebastian
Deputy State Historic Preservation Officer

LS/DWC: 37727

APPENDIX C

INDOOR AIR QUALITY MODELING TO ESTIMATE THE MAXIMUM CONCENTRATIONS OF A CHEMICAL SPILL IN A LABORATORY ENVIRONMENT

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LIST OF TABLES

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INDOOR AIR QUALITY MODELING TO ESTIMATE THE MAXIMUM CONCENTRATIONS OF A CHEMICAL SPILL IN A LABORATORY ENVIRONMENT

Accidentally spilled toxic chemicals present a serious health hazard to people exposed to excessive vapor concentrations. For the proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico, two different chemical spill scenarios were modeled. In the first scenario, the ventilation is assumed to be on and functioning. In the second scenario, the ventilation is assumed to be malfunctioning. Both scenarios assume the following conditions:

- The setting is any laboratory. This room has the dimensions of 7.3 meters (m) x 14.6 m x 4.3 m, or a total volume of 456.7 m^3.
- Only one chemical is spilled at a time.
- A 500-milliliter glass container is broken, and the resulting chemical spill is an instantaneous release.
- The spill is two millimeters thick.
- The ambient temperature is 72° Fahrenheit.
- The steady-state concentration that is calculated is the final chemical concentration in the room.

The following chemicals were used because of their toxicity and/or relatively large proposed frequency of use: acetone, benzene, hydrochloric acid (assume 38%), hydrofluoric acid (assume 53%), methanol, methylene chloride, and trichloroethylene (see Table 2-1, Section 2.1.3, of the environmental assessment text). Lead was not modeled because it does not vaporize at normal laboratory temperatures. Mercury also was not modeled because its vaporization rate is extremely slow. This accident scenario models effects associated with short-term (less than one hour) inhalation of air contaminated by chemicals released as the result of a spill. Adverse effects associated with mercury exposure are generally limited to cases in which the vapor has been inhaled chronically over time periods of months or years as a result of unmitigated spills or incorrectly stored materials, or when the material has been absorbed through direct physical contact or ingested through contaminated food or water.

Of particular importance in evaluating the potential risk is the source strength, that is, the amount of vapor released per unit of time. Some spills release vapor directly to the atmosphere, in which case the release rate is an important variable. In other situations, liquid is spilled on the ground and then evaporates from the pool into the atmosphere. In these situations, the evaporation rate must be determined based on knowledge of the chemical and the size of the liquid pool. Once the source strength is determined, this value is used in an atmospheric dispersion model to determine the potential area of effect.

Two different models were used to calculate the indoor dispersion of certain chemicals as the result of an accidental chemical spill in a laboratory. First, the U.S. Army's evaporation rate model ("the Army's model") was used to calculate the emission rates of the spilled chemicals (Kunkel, 1993):

(Equation 1)

$$Q = 0.3u^{0.8}A^{0.9}T^{-0.8}(MW)(V_p)\left[\frac{(3.1+MV^{1/3})^2}{T^{0.5}(1/29+1/MW)^{0.5}}\right]^{-2/3}$$

where:

Q	=	emission (evaporation) rate (kilograms/hour)
u	=	windspeed (meters/second)
A	=	area of spill (square meters)
MW	=	molecular weight (grams/gmole)
MV	=	molecular volume at normal boiling point (m^3/gmole)
V_p	=	vapor pressure (milliliters mercury)
T	=	temperature (Kelvin).

This model, adapted from the Chemical Engineer's Handbook, uses the vapor pressure and gram molecular weight of the spilled chemical, as well as the air temperature, windspeed, spill area, and the molecular volume, which are used to compute the diffusivity. In this model, it is assumed that there is no heat transfer due to evaporative cooling or radiation, and the pool temperature is the same as the air temperature. The emission rate is determined as a function of the Reynolds number, the Schmidt number, the molar mass velocity of air, and the vapor pressure of the spilled liquid.

Several steady-state, semiempirical models are available. The Army's model allows for the modeling of evaporation in still air for those cases where spills occur within a closed building or other confined location that precludes the movement of air during the evaporation of the toxic liquid. If the area of the spill is not known, it can be calculated as a function of a concrete or gravel surface, and the quantity of material spilled. In addition, the Army's model produces the lowest source strengths for a given set of meteorological conditions.

Using the emission rates calculated in the Army's model (Table C-1), the airborne steady-state concentrations of the spilled chemicals were then calculated using the following equation (Caravanos, 1991):

(Equation 2)

$$C = \frac{E_1 \, x \, 22.4 \, x \, 10^6}{MW \, x \, Q}$$

where:

C	=	steady-state concentration in the air (parts per million)
E_1	=	Q from the Army's equation (grams/minute)
22.4	=	volume of gas (liters per mole)
10^6	=	conversion factor to parts per million
MW	=	molecular weight
Q	=	ventilation rate (liters/minute).

Table C-1
Emission Rates of Selected Chemicals for the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Material	Emission Rate in Grams/Minute	
	Scenario 1: Ventilation Functioning	Scenario 2: Ventilation Malfunctioning
Acetone	1.22	0.064
Benzene	0.63	0.033
Hydrochloric Acid (53%)	1.06	0.056
Hydrofluoric Acid (38%)	1.84	0.096
Methanol	0.43	0.023
Methylene Chloride	3.48	0.182
Trichloroethylene	1.35	0.071

To calculate the amount of time needed to reach a steady-state concentration, the steady-state concentration (C) calculated in Equation 2 is divided by the volume of the room to obtain the mass release needed to meet the steady-state concentration. If we assume that the emission rate (E_1) is linear, then the time needed to reach the steady-state concentration is a function of the mass release divided by the evaporation rate.

The calculated steady-state concentrations of the spilled chemicals in a laboratory are shown in Table C-2. The Occupational Safety and Health Administration (OSHA) and American Conference of Governmental Industrial Hygienists (ACGIH) permissible exposure limits

(PELs), short-term exposure limits (STELs), threshold limit value - ceiling (TLV-C) concentrations, and the immediately dangerous to life or health (IDLH) concentrations are also shown for comparison. STELs are 15-minute, time-weighted average (TWA) exposure limits that should not be exceeded at any time during a work day. TLV-C concentrations must not be exceeded during any part of the work day. The IDLH represents the maximum concentration from which one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.

Table C-2
Calculated Steady-State Concentrations of Selected Chemical Spills for the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Material	Concentrations[a] in mg/m^3					
	Calculated Steady-State Concentration		PEL-TWA[b]	TLV-STEL[c]	TLV-C[d]	IDLH[e]
	Scenario 1: Ventilation Functioning	Scenario 2: Ventilation Malfunctioning				
Acetone	36	78	590	--	--	6,050
Benzene	19	40	3	16	--	1,625
Hydrochloric Acid (53%)	33	68	--	--	7	16
Hydrofluoric Acid (38%)	56	141	2.5	--	5	25
Methanol	13	28	260	325	--	7,980
Methylene chloride	107	223	1,765	--	3,530	8,119
Trichloroethylene	41	86	546	--	1,092	5,460

[a] The table lists OSHA PEL values for some chemicals. If the NIOSH recommended TWA for a chemical is lower than the OSHA PEL (NIOSH 1994), the NIOSH TWA is listed.
[b] PEL-TWA: Permissible Exposure Limit - Time Weighted Average.
[c] TLV-STEL: Threshold Limit Value - Short-Term Exposure Limit.
[d] TLV-C: Threshold Limit Value - Ceiling.
[e] IDLH: Immediately Dangerous to Life and Health.

Scenario 1: Ventilation Functioning

For the first scenario, the laboratory ventilation system was assumed to be on during the spill. Four complete air changes per hour were assumed (volumetric airflow of 30,444 liters per minute). The normal air change rate is four-to-six air changes per hour. The resulting calculations showed that, in this scenario, the steady-state concentration of benzene would exceed both the PEL and the STEL; hydrochloric acid concentrations would exceed the TLV-C; and hydrofluoric acid concentrations would exceed all the limits. Only hydrochloric and hydrofluoric acid spills could have an adverse affect on laboratory personnel.

If a linearly progressive chemical evaporation rate is assumed, steady-state concentrations of hydrochloric and hydrofluoric acids would be reached in 14 minutes. The TLV-C levels would be reached in 3 minutes for hydrochloric acid, and in 1.5 minutes for hydrofluoric acid. However, the most critical concentration limit, the IDLH, would govern evacuation time constraints. This concentration limit would be reached in seven minutes for hydrofluoric acid. When IDLH concentration levels are reached, a person would have 30 minutes to leave the area without experiencing any escape-impairing or irreversible health effects.

Scenario 2: Ventilation Malfunctioning

For the second scenario, the laboratory ventilation system was assumed to be malfunctioning or effectively disabled. One-tenth of one complete air change per hour was used for this second scenario (volumetric airflow of 761 liters per minute). The calculated steady-state concentrations of the spilled chemicals in a laboratory are shown in Table C-2. The resulting calculations showed that, in this scenario, the steady-state concentration of benzene would exceed both the PEL and the STEL; hydrochloric acid concentrations would exceed the TLV-C; hydrofluoric acid concentrations would exceed all the limits; and methylene chloride concentrations would exceed the PEL limit. Because the steady-state concentrations of benzene and methylene chloride would be well below the IDLH values (1,625 and 8,119 mg/m^3, respectively), only hydrochloric and hydrofluoric acid spills could potentially threaten laboratory employees in a spill situation.

If a linearly progressive chemical evaporation rate is assumed, steady-state concentrations of hydrochloric and hydrofluoric acids would be reached in 9 and 11 hours, respectively. The TLV-C concentration levels would be reached in 57 minutes for hydrochloric acid, and in 24 minutes for hydrofluoric acid. However, the most critical concentration limit, the IDLH, would govern evacuation time constraints. This concentration limit would be reached in 119 minutes for hydrofluoric acid. When IDLH concentration levels are reached, a person theoretically would have 30 minutes to leave the area without experiencing any escape-impairing or irreversible health effects. The exposure effects of hydrochloric and hydrofluoric acids are the same as described in Scenario 1.

Consequences

By comparing the two chemical spill scenarios, it is apparent that the lack of ventilation (Scenario 2) slows down the evaporation rate of the spilled chemical. This results in the longer time period for the concentrations to reach steady-state conditions and a longer time before evacuation is needed. However, the lack of ventilation also results in higher steady-state concentrations due to the decreased air exchange in the room.

Exposure to hydrochloric acid can produce inflammation of the nose, throat and larynx with cough and choking. Hydrofluoric acid acts as an irritant to the eyes, nose and throat and can produce nasal congestion and pulmonary edema. Both hydrochloric and hydrofluoric acid will burn the eyes and skin.

For a spill to cause injury to personnel, the following sequence of events would be required:

- Laboratory personnel violate activity-specific procedures for handling chemicals.
- Laboratory personnel fail to evacuate the laboratory before steady-state concentrations are reached that potentially could cause injury.
- Spill response personnel are not notified of the spill.
- Cleanup of the spill does not occur.

The appropriate cleanup and evacuation procedures would be taken once a spill was discovered. Proper use and storage of all chemicals should reduce the risk of a spill and consequent employee exposure.

References for Appendix C

Kunkel, Bruce A. 1993. *A Comparison of Evaporation Source Strength Models for Air Toxic Chemical Spills,* AFGL-TR-83-0307, Air Force Surveys in Geophysics, No. 445, Atmospheric Sciences Division, Air Force Geophysics Laboratory, Project-6670, U.S. Air Force Systems Command, Hanscom AFB, Massachusetts.

Caravanos, Jack. 1991. *Quantitative Industrial Hygiene: A Formula Workbook*, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

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APPENDIX D

ATMOSPHERIC MODELING TO ESTIMATE THE MAXIMUM DOWNWIND AIR CONCENTRATIONS OF RELEASED MATERIALS FROM A FACILITY FIRE

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ATMOSPHERIC MODELING TO ESTIMATE THE MAXIMUM DOWNWIND AIR CONCENTRATIONS OF RELEASED MATERIALS FROM A FACILITY FIRE

The dispersion of certain materials into the atmosphere from a facility fire was calculated by using the U.S. Environmental Protection Agency (EPA) atmospheric dispersion model, TSCREEN, Version 1.0 (EPA, 1990). A fire in the Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico, was developed as a worst-case accident scenario.

In accordance with the requirements for data input into the TSCREEN model, the following parameters and assumptions were specified:

- This is a gaseous, flared, stack release from a vent stack located at roof height. For the proposed PETL, the roof height is 15.8 meters.
- The release is the result of a one-hour duration fire, the default time period in the model. However, peak concentration values were defined over 15-minute intervals within the one-hour duration. To be conservative, a peak 15-minute average concentration was selected and treated as the instantaneous concentration (Craig *et al.*, 1993). A 15-minute concentration value is recommended for use when comparing these values with those toxic chemicals for which the Occupational Safety and Health Administration (OSHA) has established a health standard.
- The entire volume of a single stored chemical is vaporized by the heat of the fire and is emitted at a constant rate for the one-hour fire duration.
- The wind blows from one direction.
- Worst-case wind speed and atmospheric stability conditions prevail. The model accommodates actual meteorological data. However, to be conservative, the model was allowed to run using worst-case conditions to calculate the worst possible exposure.
- No PETL building downwash was used for the modeling.
- The fire heat release rate is assumed to be 19,730 Btu/second at a temperature of 1300° Centigrade (4.97×10^6 calories per second).
- Simple, flat, rural-type terrain is assumed with potential human receptors located at ground level.

Approximately 2500 different chemicals and chemical compounds are used in relatively small quantities to perform laboratory-scale general chemistry experiments and analyses. To be conservative in calculating the potential effects from a fire at the proposed PETL, eight representative chemicals were selected for modeling. The chemicals that are considered either the most toxic and/or are stored in the largest quantities were selected. These eight chemicals and their maximum expected inventory were described previously in Table 2-1 in Section 2.1.3 of the environmental assessment text. These eight chemicals and the amounts used in the model are provided in Table D-1.

Table D-1
Estimated Maximum Downwind Concentrations of Materials Released for the Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Material	Quantity	Concentrations[a] in mg/m^3				
		Concentration (15-minute Interval)	PEL-TWA[b]	TLV-STEL[c]	TVL-C[d]	IDLH[e]
Acetone	100 L	0.1	590	--	--	6,050
Benzene	3 L	0.004	0.3	3.3	--	1,625
Hydrochloric Acid (38%)	22 L	0.02	--	--	7	76
Hydrofluoric Acid (53%)	4 L + 80 lbs	0.06	2.5	--	5	25
Mercury	11 lbs	0.008	0.05	--	0.1	10
Methanol	70 L	0.08	260	325	--	7,980
Methylene Chloride	10 L	0.02	1,765	--	3,530	8,119
Trichloroethylene	25 L	0.06	540	--	1,092	5,460

L = Liters; lbs = pounds

[a] The table lists OSHA PEL values for some chemicals. If the NIOSH recommended TWA for a chemical is lower than the OSHA PEL (NIOSH 1994), the NIOSH TWA is listed.
[b] PEL-TWA: Permissible Exposure Limit - Time Weighted Average.
[c] TLV-STEL: Threshold Limit Value - Short-Term Exposure Limit.
[d] TLV-C: Threshold Limit Value - Ceiling.
[e] IDLH: Immediately Dangerous to Life and Health.

The maximum downwind air pollutant concentrations, provided in Table D-1, were calculated using TSCREEN for a 15-minute averaged time period. The permissible exposure limits (PELs), short-term exposure limits (STELs), threshold limit value - ceiling (TLV-C) concentrations, and immediately dangerous to life or health (IDLHs) concentrations are also shown for comparison.

The maximum downwind impact for the 15-minute averaged time period occurs at 695 meters from the proposed PETL for worst-case wind speed and atmospheric stability conditions.

Even with the conservative assumptions input to the TSCREEN model, none of the PELs were exceeded by the 15-minute, averaged time period concentrations (the most conservative of the concentration limit guidelines). Likewise, none of the other concentration limit guidelines were exceeded by the calculated downwind concentrations. Hydrochloric acid does not have a recommended PEL for comparison; however, the calculated downwind concentration is much lower than the recommended TLV-C and IDLH limits.

References for Appendix D

Craig *et al.* (D. K. Craig, J. S. Davis, L. G. Lee, P. J. Lein, and P. Hoffman). 1993. Toxic Chemical Hazard Classification and Risk Acceptance Guidelines For Use In DOE Facilities, prepared by Westinghouse Electric Corporation, Government Operations, for the U.S. Department of Energy, Albuquerque Field Office, Government Assistance and Operations Division, Albuquerque, New Mexico.

EPA (U.S. Environmental Protection Agency). 1990. TSCREEN: A Model for Screening Toxic Air Pollutant Concentrations, prepared by Pacific Environmental Services, Inc., for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

APPENDIX E

AIRCRAFT CRASH PROBABILITY CALCULATIONS

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AIRCRAFT CRASH PROBABILITY CALCULATIONS

Sandia National laboratories, New Mexico (SNL/NM) is located within the boundaries of the U.S. Air Force's (USAF's) Kirtland Air Force Base (KAFB) which adjoins and shares two runways operated by the Albuquerque International Airport (AIA). The eastern end of the east-west runway (the principal runway used) is approximately 1.9 miles (3.2 kilometers) southwest of the proposed Processing and Environmental Technology Laboratory (PETL), SNL/NM. Aircraft crashes can be considered credible events in the assessment of risks associated with the siting of a building. Since aircraft crashes are more likely during takeoff and landing, the location of a structure or building in relation to an airport runway is the dominant parameter in the assessment of risk. An impact probability model was developed at SNL/NM to estimate the probability of an aircraft crash into a structure or cluster of structures as a function of site location relative the distance from one or more airport runways (Smith, 1983).

Impact Probability Model

The impact probability model was used to estimate the probability of a large aircraft or a military high performance aircraft crash into the proposed PETL. The model is designed to account for differences in the probabilities of aircraft crashes during landing operations, takeoffs, and in-flight operations, as well as the difference between military and civilian crash probabilities in each of these operations. Crash statistics indicate that these differences are significant (Smith, 1983). The model accounts for these differences without a significant overprediction or underprediction of the probability of a crash.

The equation for estimating this probability is as follows:

(Equation 1)

$$P = (1/2 * N_T) * P_N(T) * D(x,y,T) * (n)A + (1/2 * N_L) * P_N(L) * D(x,y,L) * (n)A$$

where:

x = Perpendicular distance in statute miles from the center line of the runway or its projection to the structure

y = Perpendicular distance in statute miles from the threshold end of the runway or its projection to the structure

T = Takeoff phase of operations

L = Landing phase of operations

a	=	T or L
$N(a)$	=	Number of "a" aircraft operations per year at the runway
P_N	=	Probability of an aircraft crash per operation
$D(x,y,a)$	=	Crash probability density function
$P_N(a)$	=	P_N as a function of "a"
n	=	Number of buildings
A	=	Effective impact or crash area in square statute miles for an aircraft having typical crash dynamics that results in a critical impact velocity at the structure. [Note: *For the proposed PETL, the critical impact velocity will be conservatively assumed to be any residual velocity*].

The crash probability density function is calculated as:

(Equation 2)

$$D(x,y,a) = C(a) * \exp[-|x| / d(x,a)] * \exp[-|y| / d(y,a)]$$

where:

$C(a)$	=	Crash density constant as a function of a
$d(x,a)$	=	Crash density constant as a function of x and a
$d(y,a)$	=	Crash density constant as a function of y and a.

The effective impact (or crash) area (A) is calculated as:

(Equation 3)

$$A = A_{pl} + A_{sk} + A_{sh} \textit{ (square miles)}$$

where:

A_{pl} = Effective plan view area = $(L + A_w) * W$

A_{sk}	=	Effective skid area	=	$(L + A_w) * S_k$
A_{sh}	=	Effective shadow are =		$(L + A_w) * H \times \cot(i)$
L	=	Dimension perpendicular to flight path		
W	=	Dimension parallel to flight path		
H	=	Height dimension		
A_w	=	Aircraft wing-tip-to-wing-tip dimension		
S_k	=	Typical aircraft skid distance, which results in a critical impact velocity at the structure		
i	=	Typical impact angle = 15 degrees.		

The model developed by Smith (1983) assumes the following conditions:

(1) Only one runway and one structure are considered in the analysis (however, this model can accommodate multiple runways, multiple airways, and multiple structures).

(2) The number of takeoffs (N_T) and landings (N_L) are equal for both ends of the runway; the term ($1/2 * N_T$) is for the end of the runway nearest the structure.

(3) Only data for high-performance aircraft (typically military) and large aircraft (typically commercial air carrier) are calculated since these are the only aircraft with sufficient impact velocity to result in extensive damage and loss of life (a small aircraft crash could, however, result in minor building damage). The USAF high-performance aircraft crash data are assumed to be representative of all military operations.

(4) Only crash data for takeoffs and landings are modeled. These crash probability contributions dominate over the contribution from in-flight operations.

(5) All takeoff and landing operations and crash impact locations occur within five statute miles (8 kilometers) of the end of the runway.

(6) A conservative (overprediction), but not worst-case estimate assumes the aircraft flight path is perpendicular to the long axis (length) of the building. (A worst-case effective impact area may be calculated by assuming the aircraft approach is perpendicular to the diagonal dimension of the structure; this increases the specific impact areas by five percent.)

(7) Large military aircraft and commercial air carriers have similar dimensions and crash dynamics.

Statistical Data

Numerical values for the crash density constants and crash probabilities used in equations (2) and (3) are derived from statistical data provided in Smith (1983) and are presented in Table E-1. These values are based on a statistical analysis of two sets of air crash data compiled from several commercial and military aircraft crash studies (Smith, 1983). The data for commercial air carriers consisted of a total of 55 off-runway crashes within five miles of the end of a runway. The USAF data consisted of a total of 52 crashes within 10 nautical miles of a runway.

For the proposed PETL, the values for the crash probability density function were calculated using 1.9 miles as the distance from the runway (y) and 0.45 mile as the perpendicular distance to the center line of the runway (x).

Information on the types and number of aircraft operations per year at the AIA, excluding in-flight operations, were obtained from the City of Albuquerque Aviation Department (AIA, 1992). Numerical values were obtained for the number of aircraft landing and takeoff operations for the following aircraft categories: military, air carrier, air transport, and general aviation (Table E-2).

The data provided in Table E-2 were used to derive a value for the yearly number of takeoffs (N_T) and landings (N_L) most appropriate to the calculation of crash probabilities at the proposed PETL. Large aircraft in both the air transport and general aviation categories are expected to have similar crash dynamics and crash probabilities as air carriers; therefore, these data were summed to obtain a total value of 108,182. Similarly, for the military type operations, the number of large and high-performance aircraft was summed to obtain a total value of 17,699 operations. Finally, it also was assumed that the number of takeoffs and landings are roughly equal over a yearly period of time.

Table E-1
Numerical Values for Selected Parameters for the Impact Probability Model for the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Parameter	Military Aircraft		Commercial Air Carriers	
	Take-offs	Landings	Take-offs	Landings
Crash Density Constant:				
C(a)	0.043	0.11	0.28	0.28
d(x,a)	3.0	1.0	0.7	0.7
d(y,a)	3.0	3.0	1.4	1.4
Crash Probability Density Function:				
D(x,y,a) x = 0.45 mile y = 1.9 miles	0.0196	0.0372	0.0379	0.0379
Probability of a Crash per Operation: P(a)	1.6×10^{6}	3.1×10^{6}	0.6×10^{6}	2.3×10^{6}
Effective Skid Area				
S_K (feet)				
Typical	2,200		1,600	
Effective	1,000		900	
Wing Tip-to-Tip Dimension:				
A_W (feet)				
Average	150		140	
High-performance	40		--	
Proposed PETL Dimensions: Length x Width x Height (feet)	170 x 280 x 52			

Sources: Dekker and Associates 1992; Smith 1983.

There are, however, some uncertainties associated with the use of these data:

(1) The total number of yearly operations includes operations at runways other than the main east-west runway. All operations are assumed to involve the east-west runway. This assumption increases the calculated probability of a crash into the PETL.

(2) The estimates of numbers of various aircraft types (large, small, high performance) within each of the Federal Aviation Administration categories reflects the best professional judgment of air traffic control tower personnel and is, therefore, subject to a small degree of uncertainty (Slatt, 1990).

Table E-2
Total Takeoffs and Landings at the
Albuquerque International Airport (Calendar Year 1992)

Federal Aviation Administration Category	Aircraft Type[a]		
	Large[b]	High-Performance	Small
Air Carrier	66,344 (100%)	--	0 (0%)
Air Transport	27,115 (70%)	--	11,620 (30%)
General Aviation	14,723 (20%)	--	58,894 (80%)
TOTAL: 108,182			
Military	5,310 (18%)	12,389 (42%)	17,799 (40%)
TOTAL: 17,699			

Source: AIA, 1992.

[a] In-flight operations are not included.
[b] Values in parenthesis are the percentages of operations in each FAA category, which are Large, High-Performance, or Small.

Results

The effective impact area (Equation 3) for the proposed PETL was calculated using the statistical data provided in Tables E-1 and E-2. Then the aircraft crash probability (Equation 1) for the proposed PETL building was calculated. The results of these calculations are shown in Table E-3. These probabilities represent a reasonably conservative estimate based upon 1992 air traffic conditions. The sum of these two probabilities, 8.2×10^{-5}, represents the aircraft crash probability per year for the proposed PETL building.

Table E-3
Effective Impact Areas and Crash Probabilities for the Proposed Processing and Environmental Technology Laboratory (PETL), Sandia National Laboratories/New Mexico

Aircraft Type	Effective Impact Area (A) (square miles)	Crash Probabilities (P) (per year)
Air Carrier	0.023	6.8×10^{-5}
Military[a]	0.021	1.4×10^{-5}
Combined Aircraft Type	--	8.2×10^{-5}

[a]Values for A regarding military aircraft are a weighted average of A for high-performance aircraft and A for large military aircraft based upon the percentages given in Table E-2: 0.7 A (high-performance) + 0.3 A (Large military).

References for Appendix E

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