LA-13343-ENV

Environmental Surveillance and Compliance at Los Alamos during 1996

Los Alamos

NATIONAL LABORATORY

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APPENDIXES

Acknowledgments

The following four Laboratory organizations in the Environmental, Safety, and Health (ESH) Division perform enviromental surveillance, ensure environmental compliance, and provide environmental data for this report:

Air Quality Group
Water Quality and Hydrology Group
Hazardous and Solid Waste Group
Ecology Group

The beginning of each chapter credits all of the primary authors.

Julie Johnston (ESH-20) and Louisa Lujan-Pacheco (CIC-1) compiled this report with contributions from members of ESH Division.

Louisa Lujan-Pacheco and Mable Amador (CIC-1) edited the report.

Belinda Gutierrez (ESH-20) assembled this report and completed its layout.

Karen Lyncoln (ESH-19) provided technical review of the document.

Photo credit goes to Randy Balice for cover photograph. The front cover photo shows a purple fruit prickly pear (*Opuntia phaecantha*), flora native to the Los Alamos area.

Environmental Surveillance and Compliance at Los Alamos reports are prepared annually by the Los Alamos National Laboratory (the Laboratory), Environment, Safety, and Health Division, as required by US Department of Energy Order 5400.1, *General Environmental Protection Program*, and US Department of Energy Order 231.1, *Environment, Safety, and Health Reporting*.

These annual reports summarize environmental data that comply with applicable federal, state, and local environmental laws and regulations, executive orders, and departmental policies. Additional data, beyond the minimum required, are also gathered and reported as part of the Laboratory's efforts to ensure public safety and to monitor environmental quality at and near the Laboratory.

The environmental data are organized by environmental media (Chapter 4, air; Chapter 5, water; and Chapter 6, soils and foodstuffs) in a format to meet the needs of a general and scientific audience. Chapter 1 provides an overview of the Laboratory's major environmental programs. Chapter 2 reports the Laboratory's compliance status for 1996. Chapter 3 provides a summary of the maximum radiological dose a member of the public could have potentially received from Laboratory operations. A glossary and a list of acronyms and abbreviations are in the back of the report. Appendix A explains the standards for environmental contaminants, Appendix B explains the units of measurements used in this report, and Appendix C describes the Laboratory's technical areas and their associated programs.

We've also enclosed a booklet, *Overview of Environmental Surveillance and Compliance during 1996* that briefly explains important concepts, such as radiation, and provides a summary of the environmental programs, monitoring results, and regulatory compliance explained.

Inquiries or comments regarding these annual reports may be directed to the

US Department of Energy
Office of Environment and Projects
528 35th Street
Los Alamos, NM 87544

or

Los Alamos National Laboratory
Environment Safety and Health Division
P.O. Box 1663, MS K491
Los Alamos, NM 87544

To obtain copies of the report, contact

Julie Johnston
Ecology Group, Los Alamos National Laboratory
P.O. Box 1663, MS M887
Los Alamos, NM 87545
Telephone: (505)665-0231
e-mail: ***johnston_julie_a@lanl.gov***

This report is also available on the World Wide Web at
http://lib-www.lanl.gov./pubs/la-13343.htm

1. Environmental Programs Overview

primary authors:

Linda Anderman, Craig Eberhart, Don Krier, Julie A. Johnston, Louisa Lujan-Pacheco
Karen Lyncoln, Linda K. Malinauskas, David B. Rogers

Abstract

This report presents environmental data that characterize environmental performance and addresses compliance with environmental standards and requirements at Los Alamos National Laboratory (LANL or the Laboratory) during 1996. The Laboratory routinely monitors for radiation and for radioactive and nonradioactive materials at Laboratory sites as well as in the surrounding region. LANL uses the monitoring results to determine compliance with appropriate standards and to identify potentially undesirable trends. Data were collected in 1996 to assess external penetrating radiation; quantities of airborne emissions; and concentrations of chemicals and radionuclides in ambient air, surface waters and groundwaters, the municipal water supply, soils and sediments, and foodstuffs. Using comparisons with standards and regulations, this report concludes that environmental effects from Laboratory operations are small and do not pose a demonstrable threat to the public, Laboratory employees, or the environment. Laboratory operations were in compliance with all major environmental regulations.

A. Laboratory Overview

1. Introduction to Los Alamos National Laboratory

In March 1943, a small group of scientists came to Los Alamos for Project Y of the Manhattan Project. Their goal was to develop the world's first nuclear weapon. Although planners originally expected that the task would be completed by a hundred scientists, by 1945, when the first nuclear bomb was tested at Trinity Site in southern New Mexico, more than 3,000 civilian and military personnel were working at Los Alamos Laboratory. In 1947, Los Alamos Laboratory became Los Alamos Scientific Laboratory, which in turn became Los Alamos National Laboratory (LANL or the Laboratory) in 1981.

The Laboratory's original mission to design, develop, and test nuclear weapons has broadened and evolved as technologies, US priorities, and the world community have changed. Los Alamos National Laboratory is a multiprogram laboratory with the central mission of reducing the nuclear danger. The central mission at the Laboratory has evolved beyond nuclear weapons testing and development to include five major elements to reduce the nuclear danger:

- stockpile stewardship activities ensure that we keep safe, secure, and reliable those weapons that the nation needs;
- stockpile management projects provide capabilities ranging from the dismantlement to the recertification of existing nuclear weapons;
- nuclear materials management requires that we ensure the availability or safe disposition of plutonium, highly enriched uranium, and tritium;
- effective nonproliferation and counterproliferation technologies help us keep nuclear weapons, nuclear materials, and nuclear weapons knowledge out of the wrong hands; and
- environmental stewardship projects provide for the remediation and reduction of wastes from the nuclear weapons complex.

The Laboratory will continue its role in defense, particularly in nuclear weapons technology, and will increasingly use its multidisciplinary capabilities to solve important civilian problems (including initiatives in the areas of health, national infrastructure, energy, education, and the environment) and industrial collaborations (LANL 1996). The Laboratory is managed by the Regents of the University of California; the contract is administered through the Department of Energy (DOE) Los Alamos Area Office and the Albuquerque Operations Office.

2. Geographic Setting

The Laboratory and the associated residential areas of Los Alamos and White Rock are located in Los Alamos County, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (Figure 1-1). The 43-square mile Laboratory is situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep east-to-west oriented canyons cut by intermittent streams. Mesa tops range in elevation from approximately 7,800 feet on the flanks of the Jemez Mountains to about 6,200 feet at their eastern termination above the Rio Grande Canyon.

Most Laboratory and community developments are confined to mesa tops. The surrounding land is largely undeveloped, and large tracts of land north, west, and south of the Laboratory site are held by the Santa Fe National Forest, Bureau of Land Management, Bandelier National Monument, General Services Administration, and Los Alamos County. The Pueblo of San Ildefonso borders the Laboratory to the east.

The Laboratory is divided into technical areas (TAs) that are used for building sites, experimental areas, waste disposal locations, roads, and utility rights-of-way (see Appendix C and Figure 1-2). However, these uses account for only a small part of the total land area. Most land provides buffer areas for security and safety and is held in reserve for future use.

3. Geology and Hydrology

Most of the finger-like mesas in the Los Alamos area (Figure 1-3) are formed from Bandelier Tuff, which includes ash fall, ash fall pumice, and rhyolite tuff. The tuff is more than 1,000 feet thick in the western part of the plateau and thins to about 260 feet eastward above the Rio Grande. It was deposited as a result of major eruptions in the Jemez Mountains' volcanic center about 1.2 to 1.6 million years ago.

On the western part of the Pajarito Plateau, the Bandelier Tuff overlaps onto the Tschicoma Formation, which consists of older volcanics that form the Jemez Mountains. The tuff is underlain by the conglomerate of the Puye Formation in the central plateau and near the Rio Grande. Chino Mesa basalts interfinger with the conglomerate along the river. These formations overlie the sediments of the Santa Fe Group, which extend across the Rio Grande Valley and are more than 3,300 feet thick.

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the Laboratory site before they are depleted by evaporation, transpiration, and infiltration.

Groundwater in the Los Alamos area occurs in three modes: (1) water in shallow alluvium in canyons, (2) perched water (a body of groundwater above a less-permeable layer that is separated from the underlying main body of groundwater by an unsaturated zone), and (3) the main aquifer of the Los Alamos area.

The main aquifer of the Los Alamos area is the only aquifer in the area capable of serving as a municipal water supply. Water in the main aquifer is under artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande (Purtymun and Johansen1974). The source of recharge to the aquifer is presently uncertain. Isotopic and chemical composition of some waters from wells near the Rio Grande suggest that the source of water underlying the eastern part of the Pajarito Plateau may be the Sangre de Cristo Mountains (Blake et al., 1995). Groundwater flow along the Rio Grande rift from the north is another possible recharge source. The main aquifer discharges into the Rio Grande through springs in White Rock Canyon. The 11.5-mile reach of the river in White Rock Canyon between Otowi Bridge and the mouth of Rito de los Frijoles receives an estimated 4,300 to 5,500 acre feet annually from the aquifer.

4. Ecology and Cultural Resources

The Pajarito Plateau is a biologically diverse and archaeologically rich area. The plants and animals found on or near LANL property include approximately 500 plant species, 29 mammal species, 200 bird species, 19 reptile species, 8 amphibian species, and hundreds of insect species. Roughly 20 are designated as a threatened species, an endangered species, or a species of concern at the federal and/or state level.

Approximately 68.5% of DOE land in Los Alamos County has been surveyed for prehistoric and historic cultural resources, and about 1,400 sites have been recorded. More than 85% of the ruins date from the 14th and 15th centuries. Most of the sites are found in the piñon-juniper vegetation zone, with 80% lying between 5,800 and 7,100 feet in elevation. Almost three-quarters of all ruins are found on mesa tops.

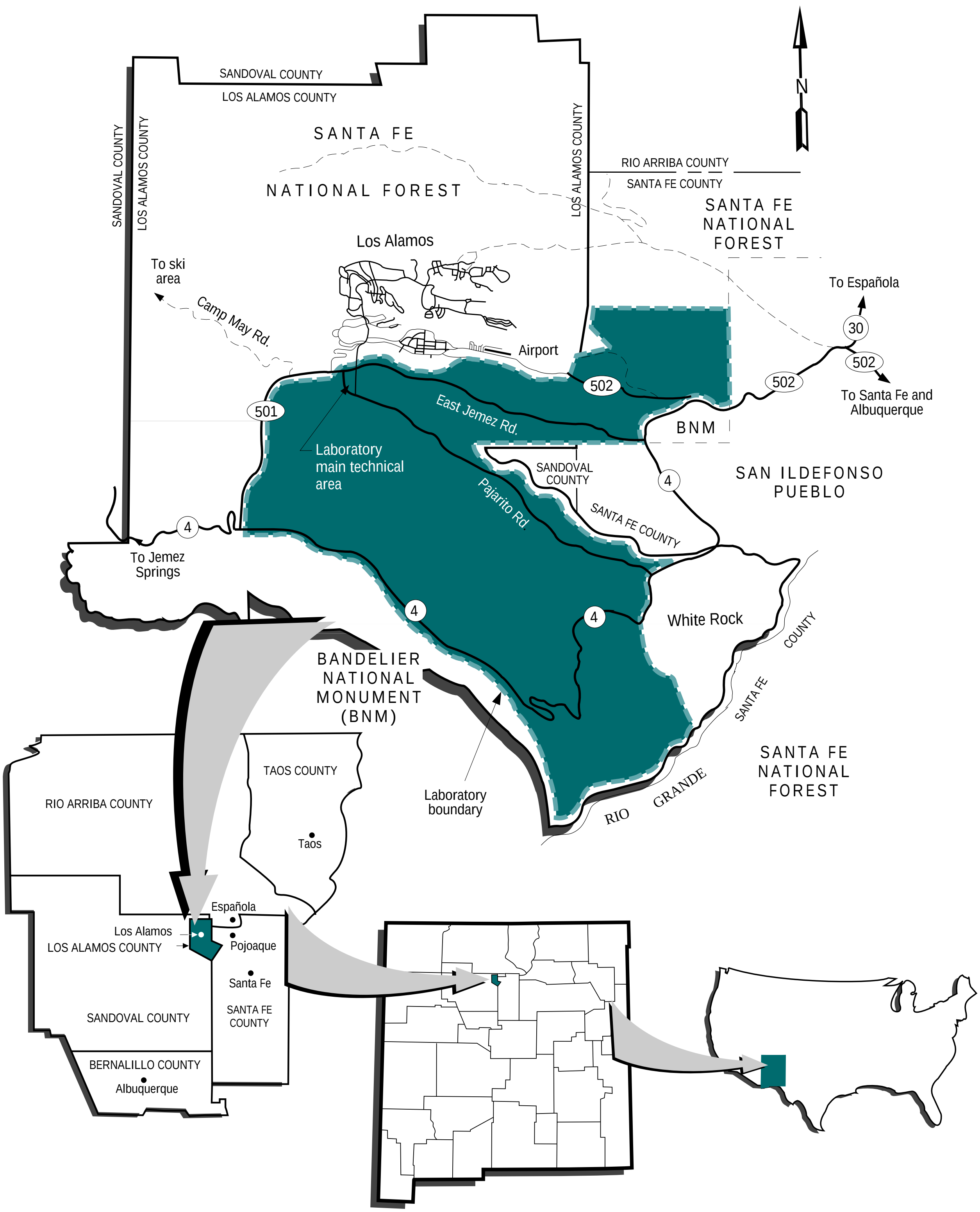

Figure 1-1. Regional location of Los Alamos National Laboratory.

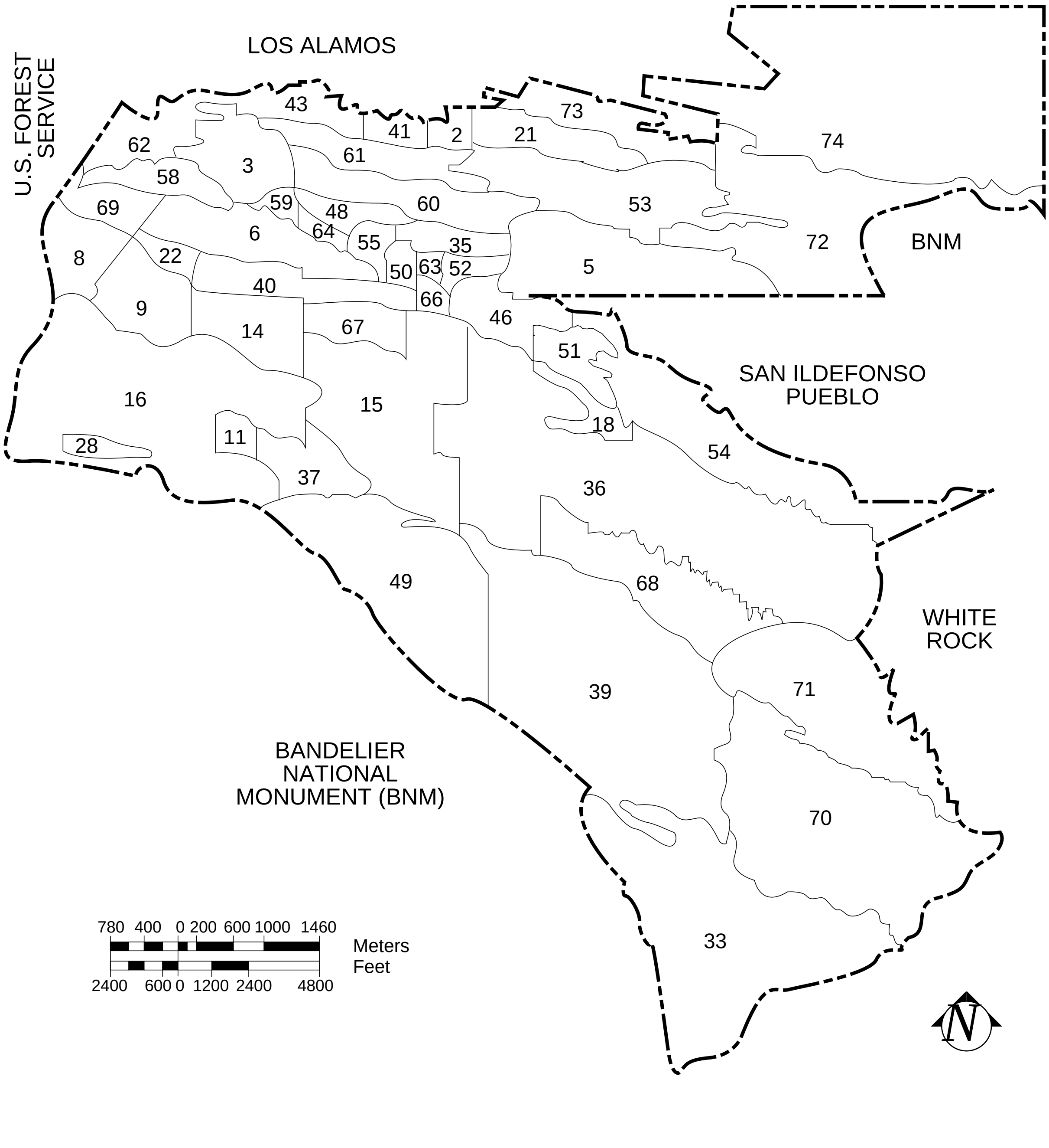

Figure 1-2. Technical areas of Los Alamos National Laboratory in relation to surrounding landholdings.

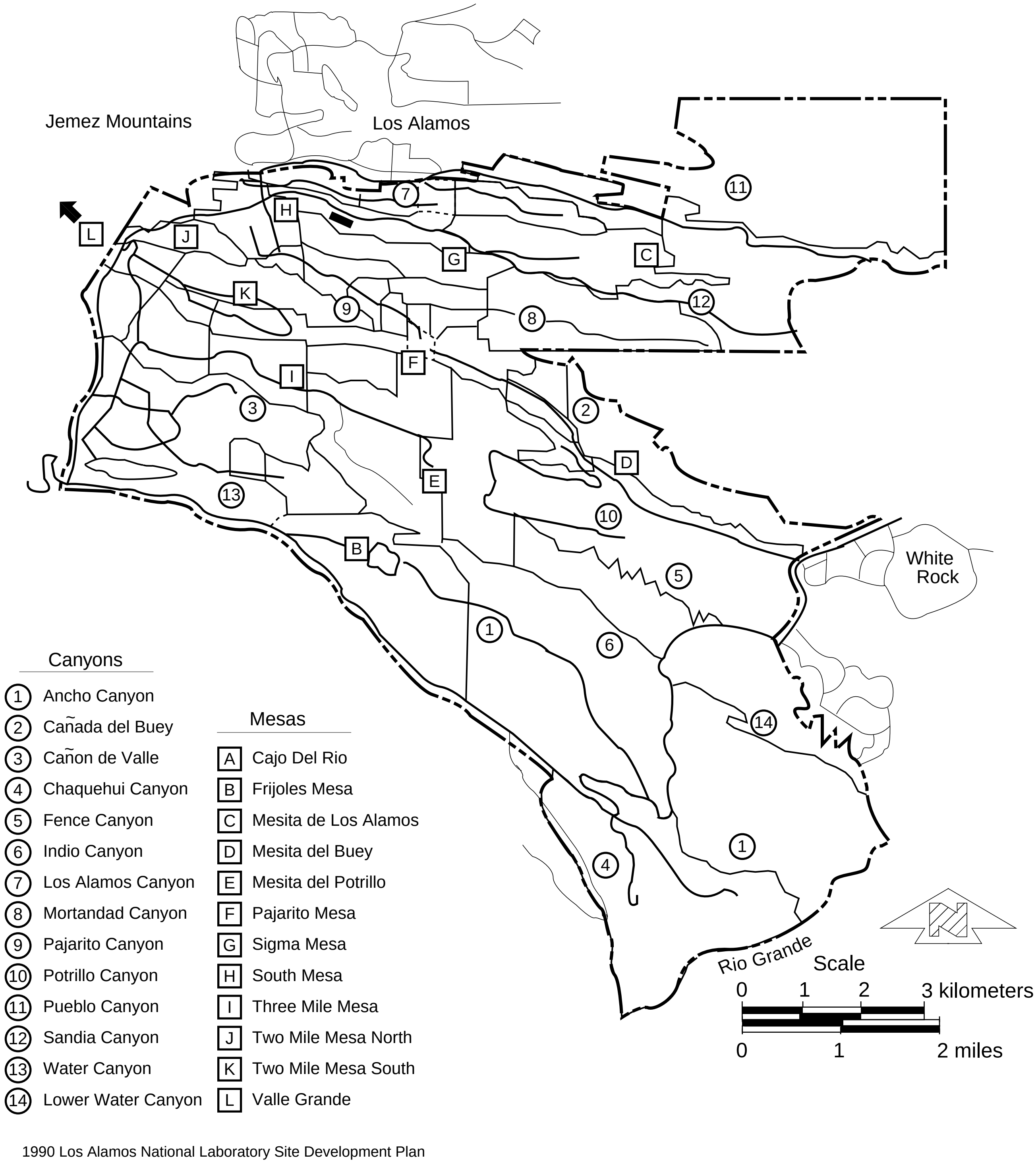

Figure 1-3. Major canyons and mesas.

B. Major Environmental Programs

1. Environmental Monitoring, Surveillance, and Compliance

The Environment, Safety, and Health (ESH) Division is in charge of performing environmental measurements and activities to help ensure that Laboratory operations do not adversely affect public health or the environment and that the Laboratory conforms with applicable environmental regulatory requirements as required by DOE Orders 5400.1 (DOE 1988) and 5400.5 (DOE 1990).

Although the Laboratory Director has primary responsibility for ESH management, ESH Division provides line managers with assistance in preparing and completing environmental documentation such as reports required by the National Environmental Policy Act (NEPA) of 1969 and the federal Resource Conservation and Recovery Act (RCRA) and its state counterpart, the New Mexico Hazardous Waste Act (HWA), as documented in Chapter 2 of this report. With assistance from the Laboratory Counsel, ESH Division helps to define and recommend Laboratory policies with regard to applicable federal and state environmental regulations and laws and DOE orders and directives. The ESH Division is responsible for communicating environmental policies to Laboratory employees and for ensuring that appropriate environmental training programs are available. Four groups in ESH Division—Air Quality (ESH-17), Water Quality and Hydrology (ESH-18), Hazardous and Solid Waste (ESH-19), and Ecology (ESH-20)—initiate and promote Laboratory programs for environmental assessment and are responsible for environmental surveillance and regulatory compliance.

Environmental measurements taken by these four groups are generally organized into two categories:

- Off-site locations include regional and perimeter stations.

  Regional stations are located within the five counties surrounding Los Alamos County (Figure 1-1) at distances up to 70 miles from the Laboratory.

  Perimeter stations are located within 2.5 miles of the Laboratory boundary, and many are in residential and community areas.

- On-site stations are within the Laboratory boundary, and many are in areas accessible only to employees during normal working hours.

More than 450 sampling locations are used for routine environmental monitoring. The general location of monitoring stations is presented in maps in the text of this report. Each year, approximately 200,000 analyses for chemical and radiochemical constituents are performed on more than 11,000 environmental samples. Samples of air particles and gases, water, soils, sediments, and foodstuffs are routinely collected at the monitoring stations and then analyzed. The results of these analyses help identify impacts of LANL operations on the environment. Additional samples are collected and analyzed to obtain information about particular events, such as major surface water runoff events, nonroutine releases, or special studies. Methods and procedures for acquiring, analyzing, and recording data are presented later in this document in Chapters 2, 3, 4, 5, and 6. Comprehensive information about environmental standards is presented in Appendix A.

a. Air Quality. ESH-17 personnel assist Laboratory organizations in their efforts to comply with federal and state air quality regulations. ESH-17 personnel report on the Laboratory's compliance with the air quality standards and regulations discussed in Chapter 2, including an overview of the status of National Emission Standards for Hazardous Air Pollutants (NESHAP) Federal Facility Compliance Agreement (FFCA). Various environmental surveillance programs are conducted to evaluate the potential impact of Laboratory emissions on the local environment and public health. These programs include measuring direct penetrating radiation, meteorological conditions, and stack emissions and sampling for ambient air contaminants. Chapter 4 contains a detailed exploration of the methodologies and results of the ESH-17 air monitoring and surveillance program for 1996, including trends from previous years. Personnel from ESH-17 monitor meteorological conditions to assess the transport of contaminants in airborne emissions to the environment and to aid in forecasting local weather conditions; Chapter 4 summarizes meteorological conditions during 1996 and provides a climatological overview of the Pajarito Plateau.

b. Dose Assessment. ESH-17 personnel are responsible for the radiation dose assessment that is presented in Chapter 3, including the methodology and assessments for specific pathways to the public and the environment; an analysis of the potential doses to the public and the environment is also included in Chapters 3, 4, 5, and 6.

c. Water Quality and Hydrology. Personnel from ESH-18 are responsible for providing environmental monitoring and activities to demonstrate regulatory compliance and to help ensure that Laboratory operations do not adversely affect public health or the environment.

ESH-18 provides technical and regulatory support to operating groups to achieve compliance with the following major state and federal regulations: Clean Water Act National Pollutant Discharge Elimination System (NPDES) outfall, storm water, spill control, and dredge and fill regulations; Safe Drinking Water Act and New Mexico Drinking Water Regulations; New Mexico Water Quality Control Commission Regulations; Federal Insecticide, Fungicide, and Rodenticide Act; and New Mexico Pesticide Control Act. Surveillance programs and activities include: groundwater, surface water, and sediments monitoring; water supply reporting for Los Alamos County; and the Groundwater Protection Management Program. Chapter 2 contains documentation on the Laboratory's compliance status with water quality regulations and includes an update of the NPDES FFCA. Chapter 5 presents the data analyzed by ESH-18 personnel from surveillance monitoring.

d. Hazardous and Solid Waste. ESH-19 personnel provide services in developing and monitoring permits under hazardous and solid waste rules, RCRA/HWA, Solid Waste Act (SWA), and letters of authorization for landfilling polychlorinated biphenyl (PCB) solids contaminated with radionuclides under the Toxic Substances Control Act (TSCA); providing technical support, regulatory interpretation, and Laboratory policy on hazardous, toxic, and solid waste issues and underground storage tank regulations to Laboratory customers; and documenting conditions at past waste sites. The Laboratory's compliance status with hazardous and solid waste regulations is presented in Chapter 2, including updates on the status of federal facility compliance agreements and orders on mixed waste and storage of radioactively contaminated PCB wastes.

e. Ecology. Personnel in ESH-20 investigate and document biological and cultural resources within the Laboratory boundaries; prepare environmental reports, including Environmental Assessments required under NEPA; and monitor the environmental impact of Laboratory operations on soil and foodstuffs. Chapter 2 documents the 1996 work in the areas of NEPA reviews and biological and archaeological reviews of proposed projects at the Laboratory. Chapter 6 contains information on the results of the soil, foodstuff, and biological monitoring programs at the Laboratory.

2. Overview of Environmental Quality Assurance Programs

Quality is the extent to which an item or activity meets or exceeds requirements. Quality assurance (QA) includes all the planned and systematic actions and activities necessary to provide adequate confidence that a facility, structure, system, component, or process will perform satisfactorily. The Quality Assurance Support Group (ESH-14) provides support for QA functions at the Laboratory. ESH-14 personnel perform QA and quality control audits and surveillance of Laboratory and subcontractor activities in accordance with the Quality Assurance Plan (QAP) for the Laboratory and for specific activities, as requested. The Laboratory's Internal Assessment Group (AA-2) manages an independent environmental appraisal and auditing program that verifies appropriate implementation of environmental requirements. The Quality and Planning Program Office provides management and coordination of the effort to become a customer-focused, unified Laboratory.

Each monitoring activity sponsored by the ESH Division has its own QAP or operating procedure. These plans and procedures are unique to activities but are guided by the need to establish policies, requirements, and guidelines for the effective implementation of regulatory requirements and to meet the requirements of DOE Orders 5400.1 (DOE 1988), 5400.5 (DOE 1990), and 5700.6C (DOE 1991). Each QAP must address the criteria for management, performance, and assessments. Monitoring activities for each environmental program performed by groups in ESH Division have been included in the current Environmental Monitoring Plan (EARE 1995).

3. Waste Management Program

Waste management activities are focused on minimizing the adverse effects of radioactive wastes on the environment, maintaining compliance with regulations and permits, and ensuring that wastes are managed safely. The Chemical Sciences and Technology (CST) Division at the Laboratory had responsibility for waste management activities until the latter part of 1996, when the Environmental Management Solid Waste Office took over these responsibilities.

1. Environmental Programs Overview

Wastes generated at the Laboratory are divided into categories based on the radioactive and chemical content. No high-level radioactive wastes are generated at the Laboratory. Major categories of waste managed at the Laboratory are presented below:

Low-Level Radioactive Waste. Low-level radioactive waste (LLW) at the Laboratory consists of solid waste or wastewater contaminated with radioactive materials, including plutonium, americium, uranium, or tritium from weapons design and test work; tracer and medical isotopes from scientific studies; mixed fission materials from nuclear energy work; and activation products from physics experiments. (Activation products are formed when a substance is struck by protons or neutrons. The atoms of the original substance are converted to another element that is unstable and, therefore, radioactive.)

LLW can include items such as equipment, paper, rags, radiation protective clothing, demolition debris from decontamination and decommissioning activities, and contaminated soils and debris from environmental cleanup activities. LLW managed at the Laboratory may require special handling and shielding to protect workers and the public. Most LLW generated at the Laboratory is disposed of on-site in pits and shafts designed and engineered for this purpose within TA-54, Area G.

Transuranic Waste. Transuranic (TRU) waste consists of rags, equipment, solidified wastewater treatment sludge, paper, and protective clothing that contain radioactive elements with atomic numbers greater than 92 and activities greater than 100 nCi/g. Radioactive contaminants at the Laboratory, such as plutonium and americium, have long half-lives.

Mixed Waste. Mixed waste contains LLW or TRU constituents mixed with nonradioactive hazardous waste regulated by RCRA. Low-level mixed waste (LLMW) at the Laboratory includes gases, liquids, and solids, such as gas cylinders of hydrogen with a tracer radioactive isotope; contaminated solvents and oils; spent solutions from electroplating operations; contaminated lead shielding; contaminated soils; or solid chemicals that react violently with water. Solid and liquid LLMW is stored on-site pending the availability of off-site DOE or commercial treatment or the development of technologies to treat those wastes that cannot be treated off-site. Currently, LANL plans to treat some limited quantities of newly generated LLMW at the generator's sites in order to reduce costs. No technology development is planned at this time to manage these wastes.

TRU mixed wastes at the Laboratory are solids. The major hazardous component is solvent contamination or the presence of heavy metals like cadmium or lead.

Hazardous Waste. Hazardous wastes are defined by regulations under RCRA and the HWA. (The State of New Mexico is authorized by the EPA to implement RCRA.) Hazardous wastes at the Laboratory include gases, liquids, and solids such as compressed gas cylinders containing combustible gases; acids, bases, and solvents; out-of-date laboratory chemicals; and lead bricks. At present, no disposal facility for hazardous wastes exists at the Laboratory. However, treatability studies, research development, and decommissioning projects are conducted. Hazardous wastes are shipped off-site for further treatment and disposal to facilities in accordance with RCRA/HWA requirements.

Nonhazardous Special Waste. Nonhazardous special waste is waste that does not fall under the technical definition of hazardous waste but still requires special handling. The SWA and other regulations, such as NESHAP, apply to some of these wastes, which include asbestos, infectious wastes, oils, coolants, and other materials that are controlled for reasons of health, safety, or security.

Today, DOE and the Laboratory conduct business in an atmosphere of sharply declining budgets and increasing public scrutiny, which mandate that operations become both more cost effective and environmentally sensitive. Incorporation of waste minimization methodologies into the daily conduct of operations can provide significant returns by avoiding waste management costs, both for the waste generating programs and the Laboratory Waste Management (WM) Program, as well as increases in employee productivity. Pollution prevention is an essential element of the LANL WM Program.

The Laboratory's Environmental Stewardship Office coordinates the integrated Laboratory pollution prevention program. Specific reductions in the generation rates of wastes and the amount of source material reduction and recycling are provided in Chapter 2.B.1.g. Other waste management activities that reduced waste generation include the following:

- continuation of financial incentives for waste reduction and innovative pollution prevention ideas,

- development of databases and automated procedures for purchases that could minimize waste or use recycled materials, and
- provision of pollution prevention expertise to Laboratory organizations in construction projects, site remediation, and decontamination and decommissioning projects.

The following list includes specific Laboratory research and development of new pollution prevention technologies in 1996:

- The Laboratory experimented with water soluble polymers that can extract metals from solution, and separate metal-laden polymers from the rest of the solution by ultrafilration for metal recycle and polymer reuse. The Laboratory is exploring the use of these polymers in various processes, including extracting radioactive metals like americium and plutonium from nuclear power reactor cooling water, extracting mercury from decontamination and decommissioning waste, extracting metals from mining and mineral processing wastes, extracting silver from photographic waste, and extracting metals from electroplating wastewaters.
- The Laboratory teamed with an industrial partner to develop small, portable, high-temperature superconducting systems in magnetic separators that can allow for the remediation of actinide-contaminated soils and liquids generated at facilities throughout the DOE complex. This technology reduces the amount of secondary waste generated by allowing the soils to be treated on-site.
- The Laboratory used a nonthermal plasma to successfully break down volatile organic compounds. The technology breaks down organic compounds into nonhazardous substances, such as carbon dioxide, water, and acids that can be neutralized. Many commonly used conventional waste treatment methods, such as incineration or carbon filtration, create secondary waste streams that are often as difficult to treat as the original contamination.
- The Laboratory developed a noninvasive chemical concentration analyzer to determine the concentrations of chemicals contained inside a pipe or small tank by using Fourier transform analysis of high-frequency acoustic signals from ultrasonic sensors. This noninvasive analysis technique greatly reduces worker risk, eliminates the need for sample preparation, and avoids secondary waste generation.
- The Laboratory is participating in a team effort to develop plasma source ion implantation. This technology has the potential to extend the useful life of manufacturing tools, such as draw dies for injection molding, metal punches, and stamping dies.

4. Environmental Restoration Project

The Environmental Restoration (ER) Project within the DOE Office of Environmental Management is responsible for assessing, cleaning up, decontaminating, and decommissioning sites at DOE facilities and sites formerly used by DOE. The objectives of the ER Project at the Laboratory meet the goals of environmental management and augment the Laboratory's environmental surveillance program by identifying and characterizing potential threats to human health and the environment from past Laboratory operations and by mitigating those threats through corrective actions that comply with applicable environmental regulations. The project is also responsible for decontaminating and decommissioning surplus facilities at the Laboratory. Corrective actions may include source containment to prevent contaminant migration, controls on future land use, and excavation and/or treatment of the source to remove or, at a minimum, reduce chemical and/or radiological hazards to acceptable human health and environmental levels.

The ER Project at the Laboratory responds to two primary laws: RCRA, which is the statutory basis for the ER Project at the Laboratory, and the Comprehensive Environmental Response, Compensation, and Liability Act, which offers a reference for remediating sites at the Laboratory that contain certain hazardous substances not covered by RCRA. The Hazardous and Solid Waste Amendments (HSWA) to RCRA mandate that certain facilities, including the Laboratory, that store, treat, and dispose of hazardous wastes operate under a formal permit system. The corrective action provisions of the RCRA permit are contained in Module VIII of the Laboratory's Hazardous Waste Permit. The Environmental Protection Agency and the New Mexico Environment Department (NMED) regulate the Laboratory's corrective action program under RCRA. The DOE has oversight for those sites not subject to RCRA and for the decommissioning program.

A summary of ER Project activities completed in 1996 is presented in Section 2.B.1.i of this report.

C. Community Involvement

The Laboratory continues to encourage public access to information about environmental conditions and the environmental impact of operations at the Laboratory. Although the Community Involvement Office (CIO) has a responsibility to help coordinate activities between the Laboratory and northern New Mexico, many organizations at the Laboratory are active in working with the public. Frequently, the subject of these interactions are related to environmental issues because of concerns regarding the Laboratory's potential impact on local safety, health, and the environment.

Some examples of how the Laboratory distributes and makes environmental information available to the public are listed below:

Public Meetings

DOE is required to have public meetings and comment periods when it undertakes an activity that could have a significant impact on the environment. It is the Laboratory's responsibility to assist DOE in activities that relate to the LANL site. During 1996, the Laboratory assisted DOE in its work on the Site-Wide Environmental Impact Statement, on meetings on Transportation and Hazardous Materials Response, and on a meeting for Highly Enriched Uranium Vulnerability Assessment. Additionally, the Laboratory held other meetings as appropriate to address the publics' environmental concerns.

Outreach Centers

CIO opened an outreach center in Española in April 1996. The new center complements the two other outreach centers located in Los Alamos and Taos. These centers are prime repositories for environmental information. During 1996, the centers jointly served an average of 250 visitors a month, many of whom were interested in obtaining information about the environmental impact of Laboratory operations.

Speakers Bureau and Tours

Laboratory personnel make presentations to a variety of audiences on a variety of topics including environmental restoration, waste management, and human health. During 1996, approximately 1,000 citizens heard presentations on environmental topics, which were arranged by the Speakers Bureau. The CIO also helps coordinate tours of environmental interest.

Tribal Interactions

In 1996, the Laboratory signed a tribal cooperative agreement with Santa Clara Pueblo. Similar to the three agreements previously signed with Cochiti Pueblo, Jemez Pueblo, and the Pueblo of San Ildefonso, the Santa Clara agreement describes the Laboratory's intent to work with the Pueblos on environment, safety, and health issues, including providing help in evaluating potential impacts and providing technical expertise to the Pueblos.

Bradbury Science Museum

Because many of the Laboratory's facilities are closed to the public, the Bradbury Science Museum provides a way for the public to learn about the kinds of work the Laboratory does, whether it is tracking the path taken by an earth-orbiting satellite or investigating possible options for disposing of the plutonium taken from dismantled nuclear weapons. In 1996, the museum hosted more than 114,000 visitors.

The World Wide Web

In response to the ever-growing interest in using electronic communications media, the Laboratory has made information available on the World Wide Web. Pages are available to the community through *http://www.lanl.gov/Public/Community/Welcome.html* or through *http://www.lanl.gov/community/*, a page maintained by CIO. Search engines for Laboratory environmental information (as well as for other topics) are available through *http://www/lanl.gov/searches/*.

Inquiries

In 1996, CIO—with the assistance of a wide variety of Laboratory organizations—responded to 351 public inquiries, many of which had an environmental theme. These inquiries came to CIO by letter, phone, fax, e-mail, and personal visits. Addresses and phone/fax numbers for the various CIO facilities are listed below:

Community Involvement & Outreach Office
Los Alamos National Laboratory
P. O. Box 1663, Mail Stop A117
Los Alamos, NM 87545

Phone: (505) 665-4400 or 1-800-508-4400;
Fax: (505) 665-4411
cio@lanl.gov

Española Outreach Center
1002 N. Oñate
Española, NM 87532

Phone: (505) 753-3682; Fax: (505) 753-4679

Los Alamos Outreach Center
1350 Central, Suite 101
Los Alamos, NM 87544

Phone: (505) 665-2127 or 1-800-985-7232;
Fax: (505) 667-3111

Taos Outreach Center
630 Paseo del Pueblo Sur
Taos, NM 87571

Phone: (505) 751-3405; Fax: (505) 751-7150

Bradbury Science Museum
1350 Central Avenue
Los Alamos, NM 87544

Phone: (505) 667-4444; Fax: (505) 665-6932

D. Assessment Programs

1. Overview of University of California/ Department of Energy Performance Assessment Program

During 1996, the Laboratory was evaluated by the University of California and DOE based on mutually negotiated performance measures. The performance measure rating periods are from July to June. The environmental components of these performance measures include the following categories:

- radiation protection of workers;
- radiation protection of the public;
- release incidents;
- toxic chemical releases;
- permit exceedances;
- environmental violations, fines, and penalties;
- status of regulatory commitments and milestones; and
- waste minimization and pollution prevention.

Specific information on the categories and the assessment scoring can be obtained on the World Wide Web at *http://labs.ucop.edu/library.html*.

2. Department of Energy Audits and Assessments

The DOE Headquarters and Albuquerque Operations Office conducted three appraisals of the ESH Division environmental programs during 1996.

The DOE Office of Oversight, Environment, Safety, and Health, prepared a "Profile of Los Alamos National Laboratory" following an on-site comprehensive inspection appraisal that was conducted September 30 to October 11, 1996. The purpose of this evaluation was to determine how effectively DOE and Laboratory line management have implemented safety management and environment, safety, and health programs. Numerous aspects of ESH were evaluated, including portions of the environmental programs. The environmental programs covered by external regulations were determined to be effective. The Laboratory's profile can be accessed through the World Wide Web at *http://WWW.tis.eh.doe.gov/web/eh2/profiles/prof-lansp.html*.

The second assessment was the Independent Air Quality Compliance appraisal that was conducted October 30 to November 1, 1996. This assessment was specifically required by the NESHAP FFCA. The scope of the assessment included the program management used by ESH-17 for the Radioactive NESHAP FFCA. There were no findings, but the report did make eight recommendations, including roles and responsibilities of LANL-wide management toward the FFCA; complexity, reviews, and training of operating procedures; compliance with Laboratory standards; and a regulatory and public communications program.

The DOE Albuquerque Field Office prepares an annual update to the Pilot Assessment Matrix, DOE Albuquerque's overall evaluation of LANL ESH performance. The DOE Pilot Assessment Report can be obtained through the World Wide Web at *http://sw2aa.lanl.gov/pocs/verbage.htm#2*. Additional information on DOE audits and assessments of LANL ESH programs is found through the DOE Home Page on the World Wide Web.

3. Cooperative and Independent Monitoring

DOE and the Laboratory have signed agreements with the State of New Mexico and four surrounding Pueblos that enable independent environmental monitoring at and near the Laboratory. The main agreements are the following:

- **Agreement-In-Principle** between DOE and the State of New Mexico.
- **Accords** between the individual Pueblos of San Ildefonso, Cochiti, Jemez, and Santa Clara and DOE.
- **Cooperative Agreements** between the individual Pueblos of San Ildefonso, Cochiti, Jemez, and

Santa Clara and the University of California, as operator of the Los Alamos National Laboratory.

The main purposes of these agreements are to build more open and participatory relationships, to improve communications, and to cooperate on issues of mutual concern. For monitoring, the agreements have allowed access to monitoring locations and encouraged cooperative sampling activities. Improved data sharing and communications on technical subjects are occurring. The agreements also provide frameworks for grant support that allow development of independent monitoring programs such as that of the NMED's DOE Oversight Bureau (see Section 2.C.2 for more information). NMED regularly holds public meetings and publishes reports on their independent assessments of environmental quality at LANL.

In addition, environmental monitoring at and near the Laboratory involves other federal agencies such as the Defense Nuclear Facilities Safety Board, the Agency for Toxic Substances and Disease Registry, the Bureau of Indian Affairs, and the US Geological Survey.

At a level closer to the public, community groups have been working with the Laboratory and NMED in establishing the Neighborhood Environmental Watch Network (NEWNET) consisting of radiological monitors, some of which are managed by interested community individuals. Data from NEWNET monitors are recorded every fifteen minutes and can be accessed by anyone using the Internet.

F. References

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2. Compliance Summary

primary authors:

Gian Bacigalupa, Bob Beers, Jeff Carmichael, Jean Dewart, Craig F. Eberhart, Roger Ferenbaugh, Timothy Haarmann, David Jardine, Julie Johnston, Beverly Larson, Karen Lyncoln, Leland R. Maez, Linda K. Malinauskas, Suzanne Moore-Mayne, Mary Mullen, David Rogers, Michael Saladen, Paul Schumann, Pat Shanley, Holly Wheeler-Benson

Highlights from 1996

Los Alamos National Laboratory (LANL or the Laboratory) staff had frequent interactions during 1996 with regulatory personnel regarding Resource Conservation and Recovery Act and New Mexico Hazardous Waste Act requirements and compliance activities. On October 4, 1995, the State of New Mexico issued the Federal Facility Compliance Order to both the Department of Energy (DOE) and the University of California requiring compliance with the Site Treatment Plan. This terminated the Federal Facility Compliance Agreement for the storage of mixed waste generated at the Laboratory that had previously been in effect.

Laboratory operations were in compliance with all federal and state nonradiological air quality requirements. Radioactive emissions generated at the Laboratory during 1996 were in compliance with the Environmental Protection Agency's (EPA's) effective dose equivalent (EDE) limitation of less than 10 mrem/yr to members of the public from airborne emissions. The EDE is calculated to be 1.93 mrem using EPA-approved methods. During 1996, the terms of the National Emission Standards for Hazardous Air Pollutants (NESHAP) Federal Facility Compliance Agreement were met, and full compliance with the radionuclide NESHAP was achieved at LANL. In April 1996, the US District Court for the District of New Mexico issued a partial summary judgment against DOE and the Laboratory Director and directed them to attempt to reach an agreement with the Concerned Citizens for Nuclear Safety concerning their lawsuit filed under the Clean Air Act.

In 1996, the Laboratory was in compliance with its on-site liquid discharge requirements in 98.8% of the samples from its sanitary effluent outfalls and in 97.9% of the samples from its industrial effluent outfalls. Concentrations of chemical, microbiological, and radioactive constituents in the drinking water distribution system remained within federal and state drinking water supply standards.

All applicable Laboratory projects were reviewed for compliance with the National Environmental Policy Act (NEPA). Laboratory staff reviewed 272 proposed projects and in 1996 sent 42 DOE Environmental Checklists and 122 NEPA Review Forms to DOE. In addition, Laboratory archaeologists evaluated 947 proposed actions for possible effects on cultural resources, which required 31 intensive field surveys. Laboratory biologists reviewed more than 500 proposed actions for potential impacts to threatened and endangered species; over 80 of the actions required additional study.

To Read About . . . **Turn to Page . . .**

2. Compliance Summary

A. Introduction

Many activities and operations at Los Alamos National Laboratory (LANL or the Laboratory) involve or produce liquids, solids, and gases that contain radioactive and/or nonradioactive hazardous materials. Laboratory policy implements Department of Energy (DOE) requirements by directing its employees to protect the environment and meet compliance requirements of applicable federal and state environmental protection regulations.

Federal and state environmental laws address handling, transport, release, and disposal of contaminants, pollutants, and wastes, as well as protection of ecological, archaeological, historic, atmospheric, soil, and water resources. Regulations provide specific requirements and standards to ensure maintenance of environmental qualities. The Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED) are the principal administrative authorities for these laws. DOE and its contractors are also subject to DOE-administered requirements regarding control of radionuclides. The environmental permits issued by these organizations and the specific operations and/or sites affected are presented in Table 2-1.

B. Compliance Status

1. Resource Conservation and Recovery Act

a. Introduction. The Laboratory produces a wide variety of hazardous wastes, most of which are produced in small quantities relative to industrial facilities of comparable size. The Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, creates a comprehensive program to regulate hazardous wastes, from generation to ultimate disposal. The HSWA emphasize reducing the volume and toxicity of hazardous waste. Regulation 40 Code of Federal Regulations [CFR] 268 requires treatment of hazardous waste before land disposal.

EPA or an authorized state issues RCRA permits to specifically regulate the storage, treatment, or disposal of hazardous waste and the hazardous component of radioactive mixed waste that is stored, treated, or disposed of on-site. A RCRA Part A permit application identifies (1) facility location, (2) owner and operator, (3) hazardous or mixed wastes to be managed, and (4) hazardous waste management methods and units. A facility that has submitted a RCRA Part A permit application for an existing unit is allowed to manage hazardous or mixed wastes under transitional regulations known as the Interim Status Requirements pending issuance (or denial) of a RCRA Hazardous Waste Facility Permit. (Note: The term unit as it is used in this section refers to RCRA hazardous waste management areas). The RCRA Part B permit application consists of a detailed narrative description of all facilities and procedures related to hazardous or mixed waste management. The DOE and the University of California (UC) were issued a Hazardous Waste Facility Permit on November 8, 1989, from the State of New Mexico.

The operations at technical areas (TA) 50, 54, and 16, which are included in the RCRA Hazardous Waste Facility Permit, are due to be renewed. The 10-year permit expires in November 1999, and the Laboratory must submit the application for renewal six months in advance. Work on the renewal application will begin during fiscal year (FY) 1998.

The Hazardous and Solid Waste Group (ESH-19) submitted permit applications during 1996 to support compliance-related activities, to continue converting existing mixed waste management units to RCRA-permitted status, and to obtain new unit permits for ongoing project expansions. ESH-19 submitted permit applications and modifications to NMED using the permitting approach proposed in 1995 under which NMED intends to issue permits for the individual TAs where hazardous or mixed waste management activities are conducted.

LANL proposed that this process could be facilitated by the availability of a LANL General Part B Information submittal, subject to approval by NMED. The General Part B contains facility-wide information and procedures such as the contingency plan, training plan, and inspection plan. Its purpose is to provide common references for Laboratory documents that can be incorporated into permit modification packages without requiring repetitive NMED reviews. A proposed General Part B application was submitted to the Hazardous and Radioactive Materials Bureau of NMED in August 1996.

The Laboratory made progress on permit modifications necessary to meet compliance conditions in 1996. ESH-19 submitted an application to NMED for the retrieval of mixed transuranic (TRU) waste at TA-54, Area G, Pads 1, 2, and 4, and for related storage at Domes 229, 230, 231, and 232 pursuant to the December 10, 1993, Consent Agreement for Compliance Orders New Mexico Hazardous Waste Act (HWA) 93-01, 93-02, 93-03, and 93-04. This application was reviewed by NMED with subsequent infor-

Table 2-1. Environmental Permits or Approvals under which the Laboratory Operated in 1996

Category/Agency	Approved Activity	Issue Date	Expiration Date	Administering
RCRA Hazardous Waste Facility	Hazardous and mixed waste storage, and treatment permit	November 1989	November 1999	NMED
	RCRA mixed waste	Part A application submitted January 1991		NMED
		Revised Part A application submitted October 1993		NMED
HSWA	RCRA Corrective Activities	March 1990	December 1999	NMED
Polychlorinated biphenyls/TSCA[a]	Disposal of PCBs at TA-54, Area G	June 25, 1996	None	EPA
NPDES[b], Los Alamos	Discharge of industrial and sanitary liquid effluents	August 1, 1994	October 31, 1998	EPA
	Storm water associated with industrial activity	September 29, 1992	September 9, 1997	EPA
NPDES, Fenton Hill	Discharge of industrial liquid effluents	October 15, 1979	June 30, 1983[c]	EPA
Groundwater discharge plan, Fenton Hill	Discharge to groundwater	June 5, 1995	June 5, 2000	NMOCD[d]
Groundwater discharge plan, TA-46 SWSC Plant[e]	Discharge to groundwater	July 20, 1992	July 20, 1997	NMED
Groundwater discharge plan, Sanitary Sewage Sludge Land Application	Land application of dry sanitary sewage sludge	June 30, 1995	June 30, 2000	NMED
Groundwater discharge plan, TA-50, Radioactive Liquid Waste Treatment Facility	Discharge to groundwater	Approval pending		NMED
Air Quality (NESHAP)[f]	Construction and operation of four beryllium facilities	December 26, 1985; March 19, 1986; September 8, 1987; April 26, 1989	None	NMED

Table 2-1. Environmental Permits or Approvals under which the Laboratory Operated in 1996 (Cont.)

Category/Agency	Approved Activity	Issue Date	Expiration Date	Administering
Open Burning (20 NMAC[g] 2.60)	Burning of jet fuel and wood for ordance testing, TA-11	September 22, 1995 October 2, 1996	September 22, 1996 January 31, 1997	NMED NMED
Open Burning (20 NMAC 2.60)	Burning of HE-contaminated[h] materials, TA-14	January 9, 1996	December 20, 1996	NMED
Open Burning (20 NMAC 2.60)	Burning of HE-contaminated materials, TA-16	April 4, 1996	May 10, 1997	NMED
Open Burning (20 NMAC 2.60)	Burning of scrap wood from experiments, TA-36	October 22, 1996 November 1995	April 3, 1997 April 1996	NMED NMED
Open Burning (20 NMAC 2.60)	Fuel Fire Burn-Propane TA-16, Site 1409	October 3, 1996	April 3, 1997	NMED
Open Burning (20 NMAC 2.60)	Prescribed Open Burning TA-15, TA-16	October 3, 1996	December 31, 1996	NMED
Open Burning (20 NMAC 2.60)	Burning of HE-contaminated Materials, TA-31	August 10, 1995	August 10, 1996	NMED

[a]Toxic Substances Control Act.
[b]National Pollutant Discharge Elimination System.
[c]Permit administratively extended.
[d]New Mexico Oil Conservation Division.
[e]SanitaryWastewater System Consolidation.
[f]National Emission Standards for Hazardous Air Pollutants.
[g]New Mexico Administrative Code.
[h]High explosive.

mation requests. A suggested text revision package was sent to NMED in January 1996. LANL had not received an approval response by the end of 1996. Temporary waste storage areas for waste characterization activities in support of this project also went through this process in 1996. A new permit application was submitted in December 1996 for the TA-50 Radioactive Materials Research, Operations, and Demonstration Facility, a similar temporary storage area for a waste characterization project. A permit modification to allow mixed waste treatment residuals for wastes generated at LANL to be allowed back onto the LANL facility, if necessary for treatment, was submitted to NMED in November 1996 to support Site Treatment Plan (STP) requirements.

The Laboratory submitted permit modifications to NMED for existing hazardous and mixed waste management facilities. These included permit applications for the TA-55, Buildings 4 and 185 container storage areas and the TA-55-4 Cementation Unit submitted in June 1996, and for TA-14, 15, 36, and 39 Thermal Treatment Units, submitted in September 1996. A permit application for two mixed waste container storage areas in TA-3, Building 29, was also prepared in 1996.

One new RCRA Research, Development, and Demonstration permit application was submitted for NMED review. The application was for the proposed LANL Electrochemical Treatment Unit and was submitted September 6, 1996. The research objective of the work to be conducted under this permit was to experimentally define waste streams amenable for an electrochemical treatment process developed at LANL, to determine treatment conditions for these waste streams, and to assess the feasibility of processing batch waste quantities larger than allowed under RCRA treatability studies.

NMED requested a revision for TRU mixed waste characterization to the LANL hazardous waste analysis plan as a condition for approval of the Transuranic Waste Inspectable Storage Project (TWISP). The revised TRU mixed waste analysis plan was submitted to NMED on March 31, 1995. NMED issued a notice of deficiency (NOD) on May 24, 1996, requesting more information on specific waste characterization and certification procedures, which were provided by the Laboratory on July 12, 1996.

b. Resource Conservation and Recovery Act Closure Activities. Closure plans for three units were reviewed by NMED and implemented by LANL in 1996. A closure plan for an indoor and outdoor container storage area at TA-21, Building 61, was submitted to NMED in March 1996. Requests for further information were received from NMED for the closure of the TA-55 Oxygen Sparging Unit in May 1996, and the TA-50 Controlled Air Incinerator Closure Plan submitted in 1995 was approved by NMED on July 1, 1996.

In cooperation with NMED, an effort was initiated in 1996 to formally withdraw or delete waste management units that had been identified as such to NMED in previous years but had not operated as regulated units or actually been built. These submittals included withdrawals for several RCRA Research, Development, and Demonstration permits, the proposed TA-63 Hazardous Waste Treatment Facility, Chemical Plating Waste Treatment Skid, and the TA-53 south impoundment.

Several solid waste management units (SWMUs) are subject to both the HSWA Module VIII corrective action requirements and the closure provisions of RCRA. The corrective action process occurs concurrently with the closure process, thereby satisfying both sets of regulations. NMED is the lead regulatory agency for these sites. The history of RCRA closures is presented in previous environmental surveillance reports. The 1996 status of these sites is given below.

- TA-35 surface impoundments—An amended closure plan was approved by NMED on September 19, 1996. The Laboratory completed Phase VI verification sampling at TA-35 TSL-85 during July 1996. LANL submitted an amended closure certification report to NMED on September 30, 1996.

- TA-16, landfill at MDA-P—LANL received an NOD from NMED on March 28, 1996. LANL responded to the NMED on May 9, 1996. NMED had not approved the closure plan by the end of 1996.

- TA-53 surface impoundments—NMED notified LANL on July 18, 1996, that LANL must submit a Part B Application for the TA-53 RCRA Hazardous Waste Facility Permit or a closure plan application for closure under interim status. Discussions with NMED indicated that the TA-53 south surface impoundment may be removed from RCRA regulation because there is no evidence that the site ever received RCRA-regulated waste.

  On April 22, 1996, NMED sent an NOD to LANL on remaining deficiencies for the north surface impoundments. ESH-19 requested an extension of the deadline for responding to the NOD until the land use/exposure scenario issue has been resolved with NMED, which was granted. The land use/exposure issue was still open as of the end of 1996.

c. Other Resource Conservation and Recovery Act Activities. TA-54, Area L, located on Mesita del Buey, was used for disposal of hazardous waste before the time such disposal became regulated under RCRA and HWA. TA-54, Area L is now used for storage of hazardous waste and some mixed waste. Area G, TA-54 is currently being used for storage of mixed wastes. Information on a groundwater monitoring waiver for both Areas L and G was submitted to NMED. Following the subsequent denial of this waiver, the Hydrogeologic Workplan was submitted to NMED to address Laboratory-wide groundwater concerns (see Section 2.B.10.a for more information on the workplan). Vadose zone monitoring is being conducted throughout Areas L and G to determine the extent of any releases from the disposal units. This type of monitoring is used to detect the presence of organic vapor in the vadose zone.

In 1996, EPA adopted new standards, under the authority of RCRA, as amended, and commonly called “Subpart CC” standards. These standards apply to air emissions from certain tanks, containers, less-than-90-day storage facilities, and surface impoundments used to manage hazardous waste capable of releasing volatile organic compounds (VOCs) at levels that can harm human health and the environment. LANL is developing implementation plans to address these new standards.

d. Resource Conservation and Recovery Act Compliance Inspection. NMED conducted its annual hazardous waste compliance inspection June 10 to 13, 1996 (Table 2-2). NMED inspectors visited hazardous and mixed waste satellite accumulation areas, less-than-90 day storage areas, and permitted and interim status storage and treatment facilities located throughout the Laboratory. On July 11, 1996, NMED sent DOE a Letter of Violation, an informal enforcement action, citing four violations that needed to be corrected. Those violations were satisfactorily addressed, and the inspection was closed out on August 15, 1996. No fines or penalties were assessed. In addition, LANL received a letter from the NMED Director noting LANL’s improvement in hazardous waste regulatory compliance observed during the 1996 inspection.

e. Underground Storage Tanks. The Laboratory’s underground storage tanks (USTs) are regulated under the New Mexico Administrative Code, Title 20, Chapter 5 (20 NMAC 5). At the end of calendar year (CY) 96, the Laboratory had 13 USTs in use. The Laboratory will close 12 of those 13 USTs by the end of CY98.

One UST was removed in CY96. UST TA-18-26 was discovered during the installation of a new natural gas line at TA-18. Best information indicates that the UST was used from 1946 to about June 1950, and was abandoned in place when the emergency generator that this UST supplied diesel fuel to was taken out of operation. The UST was removed on July 3, 1996. Upon removal, the UST was found to have leaked or been overfilled. LANL initiated a corrective action investigation and determined the extent of the diesel fuel contamination. LANL has determined that there has been no significant impact on the environment from the diesel fuel release. No highly contaminated soils were encountered during the subsurface investigation.

The Laboratory completed its investigation of the extent of contamination caused by UST TA-16-196, which was removed in 1987 (ESP 1996). This UST formerly held 4,000 gal. of leaded gasoline. Upon removal, it was observed that the UST was extensively corroded and leaking. Remediation actions involved the removal of several truckloads of contaminated soil from the site, but removal of all the soil containing lower levels of contamination was not completed. There has been no risk to the public because of this contaminated soil.

NMED did not conduct a UST inspection during 1996.

f. Solid Waste Disposal. The Laboratory has a commercial/special waste landfill located at TA-54, Area J, that is subject to New Mexico Solid Waste Act (SWA) regulations. In CY96, LANL/DOE completed the required Solid Waste Facility annual report for the previous year (CY95). In CY96, the TA-54, Area J landfill received and disposed 166 yd^3 of solid waste. Approximately 626 yd^3 of nonradioactive asbestos waste were shipped off-site from this facility to approved disposal sites. On October 10, 1996, the NMED Solid Waste Bureau conducted an inspection at the Laboratory’s TA-54, Area J, special waste landfill. No violations of the New Mexico Solid Waste Management Regulations were found during the inspection. Radioactive asbestos and asbestos suspected of being contaminated with radioactive material continue to be disposed in a monofill-constructed disposal cell (a cell that receives only one type of waste) at TA-54, Area G.

LANL also disposes of sanitary solid waste (trash), concrete/rubble, and construction and demolition debris at the Los Alamos County landfill on East Jemez

Table 2-2. Environmental Inspections and Audits Conducted at the Laboratory in 1996

Date	Purpose	Performing Agency
February 21, 1996	PM-2 Discharge	NMED/AIP[a]
February 22, 1996	Otowi-4 Startup	NMED/AIP
March 14, 1996	Sandia Canyon Pipeline Crossing	NMED/AIP
April 26, 1996	Asbestos	NMED
May 17, 1996	DP Canyon	NMED/AIP
May 17, 1996	TA-9, Area M	NMED/AIP
May 22, 1996	Sanitary Survey of Drinking Water System	NMED
June 10-13, 1996	Hazardous Waste Facility Compliance	NMED
June 28, 1996	Waste Stream Characterization Program	EPA
July 2, 1996	TA-9, Area M	NMED/AIP
July 9, 1996	General Open Burn	NMED
July 15, 1996	Liquid Release Notifications	NMED/AIP
July 24, 1996	TA-15 Road Crossing	NMED/AIP
August 19, 1996	DOE Audit	DOE/Headquarters
September 16-17, 1996	Performance Audit Review (NPDES)	EPA
September 19, 1996	Road Crossing	NMED
October 10, 1996	TA-54, Area J, Special Waste Landfill	NMED
October 22, 1996	Beryllium Machining	NMED
October 30, 1996	Solvent Burn	NMED
November 1, 1996	Rad/NESHAP Management Effectiveness	NAU-CET-ITEP[b]
November 20, 1996	Prescribed Burn	NMED

[a]New Mexico Environment Department/Agreement in Principle: the DOE Oversight Bureau.
[b]Northern Arizona University College of Engineering & Technology Institute of Tribal Environmental Professionals.

Road, which is DOE property that is operated by Los Alamos County under a special use permit. Los Alamos County has day-to-day operating responsibility for this landfill and is responsible for obtaining all related permits for this activity from the state. LANL contributed 11% (2,263 tons) of the total volume of trash landfilled at this site during CY96, with the remainder contributed by Los Alamos County and the City of Española. LANL also sent 3,502 tons of concrete/rubble, 802 tons of construction and demolition debris, 145 tons of brush for composting, and 49 tons of metal for recycling.

g. Waste Minimization. In order to comply with the HSWA Module of the RCRA, RCRA Subtitle A, Superfund Amendments and Reauthorization Act (SARA) Subtitle 313, DOE Order 5400.1 and other regulations, the Laboratory must have a waste minimization and pollution prevention program.

Section 1003 of the Waste Disposal Act cites the minimization of the generation and land disposal of hazardous wastes as a national objective and policy. All hazardous waste must be handled in ways that minimize the present and future threat to human health and the environment. The act promotes process substitution; materials recovery, recycling, and reuse; and treatment as alternatives to land disposal of hazardous waste.

The amounts of routine, nonroutine, and total RCRA-hazardous and mixed low-level wastes generated by Laboratory operations during CY93, CY94, CY95, and CY96 are provided in Table 2-3.

Routine/normal waste generated at LANL includes those activities that occur regularly that generate a waste stream of a predictable quantity and characterization. Routine activities constitute the waste generation baseline that can be trended over an extended time period, provided the mission of the area did not change to the extent that it altered the waste-generating activities.

Nonroutine/off-normal waste generation at LANL can be identified as those waste-generating activities that occur on an unscheduled basis and/or that produce a waste stream of unpredictable quantity and/or characterization. Because of the unpredictable schedule and/or characterization of the waste, waste generated from nonroutine/off-normal activities cannot be trended over an extended time period.

As evidenced in Table 2-3, LANL's generation of routine RCRA-hazardous wastes and mixed low-level wastes continue a downward trend. Nonroutine waste generation has generally increased for both waste types from the baseline year 1993, largely because of the increase in environmental restoration/decontamination and decommissioning activities occurring at LANL. Increased total mixed low-level waste generation in 1995 can also be explained by the moratorium on mixed low-level waste generation from May 8, 1992, to March 15, 1994. A full description of the moratorium is found in "Environmental Surveillance at Los Alamos during 1993" (ESP 1995).

In CY96, source reduction and recycling activities reduced the following amounts of waste:

Clean Air Act (chlorofluorocarbons)	265 lb
TRU waste:	138.4 m^3
Mixed TRU waste:	1.0 m^3
Low-level waste:	3,127.79 m^3
Mixed low-level waste:	29.04 m^3
RCRA-hazardous waste (chemicals, lead, lead acid batteries, solvents, etc.):	12,347,250 lb
Sanitary waste (paper, phone books, construction materials, rubble, electric cable, etc.):	18,459,929 lb
State-regulated waste (batteries, used tires, waste oil, etc. - not regulated by RCRA):	267,841 lb
Toxic Substances Control Act (TSCA) waste:	6,990 lb

h. Resource Conservation and Recovery Act Training. The RCRA training program, as described in the RCRA Hazardous Waste Facility Permit, is complete and only experienced minor modifications and revisions in 1996 to reflect regulatory, organizational, and/or programmatic changes.

During 1996, 87 workers completed RCRA Personnel Training, 249 workers completed RCRA Refresher Training, and 539 workers completed Waste Generation Overview. RCRA Refresher Training for treatment, storage, and disposal workers and for less-than-90-day-storage workers had previously been incorporated into Hazardous Waste Operations (HAZWOPER) Refresher Training. Of the 249 workers who required RCRA Refresher Training during 1996, approximately 195 met this requirement through completing the combined course.

The following RCRA courses were developed or revised by the Environment, Safety, and Health Training Group (ESH-13) during 1996:

- Environmental Issues for Managers (self-study)
- Environmental Regulations Overview (self-study)
- Pollution Prevention Overview (self-study)
- RCRA Refresher Training
- HAZWOPER: Refresher for Environmental Restoration Workers
- HAZWOPER: Refresher for Treatment, Storage, and Disposal Workers
- HMPT: Hazardous Materials Packaging and Transportation

The Radiological Controlled Area Waste Requirements course was developed and delivered to 168 workers, in response to a new Laboratory program

Table 2-3. Waste Generated by Laboratory Operations CY93–CY96

	RCRA-hazardous (lb)				Mixed low-level (m^3)			
	1993[a]	**1994[a]**	**1995[a]**	**1996**	**1993[a]**	**1994[a]**	**1995[a]**	**1996**
Routine	151,472	100,683	56,595	58,615	12.32	5.83	7.27	6.82
Nonroutine	33,111	327,582	2,494,231	1,965,544	11.75	65.07	79.58	58.19
Total	184,583	428,265	2,550,826	2,024,160	24.07	70.9	86.85	65.01

[a]More accurate data extraction methods were employed in CY96; therefore, CY93 to CY95 data have changed from the generation rates previously reported (ESP 1996).

for the management of waste generated in radiological controlled areas.

i. Hazardous and Solid Waste Amendments Compliance Activities. In 1996, the Environmental Restoration (ER) Project remained in compliance with Module VIII of the RCRA permit. One Class 3 permit modification proposal was submitted in September 1996, requesting removal of 42 SWMUs from the HSWA module list. The ER Project also recommended no-further-action for 84 areas of concern that are not on the HSWA module list. NMED has not yet approved this request.

During 1996, an additional 292 sites were proposed for no-further-action in 44 field investigation reports submitted to NMED. The ER Project also cleaned up 52 sites, including areas in the Los Alamos townsite. Depending on funding, the current projection for the completion of the characterization/remediation process at the Laboratory is between 2005 and 2006.

In 1996, the ER Project continued negotiations on a Document of Understanding (DOU) among the Laboratory, Sandia National Laboratory, DOE, EPA, and NMED. This DOU is intended to facilitate timely and cost-effective implementation of ER programs at the Laboratory and Sandia National Laboratory. It provides a basis for standardization in planning and execution of both programs. Additional annexes to the DOU are being written as applicable topics are identified.

j. Special Project: Ecological Risk Assessment. Work continued during 1996 on development of an ecological risk assessment methodology for use in assessing ecological risk at ER sites. This methodology follows guidance found in the US EPA "Framework for Ecological Risk Assessment" (EPA 1992, EPA 1996). It proposes a risk assessment approach based on an ecological exposure unit (EEU) concept, wherein EEUs are defined on the basis of ecological considerations—in this case primarily on the basis of habitat type. Each EEU may contain several to many potential release sites, and the risk assessment that is performed considers the contamination at all of the potential release sites as well as the uncontaminated area within the EEU.

Progress on six tasks was made during 1996.

Task 1: Develop Preliminary Contaminant of Potential Ecological Concern (COPEC) list.

Several criteria generally are used in developing a list of COPECs when performing an ecological risk assessment. They include the following:

- Contaminants that are known to have been used or known to be present at the site.
- Contaminants to which receptors are known to be sensitive.
- Contaminants identified as of concern during the human health assessment.
- Other factors, such as toxicity, persistence, exposure potential, bioavailabiltity, and potential for food chain transfer.

The preliminary COPEC list includes 17 inorganics, 5 semivolatile organic compounds (SVOCs), 3 VOCs, 4 high explosives, 8 radionuclides, and 6 pesticides. Additional chemicals can be added or deleted when there are reasons for doing so.

Task 2: Delineate Ecological Exposure Units.

Ecological Exposure Units are the ecologically defined units within which ecological risk assessments will be conducted. At LANL, EEUs will be defined on the basis of habitat and topography. The boundaries of the EEUs are coded into a geographical information system for use in preparing EEU maps.

Task 3: Define Food Webs.

The definition of food webs provides the primary basis for identifying trophic levels, appropriate receptors, and pathways of exposure. Species lists that are available for LANL (Hinojosa 1996) were broken down to sort species by habitat type, functional group, and trophic strategy.

Task 4: Define Pathways of Exposure.

This task is an assessment of the fate and transport of contaminants. It identifies sources, release mechanisms, transport pathways, points of exposure, and mechanisms of exposure. Generic conceptual models for terrestrial and aquatic pathways have been developed at the Laboratory. These generic models will be modified for specific EEUs, and potential transport pathways will be examined to ascertain whether significant contaminant transport might occur.

Task 5: Define Critical Ecosystem Functions.

Critical ecological attributes are those characteristics of the ecosystem that must be maintained in order to ensure biological diversity (ecosystem structure) and functional integrity (ecosystem function).

Task 6: Select Receptors and Assessment Endpoints.

The objective of selecting receptors is to select the minimum number of receptors that is necessary and sufficient to adequately assess the risk to the ecosystem. Receptors may represent more than one functional/trophic group. A preliminary list of receptors for the various habitat/community types at LANL has been compiled. For the purposes of screening at LANL, the assessment endpoints that are used are death, reproduction, and behavioral changes.

2. Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the SARA of 1986 mandates actions for certain releases of hazardous substances into the environment. The Laboratory is not listed on the EPA's National Priority List but follows the CERCLA guidelines for remediating ER Project sites that contain certain hazardous substances not covered by RCRA.

3. Emergency Planning and Community Right-to-Know Act

a. Introduction. Title III, Section 313, of the Emergency Planning and Community Right-to-Know Act (EPCRA), as modified by Executive Order 12856, requires all federal facilities to submit an annual Toxic Chemical Release Inventory report every July for the preceding calendar year.

Chlorine was the only chemical used in 1995 that met the reportable threshold limit of 10,000 lb. The 1996 Toxic Chemical Release Inventory reported that approximately 16,049 lb of chlorine were used in water purification operations involving noncontact cooling water, sewage treatment, and drinking water, which resulted in air emissions of 791 lb of chloroform and 2 lb of chlorine. An estimated 1,992 lb of chlorine were released with the discharged water.

b. Emergency Planning and Community Right-to-Know Act Summary. The Laboratory submits four reports each year in compliance with DOE guidance for EPCRA (see Table 2-4).

c. Emergency Planning. In accordance with DOE orders in the 5500 series, it is the Laboratory's policy to develop and maintain an emergency management system that includes emergency planning, emergency preparedness, and effective response capabilities for responding to and mitigating the consequences of an emergency. The Laboratory's Emergency Management Plan is a document that describes the entire process of planning, responding to, and mitigating the potential consequences of an emergency. The most recent revision of the plan was completed in January 1995; the plan will be updated in 1997.

4. Toxic Substances Control Act

Because the Laboratory's activities are in the realm of research and development and do not involve introducing chemicals into commerce, the polychlorinated biphenyl (PCB) regulations (40 CFR 761) have been the Laboratory's main concern under TSCA. Substances that are governed by the PCB regulations include but are not limited to dielectric fluids, contaminated solvents, oils, waste oils, heat transfer fluids, hydraulic fluids, slurries, soils, and materials contaminated as a result of spills. Most of the provisions of the regulations apply to transformers, capacitors, and other PCB items with concentrations above 50 ppm.

In 1996, the Laboratory replaced two PCB-contaminated (greater than 50 and less than 500 ppm) transformers with non-PCB transformers. The Laboratory still operates 16 PCB-contaminated transformers that will be replaced as funding becomes available. The Laboratory, through Johnson Controls, Inc. (JCI), completed its PCB survey in September 1996. In total, 2,023 structures were surveyed; 305 items were sampled for PCBs, and of those 305 items, 109 were identified by analysis as PCB items. The types of items surveyed include transformers, various pumps, oil-filled switches, light ballasts, generators, small transformers, and capacitors. If items are not in use or necessary for operations, they are recommended for disposal.

In 1996, the Laboratory had 16 off-site shipments of PCB waste. The total weight of PCBs in those shipments was 192,901 kg. PCB wastes are sent to EPA-permitted disposal and treatment facilities. The quantities of waste types disposed were 6 drums of capacitors, 13 drums of light ballasts, 2 transformers, 10 drums of water, 1,073 kg of PCB oil, and 171,186 kg of PCB-contaminated soil. All wastes are managed in accordance with 40 CFR 761 manifesting, record keeping, and disposal requirements. Light ballasts are sent off-site for recycling.

The Laboratory generates radioactively contaminated PCBs in both solid and liquid form. Liquid wastes are stored at the TA-54, Area L, TSCA storage facility. A total of 119 waste items in 73 drums are stored. Many of these items have exceeded TSCA's one-year storage limitation and are covered under the Federal Facility Compliance Agreement for Stored

Table 2-4. Compliance with Emergency Planning and Community Right-to-Know Act during 1996

Statute		Reporting Required Yes	No	Not Required
EPCRA 302-303:	Planning Notification	×		
EPCRA 304:	Extremely Hazardous Substances Release Notification	×		
EPCRA 311-312:	Material Data Safety Sheet/ Chemical Inventory	×		
EPCRA 313:	Toxic Release Inventory Reporting	×		

Polychlorinated Biphenyls (PCB FFCAgreement) (see Section 2.C.1.b for a full discussion of the agreement). Nonliquid wastes containing greater than 50 ppm PCBs and radioactive constituents are disposed of at the Laboratory's EPA-authorized TSCA landfill located at TA-54, Area G. No nonliquid radioactive PCB wastes were disposed of on-site in 1996. The Laboratory received a new disposal approval for its PCB landfill on June 25, 1996.

The primary compliance documents related to 40 CFR 761.180 are the Annual PCB report submitted to EPA, Region 6, and an annual report submitted to DOE required by the PCB FFCAgreement. EPA did not conduct an audit of the Laboratory's PCB management program during 1996.

5. Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the manufacturing of pesticides, with requirements for registration, labeling, packaging, record keeping, distribution, worker protection, certification, experimental use, and tolerances in foods and feeds. Sections of this act that are applicable to the Laboratory include requirements for certification of workers who apply pesticides. The Laboratory is also regulated by the New Mexico Pesticide Control Act, administered by the New Mexico Department of Agriculture (NMDA). NMDA did not conduct an annual inspection of the Laboratory's pesticide application program during 1996.

6. Federal Clean Air Act

a. Federal Regulations. The Laboratory is subject to a number of federal air quality regulations. These include

- National Emission Standards for Hazardous Air Pollutants (NESHAP).
- National Ambient Air Quality Standards,
- New Source Performance Standards,
- Stratospheric Ozone Protection (SOP), and
- Operating Permit Program.

All of these requirements, except the NESHAP for radionuclides and provisions relating to SOP, have been adopted by the State of New Mexico as part of its State Implementation Plan. The requirements adopted by the State of New Mexico are discussed in Section 2.B.7, New Mexico Air Quality Control Act.

The 1990 amendments to the Clean Air Act (CAA) mandate new programs that may affect the Laboratory. The new requirements include control technology for hazardous air pollutants, enhanced monitoring, prevention of accidental releases, and chlorofluorocarbon replacement. The Laboratory will continue to track new regulations written to implement the act, determine their effects on Laboratory operations, and develop programs as needed.

b. Compliance Activities.

Radionuclide NESHAP. Under 40 CFR 61, Subpart H, EPA limits the effective dose equivalent to any member of the public from radioactive airborne releases from DOE facilities, including LANL, to 10 mrem/yr. The 1996 effective dose equivalent (as calculated using EPA-approved methods that do not allow the use of shielding factors) was 1.93 mrem/yr, primarily from the Los Alamos Neutron Science Center (LANSCE) operations. Any new construction or modifications undertaken at LANL that will increase airborne radioactive emissions causing a potential increase in the dose of 0.1 mrem/yr must be approved by EPA. In 1996, approximately 60 projects were received by the Air Quality Group (ESH-17) for Laboratory review; none required EPA preconstruction approval.

Stratospheric Ozone Protection. Section 608 of the CAA, National Recycling and Emission Reduction Program, implemented by 40 CFR 82 Subpart F, prohibits individuals from knowingly venting ozone depleting substances (ODS) used as refrigerants into the atmosphere while maintaining, servicing, repairing, or disposing of air conditioning or refrigeration equipment. This regulation also established: (1) standards and requirements for recycling and recovery equipment used to maintain, service, repair, and dispose of ODS-containing appliances; (2) required practices that technicians must follow to maintain, service, repair, and dispose of air conditioning and refrigeration equipment; and (3) standards and requirements for training and certification of technicians who provide such services. Personnel performing refrigeration work at LANL are EPA-certified and use certified recovery and recycling equipment while maintaining, servicing, repairing, and disposing of air conditioning and refrigeration equipment at the Laboratory.

Section 609 of the CAA, Servicing of Motor Vehicle Air Conditioners, implemented by 40 CFR 82 Subpart B, established standards and requirements for recycling equipment used to service motor vehicle air conditioners and for training and certification of technicians who provide such services. In 1996, the Laboratory contracted with local automotive repair shops for most of LANL's automotive repair work. This work included service on motor vehicle air conditioning systems. JCI, which is in full compliance with these regulations, still provides limited service on some automotive air conditioning systems.

Section 611 of the CAA, Labeling of Products Using ODS, implemented by 40 CFR 82 Subpart E, established requirements to attach warning labels to products that contain Class I or II ODS and are introduced into interstate commerce. Laboratory groups that ship products containing ODS and ODS-containing waste off-site work with ESH-17 to ensure that, when required, the proper labeling requirements are met.

7. New Mexico Air Quality Control Act

a. State Regulations. The New Mexico Environmental Improvement Board (NMEIB), as provided by the New Mexico Air Quality Control Act, regulates air quality through a series of air quality control regulations in the NMAC. These regulations are administered by NMED. The NMACs relevant to Laboratory operations are discussed below.

b. Compliance Activities.

20 NMAC 2.07—Excess Emissions during Malfunction, Start-up, Shutdown, or Scheduled Maintenance. This provision allows for excess emissions from process equipment during malfunction, start-up, shutdown, or scheduled maintenance, provided the operator verbally notifies NMED either before or within 24 hours of the occurrence, followed by written notification within 10 days of the occurrence. No excess emissions were reported for 1996.

20 NMAC 2.11—Asphalt Process Equipment. Provisions of 20 NMAC 2.11 set emission standards according to process rate and require the control of emissions from asphalt-processing equipment. The asphalt concrete plant operated by JCI is subject to this regulation. The plant, which has a 60-ton/h capacity, is required to meet an emission limit of 33 lb/h of particulate matter.

20 NMAC 2.33—Gas Burning Equipment-Nitrogen Dioxide. Provisions of 20 NMAC 2.33 require gas burning equipment built before January 10, 1972, to meet an emission standard of 0.3 lb of nitrogen dioxide per million Btu when natural gas consumption exceeds 1×10^{12} Btu/yr/unit. The TA-3 steam/power plants have the capacity to operate at this level, although they never have. The Operating Permit Application would formalize compliance by setting voluntary federal enforceable terms to limit the operation of the units to less than 1×10^{12} Btu/yr/unit.

20 NMAC 2.34—Oil Burning Equipment-Nitrogen Dioxide. This regulation requires oil burning equipment built before January 10, 1972, to meet an emission standard of 0.3 lb of nitrogen dioxide per million Btu when the units operate at a heat input of greater than 1×10^{12} Btu/yr. The TA-3 steam/power plants have the capacity to operate at this level, although they never have. The Operating Permit Application would formalize compliance by proposing voluntary federally enforceable terms to limit the operation of these units to less than 1×10^{12} Btu/yr/unit.

20 NMAC 2.60—Regulation to Control Open Burning. This regulation controls the open burning of materials. Open burning of explosive materials is allowed when transport of these materials to other facilities may be dangerous. Research projects require open burning permits. In 1996, the Laboratory operated under seven open burning permits as listed in Table 2-1.

20 NMAC 2.61—Regulations to Control Smoke and Visible Emissions. This regulation limits visible emissions from various combustion sources, including the Laboratory boilers, to less than 20% opacity. Opacity is the degree to which emissions reduce the transmission of light and obscure the view of a background object. Because the Laboratory boilers are fueled by clean-burning natural gas, exceeding this standard is unlikely. However, oil is used as a backup fuel for the boilers. To ensure that the back-up system is working properly, the boilers must be periodically switched to oil. The Laboratory boilers can exceed the opacity standard while switching from gas to oil. An NMED-certified opacity observer reads the opacity while the switches are being made. If the Laboratory exceeds the opacity standard during the switch over, notification procedures, as required by 20 NMAC 2.07, are followed. There were no exceedances of these standards during 1996.

20 NMAC 2.70—Operating Permits. This regulation requires major sources of air pollution to obtain an operating permit from NMED. Because of LANL's large potential to emit regulated air pollutants (primarily NO_x from the steam/power plants), LANL is considered a major source. The permit application specifies the operational terms and limitations required to meet all federal and state air quality regulations. The Laboratory submitted its permit application to NMED in December 1995.

20 NMAC 2.71—Operating Permit Emissions Fees. As part of the new operating permit program, the State of New Mexico collects fees from emission sources that are required to obtain an operating permit. Fees depend on the allowable emission rates or the potential to emit. Laboratory fees for 1996 totaled $14,165.50.

20 NMAC 2.72—Construction Permits. Provisions of 20 NMAC 2.72 require permits for any new or modified source of air pollutants. The Laboratory reviews each new and modified source and makes conservative estimates of maximum hourly chemical usage and emissions. These estimates are compared with the applicable 20 NMAC 2.72 limits to determine if additional permits are required. During 1996, over 130 source reviews were conducted. None of these sources required permits under 20 NMAC 2.72.

20 NMAC 2.74—Prevention of Significant Deterioration. This regulation has stringent requirements that must be addressed before the construction of any new, large stationary emission source can begin. Wilderness areas, national parks, and national monuments receive special protection under this regulation. This impacts the Laboratory because of the proximity of Bandelier National Monument's Wilderness Area. Each new or modified source at the Laboratory is reviewed to determine whether this regulation applies; however, none of the new or modified sources in 1996 have resulted in emission increases considered "significant," and they therefore were not subject to this regulation.

20 NMAC 2.78—Emission Standards for Hazardous Air Pollutants. In this regulation, NMEIB adopted by reference all of the federal NESHAP, except those for radionuclides and residential wood heaters. The impact of each applicable NESHAP is discussed below:

Asbestos. Under the NESHAP for asbestos, the Laboratory must ensure that no visible asbestos emissions to the atmosphere are produced by asbestos removal operations at the Laboratory. During 1996, no Laboratory operation produced visible asbestos emissions. The Laboratory is also required to notify NMED of asbestos removal activities and disposal quantities. Such activities involving less than 15 m^2 (160 ft^2) or 80 lin m (260 lin ft) are covered by an annual small job notification to NMED. For projects involving greater than these amounts of asbestos, separate notification to NMED is required in advance of each project. NMED is notified of asbestos wastes (both small and large jobs) on a quarterly basis, which includes any material contaminated, or potentially contaminated, with radionuclides. Radioactively contaminated material is disposed of on-site in a designated radioactive asbestos burial area. Nonradioactive asbestos is transported off-site to designated asbestos disposal areas.

During 1996, LANL shipped off-site for disposal 53 m^3 of small job asbestos waste. There was 15 m^3 of asbestos waste buried at TA-54, Area G. Several large jobs generated 64 m^3 of waste that was buried at Area G and 1,926 m^3 that was transported off-site.

Beryllium. The beryllium NESHAP includes requirements for notification, emission limits, and stack performance testing for beryllium sources. The Laboratory has previously received four beryllium permits from NMED (Table 2-1) and has registered several additional facilities. The registered facilities do not require permits under the regulations because they existed before the adoption of the federal NESHAP. Exhaust air from each of the beryllium operations passes through air pollution control equipment before exiting from a stack. All beryllium operations meet the permitted emission limits set by NMED and have a negligible impact on ambient air quality.

8. Clean Water Act

a. National Pollutant Discharge Elimination System Program Overview. The primary goal of the

Clean Water Act (CWA) (33 U.S.C. 446 *et seq*.) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The act established the National Pollutant Discharge Elimination System (NPDES) that requires permitting point-source effluent discharges to the nation's waters. The NPDES permits establish specific chemical, physical, and biological criteria that an effluent must meet before it is discharged. Although most of the Laboratory's effluent is discharged to normally dry arroyos, the Laboratory is required to meet effluent limitations under the NPDES permit program.

In 1996, LANL had 15 NPDES permits; 1 covering the effluent discharges at Los Alamos, 1 covering the Hot Dry Rock Geothermal Facility located 30 miles west of Los Alamos at Fenton Hill, and 13 covering storm water discharges (Tables 2-1 and 2-5). The UC and DOE are co-permittees of permits covering Laboratory operations. The permits are issued and enforced by EPA Region 6 in Dallas, Texas. However, NMED performs some compliance evaluation inspections and monitoring for EPA through a Section 106 water quality grant.

In January 1996, the Laboratory's NPDES outfall permit for Los Alamos included 2 sanitary wastewater treatment facilities and 95 industrial outfalls. By the end of 1996, the Laboratory had eliminated nine permitted industrial outfalls in the NPDES permit. The NPDES permit for the geothermal facility at Fenton Hill includes only one industrial outfall. This outfall did not discharge during 1996. Under the existing NPDES permit for LANL, samples are collected for analysis on a weekly basis, and results are reported to EPA and NMED at the end of the monitoring period for each respective outfall category. During 1996, effluent limits were exceeded 2 times in the 165 samples collected from the sanitary wastewater outfalls. Effluent limits were exceeded 32 times in the 1,559 samples collected from the industrial outfalls. Overall compliance for the sanitary and industrial waste discharges during 1996 was 98.8% and 97.9%, respectively. Water quality parameter's effluent limits were exceeded twice in 1996. A summary of these outfalls and a listing of present monitoring limits are presented in Tables A-4 and A-5.

b. 1996 National Pollutant Discharge Elimination System Permit Noncompliances and Corrective Actions. The following is a summary of the corrective actions taken by the Laboratory during 1996 to address permit noncompliances as presented in Tables 2-6 and 2-7.

TA-16, Building 260 (NPDES Outfall 05A056): There were eight oil and grease noncompliances at NPDES Outfall 05A056 between January 16, 1996, and November 21, 1996. Corrective actions for the remediation of the oil and grease noncompliances were addressed in the Laboratory's High Explosive (HE) Outfall Compliance Task Force, which in conjunction with the DOE/Los Alamos Area Office (LAAO) Project Management Office, was able to secure funding ahead of the compliance schedule (Administrative Order [AO] Docket No. VI-94-1242—see Section 2.C.1.c for additional information on the AO) to allow for early procurement of the HE wastewater treatment plant recirculation equipment. Corrective actions specific to TA-16, Building 260, included the installation of a Canatxx Filter System and oil-absorbing booms in the HE sumps. Upon completion of the recirculation system, the sumps were plugged and alarms were installed. On November 22, 1996, the discharge of HE wastewater to Outfall 05A056 was stopped. All effluent from TA-16, Building 260, is pumped and trucked to the TA-16 Burn Grounds Treatment Plant (NPDES Outfall 05A055) for further treatment.

TA-21, Sewage Treatment Plant (NPDES Outfall 05S): On February 6, 1996, excessive flow from a plugged toilet discharged into the TA-21 Sewage Treatment Plant holding tank and sand beds and resulted in an unplanned discharge of an estimated 175 gal. through NPDES Outfall 05S. The TA-21 Sewage Treatment Plant was not in operation, resulting in fecal coliform concentrations in excess of the permit limit. Vacuum trucks were used to pump out the contents of the holding tank. The outfall was plugged at the time of the discharge, but the plug was compromised. A high-level alarm and automatic dialer have been installed on the holding tank.

TA-53, Cooling Towers 62 and 64 (NPDES Outfalls 03A048 and 03A049): There were six arsenic noncompliances at TA-53 Cooling Towers 62 and 64 between April 16, 1996, and May 21, 1996. The Laboratory's short-term corrective actions included using untreated redwood in cooling tower repairs, operational sampling, and temporary cessations of the discharge. The long-term corrective action has been identified as replacement of the two wooden cooling towers with new units constructed of steel, fiberglass, and plastic. Design of these cooling towers has been started. The funding for the construction of the new cooling towers has not been identified. In addition, a stuck makeup valve caused the cooling tower basin to discharge through an overflow pipe that bypassed the

Table 2-5. Los Alamos National Laboratory National Pollutant Discharge Elimination System Storm Water General Permits Industrial and Construction Activity

Permit #	Location	Submittal	Type
NMR00A384	LANL Site	09/29/92	Industrial
NMR00A527	Tar Remnant Remediation	05/26/95	Industrial
NMR00A577	TA-32, -001, -002(a,b), -003, -004	03/11/96	Industrial
NMR00A650	DP Storage Area, 01027, -030(a)	04/26/96	Industrial
NMR00A652	Hot Shots, 1-001(s), -007(1)	05/23/96	Industrial
NMR10A064	TA-53 Sanitary Pipeline Project	10/01/92	Construction
NMR10A065	US West Communication Ductbank	10/01/92	Construction
NMR10A236	Dual Axis Radigraphic Hydrotest Facility Construction	05/20/94	Construction
NMR10A277	Small Arms Firing Range	08/18/94	Construction
NMR10A378	TRU Dome Project TWISP Facility Construction	02/28/95	Construction
NMR10A469	Steam System Upgrade TA-9, -16	09/01/95	Construction
NMR10A607	Radioactive Liquid Waste Cross Country Line Erosion Control Project	07/25/96	Construction
NMR10A622	Wildlands Fire Management Program	09/05/96	Construction

dechlorination system on December 2, 1996, causing two chlorine exceedances at NPDES Outfall 03A049. The operator turned off the blow-down and makeup valve to prevent further discharge to the outfall. The makeup valve was repaired.

TA-50, Building 1 (NPDES Outfall 051): Two chemical oxygen demand (COD) concentrations exceeded the permit limit of 125 mg/L on July 1, 1996, and September 25, 1996. Oxygen-requiring chemicals were improperly disposed of into the radioactive liquid waste line by unknown sources. TA-50, Building 1, Radioactive Liquid Waste Treatment Facility, operations have implemented an operational COD sampling program. The Radioactive and Industrial Wastewater Science Group (CST-13) contained all discharges until operational sampling demonstrated that COD concentrations were within permit limits.

TA-40, Building 23 (NPDES Outfall 06A099): Discharge pH values of 5.3, 4.7, and 5.7 occurred outside the permit range of 6.0 to 9.0 on July 12, November 4, and November 28, 1996, respectively. The investigation, including storm water sampling and leachability studies of roofing material, indicated that direct rainfall to Building 23 roof drains was the cause of the noncompliances. Results of less than 6.0 were also obtained from direct rainfall field measurements at TA-43-23. Additionally, pH results of less than 6.0 have been attained from rainfall field measurements taken at the National Atmospheric Deposition Program Network Station located at Bandelier National Monument. The photo processing equipment was not in operation at the time samples were collected on November 4 and November 28, 1996. Based on this information, EPA decided these were not permit exceedances. Rainfall was also believed to be the cause of the initial pH excursion on July 12, 1996; however, it could not be verified if the photo processing equipment was operating at the time of sampling so this permit noncompliance remained. Revised Discharge Monitoring Reports (DMRs) were submitted to EPA.

Table 2-6. National Pollutant Discharge Elimination System Permit Monitoring of Effluent Quality at Sanitary Outfalls: Exceedances during 1996

Discharge Location (Category)	Date	Permit Parameters	Number of Exceedances
TA-21 (05S)	02/06/96	Fecal coliform bacteria	2
Sewage Treatment		COD[a]	0
Plant		BOD[b]	0
		TSS[c]	0
		pH	0
		Flow	0
TA-46 (13S)		Fecal coliform bacteria	0
SWSC		BOD[b]	0
Plant		TSS[c]	0
		pH	0
		Flow	0

[a]Chemical oxygen demand.
[b]Biochemical oxygen demand.
[c]Total suspended solids.

TA-8, Building 22 (NPDES Outfall 06A074): On August 14, 1996, two aluminum concentrations exceeded the daily average and daily maximum permit limits of 5.0 mg/L. The photo rinse water has been connected to the TA-46 Sanitary Wastewater Systems Consolidation (SWSC) plant and no longer discharges through NPDES Outfall 06A074.

Otowi Well #1 (NPDES Outfall 04A161): On September 11, 1996, six pH readings exceeded the maximum permit limit of 9.0 during a line disinfection operation conducted by JCI. The high pH readings were attributed to the addition of sodium thiosulfate to the discharge for dechlorination purposes. The entire discharge lasted approximately one hour. JCI has drafted and implemented new procedures for line disinfection discharge operations. The procedure documents the operating range for pH during the discharge. If the water quality exceeds the operating range for pH then the discharge will be shut off.

TA-3, Cooling Tower 285 (NPDES Outfall 03A027): There were two pH and two arsenic noncompliances between November 14 and November 18, 1996. The discharge from the TA-3-285 cooling tower (Outfall 03A027) was turned off, and there has not been a discharge from the outfall since November 21, 1996.

TA-35, Building 124 (NPDES Outfall 03A160): The total suspended solids (TSS) concentration of 54 mg/l exceeded the daily average permit limit of 30 mg/L on November 30, 1996. The condition was discovered during a manual discharge at the outfall. There will not be any further manual discharges to collect compliance samples from cooling towers.

TA-3, Building 187 (NPDES Outfall 03A024): On December 3, 1996, two arsenic concentrations exceeded the daily average and daily maximum permit limits of 0.04 mg/L. The cooling tower is currently off-line until corrective actions are implemented to address these exceedances.

c. Waste Stream Characterization Program and Corrections Project. The Water Quality and Hydrology Group (ESH-18) implemented the Waste Stream Corrections Project to correct Laboratory-wide noncomplying waste streams and potential unpermitted outfalls that discharge to the environment, as identified by the Waste Stream Characterization (WSC) Survey conducted from 1991 to 1994.

In March 1994, waste stream deficiencies identified by the WSC Survey were compiled into 83 reports that were finalized and distributed to the responsible division directors for facilities under their management. Correction of waste stream deficiencies is required for compliance with the CWA and NPDES

Table 2-7. National Pollutant Discharge Elimination System Permit Monitoring of Effluent Quality at Industrial Outfalls: Exceedances during 1996

EPA ID	Technical Area	Date	Parameter		Results/Limit	
January						
05A056	TA-16-260	01/16/96	O & G[a]	(daily max)	36/15	mg/L
05A056	TA-16-260	01/16/96	O & G	(daily avg)	24.3/15	mg/L
February—No exceedances during monitoring period.						
March—No exceedances during monitoring period.						
April						
03A049	TA-53-64	04/16/99	As	(daily max)	0.068/0.04	mg/L
03A049	TA-53-64	04/16/96	As	(daily avg)	0.068/0.04	mg/L
May						
03A048	TA-53-62	05/15/96	As	(daily max)	0.066/0.04	mg/L
03A048	TA-53-62	05/15/96	As	(daily avg)	0.053/0.04	mg/L
03A048	TA-53-62	05/21/96	As	(daily max)	0.087/0.04	mg/L
03A048	TA-53-62	05/21/96	As	(daily avg)	0.062/0.04	mg/L
June—No exceedances during monitoring period.						
July						
051	TA-50-1	07/01/96	COD[b]	(daily max)	145/125	mg/L
06A099	TA-40-23	07/12/96	pH	(min)	5.3/6.0	s.u.
August—Annual Water Quality Parameter.						
06A074	TA-08-22	08/14/96	Al	(max)[c]	43.3/5.0	mg/L
06A074	TA-08-22	08/14/96	Al	(avg)[c]	21.7/5.0	mg/L
September						
04A161	TA-0	09/11/96	pH	(max)	9.1/9.0	s.u.
04A161	TA-0	09/11/96	pH	(max)	9.4/9.0	s.u.
04A161	TA-0	09/11/96	pH	(max)	9.3/9.0	s.u.
04A161	TA-0	09/11/96	pH	(max)	9.1/9.0	s.u.
04A161	TA-0	09/11/96	pH	(max)	9.1/9.0	s.u
04A161	TA-0	09/11/96	pH	(max)	9.1/9.0	s.u
051	TA-50-1	09/25/96	COD	(daily max)	130/125	mg/L
October						
05A056	TA-16-260	10/24/96	O & G	(daily max)	64/15	mg/L
05A056	TA-16-260	10/24/96	O & G	(daily avg)	64/15	mg/L
November						
05A056	TA-16-260	11/05/96	O & G	(daily max)	45/15	mg/L
05A056	TA-16-260	11/14/96	O & G	(daily max)	30/15	mg/L
05A056	TA-16-260	11/21/96	O & G	(daily max)	16/15	mg/L
05A056	TA-16-260	11/21/96	O & G	(daily avg)	30/15	mg/L
03A027	TA-03-285	11/14/96	pH	(max)	9.2/9.0	s.u.
03A027	TA-03-285	11/18/96	pH	(max)	9.1/9.0	s.u.
03A027	TA-03-285	11/14/96	As	(daily max)	0.10/0.04	mg/L
03A027	TA-03-285	11/14/96	As	(daily avg)	0.10/0.04	mg/L
03A160	TA-35-124	11/30/96	TSS[d]	(daily avg)	54/30	mg/L

Table 2-7. National Pollutant Discharge Elimination System Permit Monitoring of Effluent Quality at Industrial Outfalls: Exceedances during 1996 (Cont.)

EPA ID	Technical Area	Date	Parameter		Results/Limit	
December						
03A049	TA-53-64	12/02/96	Free Cl Available	(daily max)	1.66/0.5	mg/L
03A049	TA-53-64	12/02/96	Free Cl Available	(daily avg)[e]	0.71/0.2	mg/L
03A024	TA-03-187	12/03/96	As	(daily max)	0.07/0.04	mg/L
03A024	TA-03-187	12/03/96	As	(daily avg)	0.07/0.04	mg/L

[a]Oil and grease.
[b]Chemical oxygen demand.
[c]Yearly water quality parameter exceedance. Permit year 08/01/95 through 07/31/96.
[d]Total suspended solids.
[e]Average is based on all samples collected during the monitoring period.

permit regulations and with the schedule requirements set forth by EPA AO Docket No. VI-94-1242. The Laboratory met the AO Docket No. VI-94-1242 requirement to have 50% of the deficiencies corrected by September 30, 1995. On September 16, 1996, a new AO (Docket No. VI-96-1236) was issued by EPA in response to a request by UC to extend the completion date for the correction of the remaining deficiencies from September 30, 1996, to March 31, 1997. The request was necessary because of a Laboratory "Stop Work" directive that was issued on January 17, 1996, because of a serious electrical accident. The "Stop Work' directive resulted in a three-month delay on the Waste Stream Corrections Project. The Laboratory must now be in 100% compliance by March 31, 1997, pursuant to the new AO.

d. National Pollutant Discharge Elimination System Storm Water Program. Laboratory storm water discharges associated with "industrial activity" are covered under NPDES General Permits. The Laboratory has 13 NPDES General Permits for its storm water discharges (Table 2-5). One permit is for the Laboratory site and includes the following industrial activities: hazardous waste treatment, storage, and disposal facilities operating under interim status or a permit under Subtitle C of RCRA, (this category includes SWMUs); landfills, land application sites, and open dumps including those that are subject to regulation under Subtitle D of RCRA; and steam electric power generating facilities. Four permits are for the remediation of ER sites off of DOE property. The other eight permits are for construction activities that disturb more than five acres.

The conditions of the General Permit require the development and implementation of a Storm Water Pollution Prevention (SWPP) Plan. During 1996, the Laboratory developed and implemented 75 SWPP Plans for activities regulated under the NPDES General Permit for storm water discharges.

Under the General Permit, monitoring activities are required at landfills and EPCRA, Section 313, facilities. In 1996, monitoring was conducted at TA-54, Areas G and J, and at TA-55. These analytical data were submitted to EPA in the form of a DMR. The Laboratory submitted DMRs to EPA on October 28, 1996, for landfills and on January 27, 1997, for EPCRA, Section 313, facilities.

As part of the NPDES Storm Water Program, the Laboratory is operating stream monitoring stations on the canyons entering and leaving the Laboratory. In 1996, there were 19 stations on watercourses at the Laboratory. The discharge information for 1996 gathered by ESH-18 was published in separate reports (Shaull et al., 1996a and Shaull et al., 1996b).

e. National Pollutant Discharge Elimination System Compliance Inspection. A performance audit inspection was conducted by EPA on September 16-17, 1996. The Laboratory received a facility evaluation rating of 4: very reliable self-monitoring program. The EPA inspector documented that the overall NPDES compliance program was superior. However, the Laboratory received an NOD for record keeping at the Radioactive Liquid Waste Treatment Facility (TA-50, Building 1). Corrective actions completed by the operating group included: pH calibration procedures were revised to provide a greater level of accountability and reliability; and the format of the daily logs was modified to ensure that all necessary information would be available for future inspections.

f. Spill Prevention Control and Countermeasures Program. The Laboratory's Spill Prevention Control and Countermeasures (SPCC) Plan is a comprehensive plan developed to meet the regulatory requirements of EPA and NMED that regulate water pollution from oil and hazardous chemical spills. The SPCC Plan, as required by the CWA, was developed in accordance with 40 CFR 112. The purpose of the SPCC Plan is to ensure that adequate prevention and response measures are provided to prevent oil spills from reaching a watercourse. Prevention measures include maintenance and inspection of facilities to ensure the integrity of the oil and chemical handling equipment, and proper operator training. Because of the wide variety of operating conditions at the Laboratory, the SPCC Plan has also diversified coverage with the implementation of a Group SPCC Implementation Plan approach.

In keeping with the site-specific Group SPCC Implementation Plan approach, the operating conditions for each location are addressed and, as these change, only the individual Group SPCC Implementation Plan is revised. In addition to requiring secondary containment provisions for all aboveground storage tanks, the plan also provides for spill control on drum and container storage, and transfer and loading/unloading areas. Training is provided for the operating group's designated Spill Coordinator on the requirements of the SPCC Plan. The Spill Coordinator plays the major role in implementation of the SPCC Plan at the group level.

g. Sanitary Sewage Sludge Management Program. In December 1992, the EPA promulgated 40 CFR Part 503: The Standards for Use or Disposal of Sewage Sludge. The purpose of these regulations is to establish numerical, management, and operational standards for the beneficial use or disposal of sewage sludge through land application or surface disposal. Under the Part 503 regulations, the Laboratory is required to collect representative samples of sewage sludge in order to demonstrate that it is not a hazardous waste and that it meets the minimum federal standards for pollutant concentrations. In addition, sewage sludge is monitored for radioactivity in order to demonstrate that it meets the standards set forth in the Laboratory's Administrative Requirement 3-5. During 1996, approximately 27 dry tons of sewage sludge were generated at the TA-46 SWSC plant as part of routine wastewater treatment operations. Although analytical monitoring of this sludge in 1996 demonstrated 100% compliance with the minimum federal and Laboratory standards for land application, the detection of low concentrations (less than or equal to 4.38 ppm) of PCBs in the sludge prompted the Laboratory to suspend all land application activities in May 1996. All sludge generated in 1996 is presently being stored on an asphalt pad at the SWSC plant while awaiting disposal.

9. Safe Drinking Water Act Program

a. Introduction. This program includes sampling from various points in the Laboratory, Los Alamos County, and Bandelier National Monument's water distribution systems and from the water supply wellheads to ensure compliance with the Safe Drinking Water Act (SDWA) (40 CFR 141). The DOE provides drinking water to Los Alamos County and Bandelier National Monument. The EPA has established maximum contaminant levels (MCLs) for microbiological organisms, organic and inorganic constituents, and radioactivity in drinking water. These standards have been adopted by the state and are included in the New Mexico Drinking Water Regulations (NMEIB 1995). The NMED has been given authority by EPA to administer and enforce federal drinking water regulations and standards in New Mexico.

The particular locations within the water system where SDWA compliance samples are collected is specified in the regulations for each contaminant or group of contaminants. In 1996, the monitoring network for SDWA compliance sampling consisted of the following four location groups within the water system:

(1) wellhead sampling from the water supply wells in operation at the time of sampling (Guaje wells G-1, G-1A, G-2, G-4, G-5, G-6; Pajarito wells PM-1, PM-2, PM-3, PM-5; and Otowi well O-4).

(2) the five entry points into the distribution system (Pajarito Booster Station #2, Guaje Booster Station #2, PM-1 and PM-3 wellheads, and Los Alamos Booster Station #4).

(3) the six total trihalomethane (TTHM) sampling locations within the distribution system; and

(4) the 41 microbiological sampling sites located

throughout the Laboratory, Los Alamos County, and Bandelier National Monument.

The sampling program for drinking water quality is designed to meet or exceed regulatory requirements under the federal SDWA (see Table A-6) and the New Mexico Environmental Improvement Act. Sampling locations, frequencies, preservation, handling, and analyses follow the requirements specified in federal and state regulations. Chemical and radiological sampling is performed by Laboratory staff and submitted for analysis to the New Mexico Health Department's Scientific Laboratory Division (SLD) in Albuquerque. Microbiological sampling and analysis are performed by the JCI Environment (JENV) labora-tory. The JENV laboratory is certified by NMED for microbiological compliance analysis. Certification requirements include proficiency samples, maintenance of an approved quality assurance/quality control program, and periodic audits by NMED. The Laboratory and JENV staff are certified by NMED to perform drinking water compliance sampling.

All data collected from SDWA compliance testing is submitted to the NMED's Drinking Water Bureau for review and filing. The SLD and JENV laboratory report their analytical results directly to NMED. ESH-18 maintains both electronic and hard-copy files of all data collected from SDWA compliance testing.

b. Radiochemical Analytical Results. As required by the SDWA, in 1996, the Laboratory collected drinking water samples at the five entry points into the distribution system to determine the radiological quality of the drinking water. As shown in Table 2-8, the concentrations of gross alpha activity were less than the screening level of 5 pCi/L, and the concentrations of gross beta activity were less than the screening limit of 50 pCi/L. When gross alpha and beta activity measurements are below the screening limits, the Laboratory does not need to perform further isotopic analyses or perform dose calculations under the SDWA program. However, it should be noted that comprehensive monitoring of the water supply wells for radiochemical constituents is conducted by ESH-18 annually (see Table 5-22).

Radon is a naturally occurring radionuclide produced during the decay of geological sources of uranium. In 1996, radon sampling was performed at the 11 operating water supply wellheads and the 5 entry points into the distribution system. This sampling was done to collect information before the issuance of final EPA regulations governing radon in drinking water. As shown in Table 2-9, the radon concentrations ranged from 226 to 616 pCi/L. If the MCL is finalized at the proposed 300 pCi/L, waters from some well fields may need radon treatment.

c. Nonradiological Analytical Results. The analytical results for TTHMs, inorganic constituents, lead and copper, and VOCs in drinking water were all less than SDWA MCLs.

In 1996, TTHM samples were collected during each quarter from six locations in the Laboratory and Los Alamos County water distribution systems. As shown in Table 2-10, the annual average for TTHM samples in 1996 was 3.7 µg/L, less than the SDWA MCL of 100 µg/L.

In 1996, inorganic constituents in drinking water were sampled at the five entry points to the distribution system, with the exception of nitrates (NO_3-N) (nitrate as nitrogen), which were sampled at the 11 operating water supply wellheads. As shown in Table 2-11, all locations and all inorganic constituents were less than the MCLs.

In accordance with the requirements of the SDWA, the sampling program for lead and copper at residential taps that was initiated in 1992, was continued in 1996. There is currently no set MCL for lead or copper in drinking water. Instead, an action level has been set for each metal. SDWA regulations specify that if more than 10% of the samples from selected residential sites exceed the action level then water suppliers must take prescribed actions to monitor and control the corrosivity of the water supplied to the customers. Additionally, if 90% of the sample sites are below the action levels for lead and copper then the water system is in compliance without the need to implement corrosion controls. As is shown in Table 2-12, all 34 samples collected during 1996 were below EPA action levels for lead and copper. The Laboratory was in compliance with the SDWA regulations for lead and copper in drinking water during 1996.

In 1996, volatile organic compound (VOC) samples were collected at the five entry points to the distribution system. No VOCs were detected at any of the sampling locations.

In 1996, no synthetic organic compound (SOC) samples were collected. Sampling for SOCs will resume in 1997, as required by regulation.

d. Microbiological Analyses of Drinking Water. Each month during 1996, an average of 46 samples was collected from the Laboratory, Los Alamos County, and Bandelier National Monument's water distribution systems to determine the free chlorine residual available for disinfection and the microbiological quality of the drinking water. Of the 547 samples analyzed during 1996, none indicated the presence of total coliforms or fecal coliforms.

Table 2-8. Radioactivity in Drinking Water (pCi/L) during 1996

	Gross Alpha			Gross Beta		
Sample Location	**Calibration Std.**	**Value**	**(Uncertainty)**	**Calibration Std.**	**Value**	**(Uncertainty)**
Entry Points:						
Pajarito Booster #2	^{241}Am	0.5	(0.3)	^{137}Cs	2.9	(1.0)
	Natural U	0.5	(0.4)	^{90}Sr, ^{90}Y	2.8	(1.0)
Guaje Booster #2	^{241}Am	1.2	(0.4)	^{137}Cs	3.4	(0.9)
	Natural U	1.3	(0.4)	^{90}Sr, ^{90}Y	3.4	(0.9)
Pajarito Well PM-1	^{241}Am	2.0	(0.6)	^{137}Cs	3.6	(0.9)
	Natural U	2.4	(0.6)	^{90}Sr, ^{90}Y	3.4	(0.8)
Pajarito Well PM-3	^{241}Am	1.6	(0.6)	^{137}Cs	3.4	(1.1)
	Natural U	1.9	(0.6)	^{90}Sr, ^{90}Y	3.2	(1.0)
Los Alamos Booster #4	^{241}Am	1.1	(0.5)	^{137}Cs	3.2	(1.1)
	Natural U	1.3	(0.5)	^{90}Sr, ^{90}Y	3.0	(1.1)
EPA Maximum Contaminant Level		15			none	
EPA Screening Level		5			50	

Noncoliform bacteria were present in 16 of the microbiological samples. Noncoliform bacteria are not regulated, but their presence in repeated samples may serve as indicators of biofilm growth in water pipes. A summary of the monthly analytical data is presented in Table 2-13.

e. Long-Term Trends. The Los Alamos water system has never incurred a violation for a SDWA regulated chemical or radiological contaminant. The water supply wells have, on occasion, exceeded proposed SDWA MCLs for arsenic and radon because of their natural occurrence in the main aquifer. Violations of the SDWA MCL for microbiological constituents occurred in 1993 and 1994. Both of these violations were attributed to localized contamination in the distribution system and not microbiological contamination of the main aquifer.

f. Drinking Water Inspection. On May 22, 1996, the District II Field Office of the NMED conducted an inspection of the drinking water system under the provisions of the New Mexico Drinking Water Regulations (NMEIB 1995). No deficiencies were found, and the inspectors reported that the system was well maintained and supervised.

10. Groundwater

a. Groundwater Protection Compliance Issues. Groundwater monitoring and protection efforts at the Laboratory have evolved from the early programs initiated by the US Geological Survey to present efforts. The major regulations, orders, and policies pertaining to groundwater are as follows.

DOE Order 5400.1 requires the Laboratory to prepare a Groundwater Protection Management Program Plan (GWPMPP). The program was required by the order to (1) document the groundwater regime with respect to quantity and quality; (2) design and implement a groundwater monitoring program to support resource management and comply with applicable environmental laws and regulations; (3) establish a management program for groundwater protection and remediation, including specific SDWA, RCRA and CERCLA actions; (4) summarize and identify areas that may be contaminated with hazardous substances; (5) develop strategies for controlling sources of these contaminants; (6) establish a remedial action program that is part of the decommissioning and other remedial programs contained in DOE directives. The GWPMPP focuses on protection of groundwater resources in and around the Los Alamos area and

Table 2-9. Radon in Drinking Water (pCi/L) during 1996

Sample Location	Value	(Uncertainty)
Entry Points:		
Pajarito Booster #2	520	(29)
Guaje Booster #2	226	(17)
Pajarito Well PM-1	278	(18)
Pajarito Well PM-3	357	(23)
Los Alamos Booster #4	491	(29)
Well Heads:		
Pajarito Well PM-1	278	(18)
Pajarito Well PM-2	616	(35)
Pajarito Well PM-3	357	(23)
Pajarito Well PM-5	446	(27)
Otowi Well O-4	512	(30)
Guaje Well G-1A	381	(23)
Guaje Well G-1	349	(22)
Guaje Well G-2	392	(24)
Guaje Well G-4	361	(23)
Guaje Well G-5	464	(28)
Guaje Well G-6	423	(25)
Proposed EPA Maximum Contaminant Level	300	

Table 2-10. Total Trihalomethanes in Drinking Water (μg/L) during 1996

	1996 Quarters			
Sample Location	**First**	**Second**	**Third**	**Fourth**
Distribution Sites:				
Los Alamos Airport	2.2	5.5	8.0	11.6
White Rock Fire Station	<0.5	<0.5	<0.5	<0.5
North Community Fire Station	2.3	7.0	5.7	4.2
TA-16, S-Site Fire Station	<0.5	<0.5	5.5	0.7
Barranca Mesa School	1.3	1.1	7.7	1.0
TA-33, Bldg. 114	2.4	7.5	NST[a]	NST
TA-39, Bldg. 02	NST	NST	NST	8.7
1996 Average of 3.7				
EPA Maximum Contaminant Level			100.0	
Sample Detection Limit			0.5	

[a] NST = No sample taken.

Table 2-11. Inorganic Constituents in Drinking Water (mg/L) during 1996

Sample Location	As	Ba	Be	Cd	Cr	F	CN	Hg	Ni	NO_3 (as N)	Se	Sb	Tl
Entry Points:													
Pajarito Booster #2	<0.002	<0.1	<0.002	<0.001	0.004	0.3	<0.02	<0.0002	<0.02		<0.005	<0.001	<0.001
Guaje Booster #2	0.012	<0.1	<0.001	<0.001	0.004	0.5	<0.02	<0.0002	<0.02		<0.010	<0.001	<0.001
Pajarito Well PM1	<0.002	<0.1	<0.002	<0.001	0.003	0.2	<0.02	<0.0002	<0.02		<0.005	<0.001	<0.001
Pajarito Well PM3	<0.002	<0.2	<0.002	<0.002	0.003	0.3	<0.02	<0.0002	<0.02		<0.005	<0.002	<0.002
Los Alamos Booster #4	<0.002	<0.1	<0.002	<0.001	0.003	0.3	<0.02	<0.0002	<0.02		<0.005	<0.001	<0.001
Wellheads:													
Pajarito Well PM-1										0.5			
Pajarito Well PM-2										0.3			
Pajarito Well PM-3										0.4			
Pajarito Well PM-5										0.3			
Otowi Well O-4										0.4			
Guaje Well G-1A										0.4			
Guaje Well G-1										0.4			
Guaje Well G-2										0.4			
Guaje Well G-4										0.6			
Guaje Well G-5										0.7			
Guaje Well G-6										0.5			
EPA Maximum Contaminant Levels	0.05[a]	2.0	0.004	0.005	0.1	4.0	0.2	0.002	0.1	10.0	0.05	0.006	0.002

[a] Proposed SDWA Primary Drinking Water Standard.

Table 2-12. Lead and Copper in Drinking Water at Residential Taps during 1996

Values	Lead		Copper	
Values less than or equal to detection limit	33	samples	19	samples
Values detectable but less than action level	1	samples	15	samples
Values greater than action level	0	samples	0	samples
Total	34	samples	34	samples
Sample detection limit	5	µg/L	50	µg/L
90th percentile value	<5	µg/L	90	µg/L
EPA action level	15	µg/L	1,300	µg/L

ensures that all groundwater-related activities comply with the applicable federal and state regulations.

Module VIII of the RCRA Hazardous Waste Facility Permit, i.e., HSWA Module, Task III, requires the Laboratory to collect information to supplement and verify existing information on the environmental setting at the facility and collect analytical data on groundwater contamination. Historically, the groundwater monitoring requirements of RCRA (40 CFR 264 Subpart F) were not applied to the Laboratory's regulated units because DOE and LANL had submitted groundwater monitoring waiver demonstrations. However, as of May 30, 1995, the NMED denied the DOE/LANL groundwater monitoring waiver demonstrations, and groundwater monitoring program plans were requested for DOE/LANL to be in compliance with RCRA. In the denial letter, NMED recommended the development of a comprehensive groundwater monitoring program plan that addresses both site-specific and Laboratory-wide groundwater monitoring objectives. Under Task III, Section A.1, the Laboratory is required to conduct a program to evaluate hydrogeologic conditions. Under Task III, Section C.1, the Laboratory is required to conduct a groundwater investigation to characterize any plumes of contamination at the facility.

New Mexico Water Quality Control Commission (NMWQCC) regulations control liquid discharges onto or below the ground surface to protect all groundwater in the State of New Mexico. Under the provisions, a groundwater discharge plan must be submitted by the facility and approved by NMED or the Oil Conservation Division for energy/mineral extraction activities. Subsequent discharges must be consistent with the terms and conditions of the plan.

The Laboratory has three approved groundwater discharge plans to meet NMWQCC regulations (Table 2-1). One for TA-57 (Fenton Hill); one for the TA-46 SWSC plant; and one for the land application of dried sanitary sewage sludge from the TA-46 SWSC plant. At the request of NMED, on August 19, 1996, the Laboratory submitted a groundwater discharge plan application for the Radioactive Liquid Waste Treatment Facility at TA-50. As of December 31, 1996, approval of the plan by NMED was still pending.

b. Compliance Activities. The Laboratory's revised GWPMPP was approved by DOE in March 1996. The plan provides general management goals and direction to activities pertaining to groundwater quality and quantity.

In December 1996, the DOE/LANL submitted to NMED a proposed comprehensive hydrogeologic characterization and groundwater monitoring plan for the Laboratory. The plan was developed in response to NMED's denial of the Laboratory's RCRA groundwater monitoring waiver demonstrations. The plan proposes a major long-term drilling and hydrologic analysis program to broadly characterize the hydrogeology of the Pajarito Plateau and to assess in detail the potential for groundwater contamination to occur from individual waste disposal operations. The plan contains a prioritized list of activities and studies addressing the above.

The Laboratory continued an ongoing study of the hydrogeology and stratigraphy of the region, as required by the HSWA Module of the RCRA permit and DOE Order 5400.1. Studies by various Laboratory programs are integrated by the Groundwater Protection

Table 2-13. Bacteria in Drinking Water at Distribution System Taps during 1996

Month	No. of Samples Collected	No. of Positive Tests		
		Coliform	Fecal Coliform	Noncoliform
January	45	0	0	0
February	46	0	0	0
March	45	0	0	3
April	46	0	0	1
May	46	0	0	2
June	47	0	0	0
July	44	0	0	2
August	46	0	0	1
September	46	0	0	3
October	46	0	0	3
November	45	0	0	1
December	45	0	0	0
Total 1996	547	0	0	16
Maximum Contaminant Level (MCL)		[a]	[b]	[c]

[a] The MCL for coliforms is positive samples not to exceed 5% of the monthly total.
[b] The MCL for fecal coliforms is no coliform positive repeat samples following a fecal coliform positive sample.
[c] There is no MCL for noncoliforms.

Management Plan administered by ESH-18. Some key 1996 activities are listed as follows:

(1) The Waste Management Program prepared a series of reports in support of the Performance Assessment of TA-54, Area G. Critical geological, hydrological, and geochemical studies have been performed and formulated into a conceptual hydrogeologic model. Computer simulations forecast the long-term performance of the disposal area over 1,000 years.

(2) The ER Project has entered information from all significant drill holes into a computer based three-dimensional stratographic model of the Pajarito Plateau. This model will be continually updated during the ongoing hydrogeologic characterization of the Laboratory and will serve as a cornerstone for long-term numerical modeling efforts.

(3) The ER Project has prepared preliminary surface maps of key geologic units. Trends in the geologic surfaces have been analyzed to evaluate paleotopographic controls on groundwater flow.

(4) The ER Project and environmental surveillance projects continued evaluation of contaminant transport of sediments within critical drainage systems.

11. National Environmental Policy Act

a. Introduction. The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4331 et seq.) mandates that federal agencies consider the environmental impact of their proposed major actions and allow public input before making a final decision on what actions to take. The DOE is the sponsoring agency for most LANL activities, and it is DOE's responsibility to follow the letter and spirit of NEPA. DOE must comply with the regulations for implementing NEPA published by the Council on Environmental Quality at 40 CFR Parts 1500–1508 and its own NEPA Implementing Procedures as published at 10 CFR Part 1021. Under these regulations and DOE Order 451.1, DOE reviews proposed LANL activities and determines whether the activity qualifies for a categorical exclusion from the need to prepare further NEPA documentation based on previous agency experience and analysis or whether to prepare the following:

- an Environmental Assessment (EA), evaluating environmental impacts should briefly provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI) for the proposed action,
- an EIS, which is a detailed written statement of impacts.

If an EA or an EIS is required, the DOE is responsible for its preparation. In some situations, a LANL project may require an EA or EIS but, because the project is connected to another larger action requiring an EIS (e.g., the LANL Site-Wide EIS or a programmatic EIS done at the nationwide level), it may be included in the EIS analyzing the larger action or may later tier off the final programmatic EIS after a Record of Decision (ROD) is issued.

LANL project personnel initiate NEPA reviews by completing environment, safety, and health identification documents, which form the basis of a DOE NEPA Environmental Review Form formerly known as a DOE Environmental Checklist written by the LANL Ecology Group (ESH-20) using the streamlined format specified by the DOE/LAAO. In April, 1996, ESH-20 began to use the streamlined, shorter NEPA Review Form for projects that would receive a NEPA determination from the DOE/LAAO.

b. Compliance Activities. In 1996, LANL sent 42 DOE Environmental Checklists and 122 NEPA Review Forms to DOE for review. Also in 1996, DOE categorically excluded 155 actions and made a determination for 4 other actions. LANL applied previously so-called “umbrella” categorical exclusion determinations for 108 actions. DOE issued four FONSIs in 1996. Two project-specific analyses were drafted in 1996 for inclusion in the LANL Site-Wide EIS.

c. Environmental Assessments. The status of the Laboratory’s EA-level NEPA documentation, and project descriptions follow.

TRU Waste Drum Staging Building. This action is designed to increase safety and minimize the volume of waste generated at the Laboratory’s Plutonium Processing Facility at TA-55. This action consists of using a prefabricated, concrete-floored, metal building for temporary storage of drums of solid TRU waste that is pending certification and transport to a longer term storage area. Alternatives to the proposed action include constructing a new building or continuing operations under current conditions. Some of the potential environmental, safety, and health issues include air emissions, work safety, on-site TRU waste management, and TRU waste transportation. This action received a FONSI in February 1996.

Low-Energy Demonstration Accelerator. The proposed action is to design, build, and test critical components of a full-size prototype accelerator system for tritium production using a proton linear accelerator at LANL. The Low-Energy Demonstration Accelerator (LEDA) project would be divided into five separate stages that would develop and test an accelerator apparatus section by section over the next six years. Personnel at LANL would modify an existing proton accelerator facility at TA-53 and conduct component and prototype tests in order to verify equipment and prototype design and resolve related performance and production issues for future full-scale operation. The potential environmental, safety, and health issues for LEDA include utility demands, air emissions, environmental restoration, human health, and waste management. This action received a FONSI in April 1996.

In conjunction with the LEDA EA FONSI, DOE issued a Mitigation Action Plan (MAP) that defined a scope of activities that would be implemented to mitigate some of the potential impacts associated with the LEDA project. The LEDA MAP is being coordinated by DOE/LAAO, ESH-20, and LEDA project management.

As required by the MAP, an annual report (Rangel 1997) was written to report the status of the LEDA schedule and the action taken on the identified mitigation measures.

1996 was the first year of LEDA project development, but LEDA will only proceed to Stage III as allowed by the current safety analysis document. Because the Stage V development has been removed from the LEDA project schedule, large quantities of water and power use estimated in the final LEDA EA will no longer be required and generated. This affects the LEDA MAP because the land disturbance issue for utility line installation is removed and the quantity of water released into Sandia Canyon will be much less. As a result, no erosion is expected at the drainage channel of NPDES Outfall 03A113, and it is unlikely that a wetland will be created in Sandia Canyon although baseline biological data will continue to be collected in Sandia Canyon.

During FY96, planning was conducted for the remediation of a potential release site containing lead shot (pellets) near Outfall 03A113. All of the necessary documentation and approvals for the cleanup by the LANL ER Project have been conducted; the cleanup is expected to take place in the spring of 1997.

Criticality Experiments. The proposed action is to consolidate certain nuclear materials and machines at the Los Alamos Critical Experiments Facility for the purpose of general purpose criticality experimentation and training. The proposed action consists of moving materials and machines from Hanford Site, Sandia National Laboratory, Oak Ridge National Laboratory, and Idaho National Engineering Laboratory to the Los Alamos Critical Experiments Facility. No new construction, operations, waste streams, or emissions were anticipated. Alternatives included (1) conducting criticality experiments and criticality training at an alternative DOE or LANL site and (2) receiving and storing materials at LANL or an alternative DOE site, but not conducting the criticality experiments or training. No adverse effects on environment and potentially only negligible effects on human health and transportation were identified. This action received a FONSI on May 22, 1996.

Effluent Reduction. The proposed action is to eliminate industrial effluent from approximately 27 outfalls at LANL through waste stream correction measures. These corrective measures are needed to comply with directives by EPA to DOE and UC requiring proper characterization of waste streams and compliance with the discharge limitations specified in LANL's NPDES permit. In addition, effluent reduction provides proactive measures by the Laboratory to reduce pollution into the environment, reduce administrative and permitting costs, and minimize the number of NPDES exceedances. The proposed corrective actions include both simple and extensive plumbing modifications, which would result in the elimination of industrial effluent being released to the environment. The No Action alternative, which would maintain the status quo for LANL's outfalls, was also analyzed. One of the primary environmental effects of the proposed action would be an increase in compliance with LANL's NPDES permit limits. Other potential environmental, safety, and health issues for this project include changes in wetland vegetation, loss of wetland acreage, effects on fauna that drink water or use the areas near the outfalls, human health, waste management, and contaminant transport. This action received a FONSI in September 1996.

Expansion of TA-54, Area G. Routine activities at the Laboratory generate solid low-level radioactive wastes (LLWs) that are disposed of or stored at TA-54, Area G, which is currently a 63-acre site. For some types of waste, burial in pits or shafts is the only feasible disposal method that complies with all regulations. A draft project-specific analysis was in progress during the last quarter of CY96. The analysis for this project considers five alternatives for the management of LLWs: (1) using the active disposal area at Area G until it is full, (2) developing Zone 4 at TA-54, west of the active disposal area, (3) developing Zone 6 at TA-54, west of Area L and extending to Area J, (4) developing the North Site at TA-54, north of Zone 6, and (5) developing another location within the Laboratory, with TA-67 used as a representative undeveloped mesa site. Potential environmental, safety, and health issues include land use, air quality, ecological resources, soil, surface water, threatened and endangered species, cultural resources, and environmental restoration.

Enhancement of Pit Manufacturing Operations. The proposed action is to relocate or upgrade certain existing operations and to construct a new facility and access road to support plutonium pit (the central core of a nuclear weapon typically composed of plutonium-239 and/or highly enriched uranium) manufacturing operations at LANL. Essential operations at TA-55 and the Chemistry and Metallurgy Research (CMR) Building would be expanded and relocated between TA-55 and the CMR Building or upgraded in place. A new support building would be constructed at TA-55 as well as a controlled access road between TA-55 and the CMR Building. As a result of these upgrades and construction activities, LANL would be able to manufacture each type of pit required to support the enduring nuclear weapons stockpile. In addition, the Laboratory would be able to produce a maximum of up to 80 pits a year if required. Alternatives to the proposed action include an add-on configuration for using existing facilities as well as the construction of an all-new facility. Potential environmental, safety, and health issues include worker exposure to construction hazards as well as interruption to existing traffic patterns and minor increases in traffic volumes. The NEPA review for this project was initiated in 1996 for inclusion in the LANL Site-Wide EIS.

Radioactive Liquid Waste Treatment Facility—New Process Building. The NEPA review for this project was in progress during the last quarter of CY96. Because of the reduction in scope of this project in 1997, it is anticipated that this action will be categorically excluded from further NEPA review.

Chemical and Metallurgy Research Building Upgrades. The CMR Building was constructed as a major chemical research and analysis laboratory facility for radioactive materials in 1952. Despite some repairs and upgrades since that time, the CMR Building does not meet current DOE regulations governing construction of a new nonreactor nuclear facility. LANL proposes to extend the life of the building 20 years by upgrading several major systems including seismic upgrades, ventilation system replacements and confinement zone separations, acid vents and drain lines replacements, and electrical system upgrades. The alternative action is not to upgrade the facility. Potential environmental, safety, and health issues include worker safety while the work is performed and LLW disposal. The EA for this proposed action was being prepared during 1996.

Transfer of the DP Road Tract to the County of Los Alamos. Under the proposed action, DOE intends to transfer ownership of a 28-acre tract of land located along DP Road, currently part of TA-21, to the County of Los Alamos. The transfer of this tract of land would result in a permanent change to the existing DOE property boundaries for TA-21. The county would develop the tract of vacant land for use as a business park or for light industrial use. The county specifically proposes to construct a new office building to house county employees, a new warehouse, garages, and a support building in order to transfer its equipment maintenance, school bus yard, and school supplies warehousing activities to the site. The alternative action is not to transfer the land and to continue to maintain government ownership of the tract. Potential environmental, safety, and health issues include worker and public exposure to construction hazards and nonradioactive air emissions from operations and from increased vehicular traffic. The proposed action could create approximately 450 new direct jobs and 585 indirect jobs. The EA for this action was under preparation during 1996.

d. Special Project: Dual Axis Radiographic Hydrodynamic Test Facility Mitigation Action Plan. In August 1995, DOE published a final EIS on the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility at LANL (DOE/EIS-0228, August 1995). DOE published a ROD on this final EIS in the Federal Register (60 FR 53588) on October 16, 1995. The DARHT ROD states that DOE has decided to complete and operate the DARHT facility while implementing a phased-containment program to conduct most tests inside steel containment vessels with containment to be phased-in over 10 years. The ROD further states that DOE must develop several mitigation measures to protect workers, soils, water, and biotic and cultural resources in and around the DARHT facility. In January 1996, DOE published a DARHT MAP, which identified potential impacts associated with the course of action selected in the ROD. The MAP also documents commitments and action plans that DOE considers necessary to mitigate these potential impacts. DOE has committed to reporting the status on MAP activities and commitments to the public.

The functions of the DARHT MAP are to (1) document potentially adverse environmental impacts of the Phased Containment Option delineated in the final EIS, (2) identify commitments made in the final EIS and ROD to mitigate those potential impacts, and (3) establish action plans to carry out each commitment.

In Section 6.C.8 of this report there is a description of DARHT Mitigation Action Plan activities of studies with mammals.

12. Cultural Resources

a. Introduction. The Cultural Resources Team in ESH-20 is responsible for maintaining a database of all cultural resources found on DOE land, supporting DOE's compliance requirements with appropriate cultural resource legislation as listed below, and providing appropriate information to the public on cultural resource management issues. Cultural resources are defined as archaeological sites, prehistoric or historic districts, sites, buildings, structures, traditional use areas, or objects included in, or eligible for inclusion in, the National Register of Historic Places. Artifacts, records, and remains related to and located within such properties are considered cultural resources.

b. Compliance Overview. Section 106 of the National Historic Preservation Act (implemented by 36 CFR 800, Public Law 89-665) requires agencies to evaluate the impact of all proposed actions on cultural resources and to consult with the State Historic Preservation Officer (SHPO) and/or National Advisory Council on Historic Preservation concerning possible effects to identified resources.

During 1996, Laboratory archaeologists evaluated 947 Laboratory proposed actions; 31 new field surveys were conducted to identify cultural resources. The results of 12 surveys were sent by DOE to the SHPO for concurrence in findings of effects and determinations of eligibility for National Register inclusion of any cultural resources located during the survey. Copies were also sent to the governors of the Pueblos of San Ildefonso, Santa Clara, Cochiti, Jemez, and to the President of the Mescalero Apache tribe for comment and identification of any traditional cultural properties which may be affected by a proposed action.

No adverse effects to prehistoric cultural resources were identified in 1996.

The American Indian Religious Freedom Act of 1978 (Public Law 95-341) stipulates that federal undertakings should not impact the practice of traditional religions. Notification must be given to tribal groups of possible alteration of traditional and sacred places. The Native American Grave Protection and Repatriation Act of 1990 (Public Law 101-601) states that if burials or cultural objects are inadvertently disturbed by federal activities, work must stop in that location for 30 days and the closest lineal descendent must be consulted for disposition of the remains.

The Archeological Resources Protection Act of 1979 (implemented by 43 CFR 7, Public Law 96-95, 16 USC 470) provides protection of cul-tural resources and sets penalties for their damage or removal from federal land without a permit. One illicit pot-hunting incident was discovered on DOE land in 1996. The site damaged, Laboratory of Anthropology 6787-A, is a low pueblo mound of approximately 10 rooms. This site was also illegally plundered in 1995. Security personnel from Bandelier National Monument were notified, but no suspects have been identified.

13. Biological Resources

a. Introduction. The DOE and the Laboratory must comply with the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald Eagle Protection Act. The Laboratory also considers plant and animal species listed under the New Mexico Conservation Act and the Endangered Species Act.

b. Compliance Activities. During 1996, ESH-20 reviewed more than 500 proposed Laboratory actions for potential impact on threatened and endangered species. The Biology Team of ESH-20 identified more than 50 projects that required reconnaissance surveys. These surveys are designed to evaluate the amount of previous development or disturbance at the site and to determine the presence of any surface water or floodplains in the site area. The Biology Team also identified approximately 20 projects that required habitat evaluator surveys to assess if the appropriate habitat types and habitat parameters were present to support any threatened or endangered species. In addition, the Biology Team identified 11 projects that required a species-specific survey designed to determine the presence or absence of a threatened or endangered species at the project site. The Laboratory adhered to protocols set by the US Fish and Wildlife Service and permit requirements of the New Mexico State Game and Fish Department.

c. Biological Assessments. The Biology Team identified projects requiring a survey by first reviewing a literature database that compiles all habitat requirements of federal and state endangered, threatened, and candidate species. After the surveys were completed, the habitat characteristics of the surveyed sites were compared with the habitat requirements of the species in question. Biological evaluations are being prepared for projects that may influence threatened and endangered species that require consultation with US Fish and Wildlife for written concurrence of findings under the Endangered Species Act.

The Biology Team is currently preparing a threatened and endangered species habitat management plan as part of the DARHT MAP commitments by DOE. The plan should be completed in 1998 and will be used to further evaluate and manage the threatened and endangered species occupying LANL property.

14. Floodplain and Wetland Protection

a. Introduction. The Laboratory must comply with Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands (EPA 1989) and Section 404 of the CWA.

b. Compliance Activities. During 1996, more than 500 proposed Laboratory actions were reviewed for their impact on floodplains and wetlands. Nine proposed projects required a floodplain and wetland review.

C. Current Issues and Actions

1. Compliance Agreements

a. Mixed Waste Federal Facility Compliance Order. DOE and the Laboratory are required by the Federal Facility Compliance Act of 1992 (section 3021[b] of RCRA) to prepare an STP describing the development of treatment capacities and technologies for treating mixed waste generated at LANL that is being stored beyond the one-year time frame provided for in the land disposal restrictions (Section 3004(j) of RCRA and 40 CFR Section 268.50). On October 4, 1995, the State of New Mexico issued the Federal Facility Compliance Order to both DOE and UC requiring compliance with the STP and thereby terminating the Federal Facility Compliance Agreement that had previously been in effect (ESP 1996).

b. Federal Facility Compliance Agreement on Storage of Polychlorinated Biphenyls. On August 8, 1996, DOE, the Naval Nuclear Propulsion Program, and EPA entered into a PCB FFCAgreement pertaining specifically to radioactive PCBs and PCB waste containing RCRA wastes. The FFCAgreement is intended to be a compliance bridge from now until EPA's December 6, 1994, proposed rule updating the PCB regulations is final. The FFCAgreement also contains provisions to address the discrepancy created in the TSCA PCB regulations when the Department of Transportation changed its container specifications. The PCB FFCAgreement incorporates the proposed rule and provides regulatory relief for facilities now. When EPA makes the final decision, it will supersede the PCB FFCAgreement. The PCB FFCAgreement covers 29 facilities, including LANL, and the conditions of the agreement bind all the facilities together so that if one facility is noncompliant, all facilities are noncompliant. LANL has a total of 119 items that meet the criteria for inclusion in the PCB FFCAgreement.

The PCB FFCAgreement requires an annual report to be prepared by DOE and submitted to EPA. Each facility was required to compile the required information on its radioactive and mixed PCBs and submit it to DOE by November 13, 1996. LANL met that deadline.

c. National Pollutant Discharge Elimination System Federal Facility Compliance Agreement and Administrative Order. AO Docket No. VI-94-1242, issued to the Laboratory on June 15, 1994, incorporated the revised HE Wastewater Treatment Facility schedule and the new schedule for completion of the remaining corrective actions for the WSC project. The Laboratory met the September 30, 1995, deadline to complete 50% of the WSC corrective actions, as specified in the AO. A new Federal Facilities Compliance Agreement (FFCA) (Docket No. VI-96-1237) was issued to DOE by EPA on December 12, 1996, which corresponds to the Laboratory's AO Docket No. VI-96-1236 issued December 10, 1996.

The new TA-16 HE Wastewater Treatment Facility (NPDES Outfall 05A055) is also covered under AO VI-96-1236. The construction is currently ahead of schedule and is expected to be in compliance with final permit limits by October 1997, as required. All but two HE (05A) outfalls will be eliminated upon completion of this facility.

d. National Emission Standards for Hazardous Air Pollutants Federal Facility Compliance Agreement. In 1991 and 1992 the Laboratory received two Notices of Noncompliance (NONs) from the EPA for not meeting all provisions of 40 CFR 61, Subpart H. Specific findings of the NON included deficiencies in LANL's identification and evaluation of release sources, noncompliant stack monitoring equipment on all point release sources, incomplete quality assurance programs, and incomplete reporting. The 1992 NON stated that LANL had used a shielding factor without previous EPA approval and exceeded the 10 mrem/yr standard. As a result of the NON, the DOE negotiated a NESHAP FFCA with EPA Region 6, which was signed in June 1996. The Laboratory is meeting the terms of the NESHAP FFCA and had achieved full compliance in June 1996 with the radionuclide NESHAP, as defined by the FFCA.

2. Environmental Oversight and Monitoring Agreement

The Environmental Oversight and Monitoring Agreement—known as the Agreement in Principle (AIP)—between DOE and the State of New Mexico provides technical and financial support by DOE for state activities in environmental oversight, environmental surveys and sampling, site visits, and document review. The period for the current AIP is October 1, 1995, through September 30, 2000.

During 1996, the NMED/AIP staff conducted oversight of several of the Laboratory's environmental programs. This independent monitoring program allows the Laboratory's data to be verified. Highlights of these activities are presented below (NMED 1997).

External penetrating radiation dosimetry: The DOE Oversight Bureau maintains a network of thermoluminescent dosimeters (TLDs) for measuring the levels of gamma radiation present in the environment to assess the background baseline and any Laboratory-related gamma radiation anomalies. The data collected from the TLDs were at or below natural background radiation levels at all locations.

Ambient air: The values for plutonium, americium, and uranium measured by the DOE Oversight Bureau's stations, co-located with five of LANL's monitoring stations, are all approximately two to three orders of magnitude below DOE concentration guidelines.

Surface water and groundwater: The DOE Oversight Bureau expanded its routine oversight activities to include field explorations leading to the discovery of on- and off-site springs previously undocumented by the Laboratory and DOE. An analysis of data collected from several years shows that contaminants were detected within each of the four saturated zones in the Los Alamos area. The largest and most diverse concentrations of contaminants in groundwater are found within canyon alluvium.

Sediments, soils, vegetation, and foodstuffs: A preliminary comparison of historical radiological data for foodstuffs indicated that the data collected by the DOE Oversight Bureau are consistent with LANL's data.

Environmental Restoration: The DOE Oversight Bureau staff actively participated in the planning and expedited cleanup of TA-9, Area M, an abandoned dump site. Staff observed activities in the field throughout the cleanup process and evaluated the effectiveness of the cleanup. The bureau was instrumental in the formation of a Watershed Management Task Force to address the potential migration of contaminants into watercourses at the Laboratory from potential release areas, areas at the Laboratory that may require cleanup activities in the future. The bureau continued to work with EPA, DOE, and LANL to develop methods of evaluating potential release sites for risks to sensitive habitats or threatened or endangered species.

NEPA: The DOE Oversight Bureau reviewed and commented on six DOE NEPA documents for proposed activities at the Laboratory.

3. Significant Accomplishments

On August 30, 1996, the Laboratory received an Environmental Excellence Award from EPA for Wastewater Treatment Operations and Maintenance for the high level of success of the SWSC plant at TA-46 in a ceremony at the New Mexico State Capitol.

In addition, on September 8, 1996, the Laboratory received a 1995 Operator Award from the Rocky Mountain Section of the American Water Works Association for "the success of the Sanitary Wastewater Systems Consolidation plant consistently meeting established NPDES effluent limitations," and for "plant performance." The SWSC plant is operated and maintained by JCI.

The Laboratory received two Research & Development 100 Awards for environmentally responsive technologies in 1996

- Plasma Mechanical Cleaner for Silicon Wafer, which uses harmless inert gases to clean silicon wafers used in integrated circuits, and therefore produces no polluting byproducts and reduces the amount of water used by semiconductor manufacturers; and

- Transportable Remote Analyzer for Characterization and Environmental Remediation, which uses laser pulses to vaporize samples *in situ* to perform spectral analysis for various elements in a single sample. This procedure drastically reduces the amount of personal protective equipment required, eliminates sample preparation, and reduces analysis time to less than one minute.

The Laboratory received a "Best of What's New" award from Popular Science magazine for a system that replaces harsh dry cleaning chemicals with a liquid carbon dioxide cleaning process. The Laboratory shared the award with Hughes Environmental Systems, Inc., a subsidiary of Hughes Aircraft Company.

4. Significant Issues

a. Dome Fire. More than 16,000 acres of US Forest Service land southwest of the Laboratory burned during April 1996. Referred to as the Dome Fire, the blaze threatened archaeological sites, recreational sites, flora, and fauna in Bandelier National Monument, and research facilities on the southwestern perimeter of the Laboratory as it spread quickly because of extremely dry conditions.

The proximity of the fire and its potential to burn facilities that use radioactive materials raised public concerns about the potential for releases of radiation. NMED's DOE Oversight Bureau confirmed LANL's Neighborhood Environmental Watch Network (NEWNET) monitoring results that there had been no increases in radiation levels during or after the Dome Fire (NMED 1997).

After the Dome Fire, LANL formed the Interim Fire Management Team. The team is cochaired by the Deputy Group Leader of the Emergency Management and Response Group and the Group Leader of ESH-20. The team also includes members from the DOE, the US Forest Service, the Los Alamos Fire Department, the NMED DOE Oversight Bureau, the Pueblo of San Ildefonso, and Bandelier National Monument, along with Laboratory personnel involved with fire protection, environmental issues, storm water, archaeology, and site remediation.

The team has developed a list of precautionary measures to make the Laboratory safer from wildfire. Some immediate measures include improving fire roads, widening fire breaks, clearing vegetation beneath power lines, and conducting prescribed burns. The team will develop long-term measures in cooperation with Laboratory facility managers, the US Forest Service, the DOE, Bandelier National Monument, the Pueblo of San Ildefonso, and resource protection specialists.

b. Lawsuit. In 1994 a citizens' group, Concerned Citizens for Nuclear Safety (CCNS) sued DOE and the Laboratory Director under the CAA.

2. Compliance Summary

CCNS was concerned about the time it was taking to achieve compliance with 40 CFR 61 Subpart H at the Laboratory. In April 1996, the US District Court for the District of New Mexico issued a partial summary judgment against DOE and the Laboratory Director and directed the parties to attempt to reach a settlement. This agreement was finalized on March 25, 1997, following a period of public comment. The provisions of the agreement include:

- $150,000 payment to the US Treasury
- Independent comprehensive technical audits of the Laboratory's 40 CFR 61 Subpart H program in 1997 and 2000. A third audit in 2003 is required if recommended by the independent auditor
- 5-yr operation of 2 additional AIRNET stations to be located at TA-33 and in Santa Fe
- 5-yr operation of additional TLD stations to be located at 6 Laboratory technical areas and at AIRNET stations
- 5-yr operation of the northern New Mexico portion of NEWNET
- Quarterly ESH public meetings
- $450,000 payment to the University of New Mexico School of Medicine, Masters in Public Health program, for environmental health curriculum development
- 5-day course in radiation education for representatives of local and tribal governments surrounding Los Alamos
- Radiation monitoring equipment loan program for representatives of local and tribal governments who have participated in the radiation education training program.

D. References

EPA 1989: US Environmental Protection Agency, US Army Corps of Engineers, US Fish and Wildlife Service, and USDA Soil Conservation Service, *Federal Manual for Identifying and Delineating Jurisdiction Wetlands*, (US Government Printing Office, Washington, DC 1989).

EPA 1992: US Environmental Protection Agency. “Framework for Ecological Risk Assessment.” Environmental Protection Agency Report No. EPA/630/R-92/001, Washington, DC (1992).

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ESP 1996: Environmental Surveillance Program, “Environmental Surveillance at Los Alamos during 1995,” Los Alamos National Laboratory report LA-13210-ENV (October 1996).

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NMED 1997: New Mexico Environment Department, “Environmental Oversight and Monitoring at Department of Energy Facilities in New Mexico, 1996 Annual Performance Report,” New Mexico Environment Department (April 1, 1997).

NMEIB 1995: New Mexico Environmental Improvement Board, State of New Mexico, “New Mexico Drinking Water Regulations” (as amended through January 1995).

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Shaull et al., 1996a: D. A. Shaull, M. R. Alexander, and R. P. Reynolds, “Surface Water Data at Los Alamos National Laboratory: 1995 Water Year,” Los Alamos National Laboratory report LA-13177-PR (August 1996).

Shaull et al., 1996b: D. A. Shaull, M. R. Alexander, R. P. Reynolds, and C. T. Mclean, “Surface Water Data at Los Alamos National Laboratory: 1996 Water Year,” Los Alamos National Laboratory report LA-13234-PR (November 1996).

3. Environmental Radiological Dose Assessment

primary authors:

Dennis R. Armstrong, Jean M. Dewart, Keith W. Jacobson, David H. Kraig

Highlights from 1996

In the past, the maximum individual exposure from Los Alamos National Laboratory (the Laboratory) sources to a member of the public was calculated to be from an air pathway occurring near East Gate, north of the Los Alamos Neutron Science Center. For 1996, this is still the location of the maximum exposure for areas outside of Laboratory boundaries. In addition, another analysis was performed for individuals who are not Laboratory workers but are in transit within Laboratory boundaries. The maximum individual dose from this analysis is 8 mrem as calculated to occur near the Technical Area 18 criticality facility. This dose would be from direct radiation. The applicable regulatory dose limit for comparison purposes is 100 mrem, the allowed dose from all pathways (DOE 1990).

To Read About . . . Turn to Page . . .

A. Radiological Dose Equivalents

1. Overview of Radiological Dose Equivalents

Radiological dose equivalents are the potential doses received by individuals exposed to radioactivity in the environment. Dose equivalent refers to the quantity of radiation energy absorbed per unit mass (dose), multiplied by adjustment factors for the type of radiation absorbed. The effective dose equivalent (EDE), also referred to here as dose, is the principal measurement used in radiation protection. The EDE is a hypothetical whole-body dose equivalent that would equal the same risk of cancer mortality and serious genetic disorder as the sum of the weighted dose equivalents of those organs considered to be most seriously affected by the radionuclide in question. The EDE includes the committed effective dose equivalent (CEDE) from internal deposition of radionuclides and the EDE resulting from penetrating radiation from sources external to the body.

Federal government standards limit the EDE to the public (Department of Energy [DOE] Order 5400.5 [DOE 1990], 40 Code of Federal Regulations [CFR] Part 61). DOE's public dose limit (PDL) is 100 mrem/yr EDE received from all pathways (i.e., ways in which people can be exposed to radiation, such as inhalation, ingestion, and from airborne emissions of radionuclides); however, the dose received from airborne emissions of radionuclides is further restricted by the Environmental Protection Agency's (EPA's) effective dose standard of 10 mrem/yr (see Appendix A). These values are in addition to exposures from normal background, consumer products, and medical sources.

2. Methods for Dose Calculation

a. Introduction. Annual radiation doses to the public are evaluated for three principal exposure pathways: inhalation, external exposure, and ingestion.

Two evaluations of releases are conducted: one to satisfy 40 CFR Part 61 requirements (emissions of radionuclides to air) and one for all sources and pathways. Results of environmental measurements are used as much as possible in assessing doses for all pathways. Calculations based on these measurements follow procedures recommended by federal agencies to determine radiation doses (DOE 1991, NRC 1977). Population and some individual doses attributable to Los Alamos National Laboratory (LANL or the Laboratory) activities are estimated through computer modeling.

b. Inhalation Dose. Annual average air concentrations of tritium; plutonium-238; plutonium-239,-240; uranium-234; uranium-235; uranium-238; and americium-241, determined by the Laboratory's air monitoring network (AIRNET), are corrected for background by subtracting the average concentrations measured at representative background stations. The net air concentrations are then multiplied by a standard breathing rate and the 50-year CEDE for each radionuclide (DOE 1988a). To estimate a representative Los Alamos CEDE, AIRNET data from 13 stations in or near the townsite were averaged. The White Rock calculated dose is based on the data from four AIRNET stations in White Rock and Pajarito Acres.

This procedure for dose calculation assumes that exposure to the measured air concentration is continuous throughout the entire year (8,760 h).

c. External Radiation Dose. The Laboratory's largest contributor to the penetrating radiation environment is the Criticality Facility at Technical Area (TA) 18. Criticality experiments produce neutrons and photons, both of which contribute to the external penetrating radiation dose. During experiments that have the potential to produce a dose in excess of 1 mrem per operation, public access is restricted by closing Pajarito Road from White Rock to TA-51.

The other potentially significant contributor to penetrating radiation exposures is the Los Alamos Neutron Science Center (LANSCE) at TA-53. During experimentation at LANSCE, short-lived positron emitters are released from the stacks and diffuse from the buildings. These emitters release photon radiation as they decay, producing a potential external radiation dose. Most of the emitters decay very quickly, and within a few hundred meters from LANSCE the dose is negligible. However, the dose at East Gate (the Laboratory boundary north-northeast of LANSCE) is elevated by these Laboratory emissions. The Laboratory's contribution to the penetrating radiation dose at East Gate is derived by modeling and environmental measurements. In one method, data from a high-pressure ion chamber (located very near East Gate) have been used to develop a direct evaluation of the penetrating radiation exposure rate. (In 1996, the measured data were not complete and so were not used.) In the other method, calculated or measured emissions from the stacks and buildings at LANSCE are input to CAP-88 to model the potential dose at East Gate. The modeling generally results in an overestimation of the Laboratory's contribution to the hypothetically exposed individual. Residential locations are also modeled to determine potential doses from LANSCE operations.

Environmental thermoluminescent dosimeters (TLDs) are used to estimate external penetrating radiation doses. The Laboratory has a network of TLDs (TLDNET) in fixed locations around the Laboratory and townsite (refer to Figure 4-1). The large variations in the natural background levels of penetrating radiation limit the ability of TLDs to discern the low-level Laboratory releases from natural background fluctuations. However, if there were a release of penetrating radiation significantly above background, TLDs could be used as an indicator of the magnitude and locations of the exposures. TLDs near the TA-18 facility have shown exposure levels above background as discussed further in Section 3.A.4.b. The Laboratory's TLDNET is not sensitive enough to reliably distinguish LANSCE emissions from background.

The TLDNET data are used to quantify the exposure from penetrating radiation in and around Los Alamos. The dose from self-irradiation, caused by natural radioactive emitters such as potassium-40 within the body, is about 40 mrem annually and is also factored into the calculation.

d. Ingestion Dose. Radioanalytical data from samples of foodstuffs are used to estimate the annual committed dose equivalent (CDE) to various tissues in the body and the total CEDE to the whole body for the maximum consumer of food products within the general population. The CEDE from food products is calculated by multiplying the CDE, representing the total dose which an organ or tissue of the body is expected to receive over the 50-year period following an intake of radioactive material, by the weighting factors for that tissue as given in the International Commission on Radiological Protection (ICRP) 26 (ICRP 1977). The CDE (and thus the CEDE) does not include contributions from exposures external to the body.

To calculate the CEDE, the radionuclide concentration in a particular foodstuff is multiplied by an estimated annual consumption rate to obtain the total adjusted intake for a particular radionuclide. The estimated annual consumption rates used for these calculations are presented in Table 3-1. Multiplication of this annual adjusted intake by the appropriate radionuclide dose conversion factor for a particular organ gives the estimated CDE to the organ and, similarly, the CEDE to the entire body [DOE 1988b]. To determine the Laboratory impacts, if any, on a particular foodstuff, the maximum CEDE (i.e., average CEDE + 2 sigma) at regional stations or other background stations is subtracted from the maximum CEDE at each monitoring location. Because one cannot have a "negative exposure to radiation," all negative values are set to zero leaving only the net positive differences between the sampling location of interest and the background stations. This net positive difference is summed over all the monitored radionuclides to obtain

Table 3-1. Annual Consumption Rates for Calculating the Committed Effective Dose Equivalent in Foodstuffs

Food Groups	Average Exposed Individuals	Maximum Exposed Individuals
Dairy Products	120 kg (0.3 L/d)[a]	300 kg (0.8 L/d)[a]
(Fresh Cow's Milk)	96 kg (0.25 L/d)[a]	190 kg (0.5 L/d)[a]
Beef		
Meat	95 kg (210 lbs)[b]	110 kg (243 lbs)[b]
Bone	23.8 kg (53 lbs)[d]	27.5 kg (61 lbs)[d]
Elk		
Meat	9.5 kg (21 lbs)[a]	23 kg (50 lbs)[c]
Bone	2.4 kg (5 lbs)[d]	5.7 kg (13 lbs)[d]
Fish (Fresh)	5.7 kg (13 lbs)[a]	21 kg (46 lbs)[b]
Fruits	17 kg (37 lbs)[e]	46 kg (102 lbs)[e]
Vegetables	42 kg (91 lbs)[e]	114 kg (250 lbs)[e]
Beverages		
(Tap Water)[h]	540 kg (1.5 L/d)[a]	730 kg (2.0 L/d)[f]
(Tea & Water Based Drinks)	421 kg (1.1 L/d)[a]	557 kg (1.5 L/d)[a]
Eggs	12 kg (34 g/d)[a]	20 kg (55 g/d)[g]
Honey	1.4 kg (3 lbs)[i]	5 kg (11 lbs)[i]

[a] EPA 1984.
[b] NRC 1977.
[c] Based on the consumption of one 233 kg elk (Meadows and Hakonson 1982) per year per 4.5 persons family.
[d] Based on the meat consumption rate and the weight distribution of elk tissue groups (Meadows and Hakonson 1982).
[e] Based on values from the NRC Regulatory Guide 1.109 (NRC 1977) with 22% fruit and 54% vegetables. The homegrown fraction is estimated at 40% (EPA 1989a).
[f] 40 CFR 141.
[g] EPA 1991.
[h] Modified to reflect the percent of water that a particular well contributed to the total amount of drinking water pumped in a year.
[i] Value used in previous years and/or based on professional judgment.

the total net positive difference, which is expressed in mrem. The total net positive difference is also reported as a percentage of the DOE's 100 mrem/yr PDL (DOE 1990), and can be used to calculate the risk of cancer fatalities from consuming a particular foodstuff.

3. Estimation of Radiation Dose Equivalents for Naturally Occurring Radiation

Published EDE values from naturally occurring background radiation and from medical and dental uses provide a comparison with doses resulting from Laboratory operations. Global fallout doses resulting from atmospheric testing of nuclear weapons are only a small fraction of total environmental doses (<0.3% [NCRP 1987a]). Naturally occurring radiation dose is due primarily to exposure to the lungs from radon decay products and exposures from nonradon sources that affect the whole body.

External radiation comes from two sources of approximately equal magnitude: the cosmic radiation from space, and terrestrial gamma radiation from radionuclides in the environment. Estimates of natural radiation are based on a comprehensive report by the National Council on Radiation Protection and Measurements (NCRP 1987b) that uses 20% shielding by structures for high-energy cosmic radiation and 30% self-shielding by the body for terrestrial radiation.

Whole-body external dose is incurred from exposure to cosmic rays, external terrestrial radiation from naturally occurring radioactivity in the earth's surface, and from global fallout. The EDE from internal radiation is due to radionuclides naturally present in the body and inhaled and ingested radionuclides of natural origin.

Annual external background radiation exposures for sources other than radon vary depending on factors such as snow cover and the fluctuations from solar radiation (NCRP 1975a). Estimates of background radiation in 1996 from nonradon sources are based on environmental dosimeter measurements of 160 mrem in Los Alamos and 140 mrem in White Rock using complete datasets only (i.e., measurements for all four quarters). The elevation difference between Los Alamos and White Rock accounts mainly for the difference between the two numbers. These measured doses were adjusted for structural shielding by reducing the cosmic ray component by 20%. The measured doses were also adjusted for self-shielding by the body by reducing the terrestrial component by 30%.

The neutron dose from cosmic radiation and the dose from self-irradiation (NCRP 1987b) were then included to obtain the whole-body environmental dose of 160 mrem at Los Alamos and 140 mrem at White Rock from sources other than radon. Uranium decay products occur naturally in soil and building construction materials. Inhalation of radon-222 produced by decay of radium-226, a member of the uranium series, results in a dose to the lung, which also must be considered. The EDE from radon-222 decay products is assumed to be equal to the national average, 200 mrem/yr. This estimate may be revised if a nationwide study of background levels of radon-222 in homes is undertaken. Such a national survey has been recommended by the NCRP (NCRP 1984, 1987a).

In 1996 the EDE to residents was 360 mrem at Los Alamos and 340 mrem at White Rock from all natural sources. The individual components of the background dose for Los Alamos and White Rock, and the average EDE of 53 mrem/yr to members of the US population from medical and dental uses of radiation (NCRP 1987a) are listed in Table 3-2.

4. Total Maximum Individual Dose to a Member of the Public or to Individuals Who are not Laboratory Workers

The 1.93 mrem dose reported in Chapter 2 is similar to the following reported doses but is derived solely from an EPA-approved air transport model. The doses in this chapter are based on actual measurements as well as transport modeling. Both methods of dose calculation are valid and are included here to provide a range for consideration.

Table 3-2. Calculation of Total Effective Dose Equivalent (mrem/yr) from Natural or Man-Made Sources

	Los Alamos	White Rock
Radon	200	200
Self-irradiation	40	40
Total External[a]	120	100
Total Effective Background Dose	360	340
Medical	53	53

[a] Includes correction for shielding.

a. Maximum Individual Dose—Off-Site Locations. The maximum effective dose equivalent (EDE or dose) was calculated at various locations to assess the maximum radiological impact from the Laboratory to areas inhabited by the public. The East Gate area was found to be the location of the maximum off-site dose. This maximum EDE is the total dose from all potential routes of radiation exposure and is based on data gathered by both the environmental surveillance program and radiological effluent monitoring program. The maximum dose, or the ninety-fifth percentile value, was 5.3 mrem and the median value (fiftieth percentile) for this estimate was 1.4 mrem.

b. Maximum Individual Dose—On-Site Locations. Potential doses that an individual who is not a Laboratory worker could have received while within the Laboratory boundary were calculated as 8.0 mrem for the maximum dose, or ninety-fifth percentile value, and 2.9 mrem for the median dose, or fiftieth percentile value. The location of the maximum potential exposure is a section of Pajarito Road near TA-18. The frequency and amount of time a member of the public may spend traveling this section of Pajarito Road, as well as the operational cycles of the TA-18 facility, were factored into the above dose calculations, which also used readings of external penetrating radiation measurements taken at TA-18 during the operation of criticality experiments. Potential doses to public members from TA-18 operations are limited using well-established principles of controlling exposure level, frequency, and duration. The section of Pajarito Road near TA-18 is closed during experiments when TA-18-generated doses may exceed one mrem. For experiments involving lower dose levels, the road is controlled so that public members may pass by but not remain near TA-18. The 8.0 mrem maximum dose is a conservative estimate. An actual dose to an average public member who regularly commutes on Pajarito Road is estimated to be much lower.

c. Total Maximum Individual Combined Dose. By combining the calculated maximum off-site dose with the maximum on-site dose estimate, the maximum dose a member of the public could have received from the Laboratory during 1996 was estimated. The maximum dose, or the ninety-fifth percentile value, was equivalent to 13.3 mrem, or 13.3% of the DOE's annual public dose limit of 100 mrem EDE from all pathways. The median value (fiftieth percentile) for this dose estimate is 4.3 mrem; this dose is 1% of the total annual dose contribution from all sources of radiation (Figure 3-1). The contribution to the total maximum individual (median) dose via each pathway is presented in Figure 3-2.

5. Summary of Doses to Public Members of Nearby Residential Areas

Inhalation. The net CEDE resulting from the exposure, primarily through inhalation, to airborne emissions as measured by the AIRNET in 1996 for the townsites of Los Alamos and White Rock are 0.05 mrem and 0.04 mrem, respectively. These potential doses to the public are below the EPA standard of 10 mrem/yr for airborne emissions (EPA 1989b). Section 4.B.1.c provides further discussions on the CEDE by sampling locations as well as the radionuclides that contributed to this dose estimate.

External Exposure. For most environmental monitoring locations, no direct penetrating radiation dose equivalent to members of the public from Laboratory operations could be distinguished by measurements in 1996. The external penetrating radiation doses caused by Laboratory emissions of radionuclides to the air to residents of Los Alamos and White Rock were calculated to be 0.2 mrem and 0.01 mrem, respectively. However, higher-than-normal readings caused by external penetrating radiation sources at LANL were measured at one on-site location to which the public has access (Pajarito Road) and on-site locations to which individuals who are not Laboratory workers have some degree of access. For further discussion on additional potential individual exposures from Laboratory operations, see Sections 3.A.5.e below and 3.A.4.a above.

Ingestion Dose. Using the maximum consumption rate (see Table 3-1), the maximum difference between the total positive CEDE at sampling locations in the Los Alamos area and the regional background locations for each food group is as follows: fruits and vegetables, 0.77 mrem; milk, 0.083 mrem; honey, 0.036 mrem; eggs, 0.12 mrem; fish (bottom feeders), 0.083 mrem; fish (higher level feeders), 0.03 mrem; elk muscle, 0.011 mrem; elk bone, 1.4 mrem.; deer muscle, 0.013 mrem, deer bone, 1.1 mrem; and tea, 0.24 mrem. Assuming one individual consumed the total quantity for each food group (except bone tissue), the total net positive difference for the CEDE is 1.7 mrem. No LANL operation-caused radiation has been detected by analyzing the drinking water supply. Chapters 5 and 6 provide further discussions on the CEDE for other locations and for additional types of sample media.

Additional Public Exposure Scenarios and Doses from Laboratory Operations. In addition to the maximum individual dose presented in Sections 3.A.4.a and 3.A.4.b, hypothetical exposure scenarios are used to estimate the dose equivalents to individuals who walk, hike, or jog on certain parts Laboratory property. The scenarios considered in this section involve areas of Laboratory property to which the public is not technically granted access. However, these are areas where access is not designated as restricted by any means other than the generic Laboratory and/or federal government posting at the site boundary. The individuals within these scenarios are not authorized to be in these locations and would be trespassers. These scenarios are not expected to be realistic but were developed for informational purposes.

Exposure to TA-50 Effluent and Radioactive Liquid Waste Treatment Facility, Mortandad Canyon Stream Below National Pollutant Discharge Elimination System Outfall 051. Using radionuclide concentration and activity measurements from the TA-50 effluent and effluent from the stream below the Radioactive Liquid Waste Treatment Facility, National Pollutant Discharge Elimination System Outfall 051, the maximum CEDE using the maximum consumption rate of 16.1 L/yr is estimated at 19 mrem (19% of the DOE PDL) and 0.77 mrem (<0.8% of the DOE PDL), respectively. Using the average consumption rate of 5.7 L/yr, this annual CEDE decreases to 6.5 mrem and 0.27 mrem, respectively. Section 5.B.3.c provides further discussions on the assumptions used in this calculation.

Exposure to Sediments in Mortandad Canyon. Radioactivity in excess of background and fallout levels was measured in the Mortandad Canyon stream channel at four monitoring locations in 1996. The estimated maximum total effective dose equivalent (TEDE) (i.e., the total of the EDEs from all pathways plus twice the error term), using the dose modeling program RESRAD V5.61, to an individual frequenting

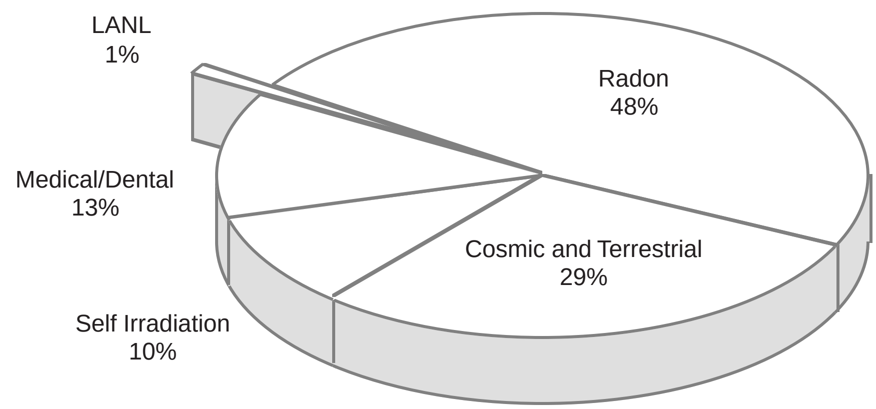

Figure 3-1. Total contributions to 1996 dose for the Laboratory's maximum exposed individual.

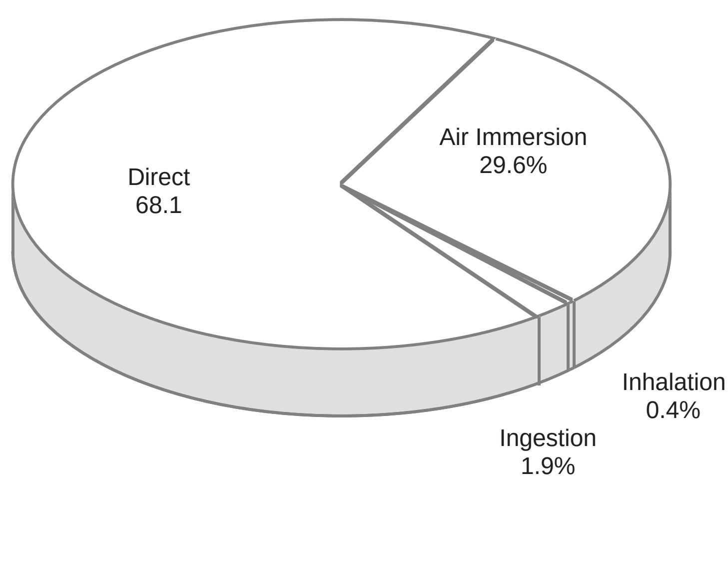

Figure 3-2. The Laboratory's contribution to dose by pathway for the Laboratory's maximum exposed individual.

the stream channel is 28 mrem/yr. However, because a hiking path exists approximately 3 m from the stream channel and the external penetrating radiation component (88% of the TEDE) falls off with increasing distance from the source, a more realistic estimated TEDE is approximately 6 mrem/yr. More detailed information on the calculations used to estimate this dose can be found in Section 5.C.3.a.

Exposure to Surface Contamination at Radioactive Waste Management Area T, TA-21. One of the monitoring locations at the waste management site, Area T, at TA-21 indicated a reading of 267 ± 10 mrem in 1996. This value is consistent with values observed at this location in the past and is attributed to cesium-137 on the ground. Applying the occupancy factor for industrial settings of 0.01 (Robinson and Thomas 1991) to the annual exposure rate, the maximum (i.e., the ninety-fifth percentile value) external penetrating dose to an individual frequenting the access road north of TA-21, Area T, for hiking or jogging is estimated at 2.9 mrem/yr. Additional information on the external penetrating measurements collected at TA-21 can be found in Section 4.C.5.b. (Low-Level Radioactive Waste Management Areas Network (WASTENET).

6. Population Distribution

The population distribution is used to calculate the collective dose resulting from 1996 Laboratory operations. In 1996, the estimated population of Los Alamos County was approximately 18,000 (BBER 1995). The two residential areas of Los Alamos townsite and White Rock and a few commercial areas exist in the county (Figure 1-1). The Los Alamos townsite (the original area of development) now includes residential areas known as Eastern Area, Western Area, North Community, Barranca Mesa, and North Mesa. The townsite had an estimated population of 12,000 residents in mid-1996. It is estimated that more than 246,000 persons lived within an 80-km (50-mi) radius of the Laboratory in mid-1996 (Table 3-3).

Table 3-3. Projected 1996/1997 Population within 80 km of Los Alamos National Laboratory[a]

	Distance from TA-53 (km)									
Direction	**0-1**	**1-2**	**2-4**	**4-8**	**8-15**	**15-20**	**20-30**	**30-40**	**40-60**	**60-80**
N	7	87	234	131	0	13	90	950	811	587
NNE	6	64	93	23	2	10	2,338	395	671	313
NE	3	11	0	0	1	1,181	14,743	2,536	2,457	3,591
ENE	1	0	0	0	559	1,499	4,546	3,585	1,416	1,601
E	0	0	0	1	316	1,332	4,096	386	22	413
ESE	0	0	0	0	9	10	669	8,017	727	2,240
SE	0	2	0	4,468	565	0	984	72,724	7,485	664
SSE	3	3	0	510	341	0	293	5,656	2,577	110
S	2	2	0	0	21	0	16	148	399	3,056
SSW	3	3	0	0	30	1	794	1,316	6,974	53,789
SW	3	10	0	1	4	1	0	0	2,249	188
WSW	1	16	27	0	7	0	32	387	2,474	5
W	0	3	119	173	0	7	66	291	64	72
WNW	2	14	1,007	5,839	0	0	26	30	63	2,622
NW	5	29	886	1,431	0	2	24	49	0	577
NNW	6	59	681	282	0	6	19	259	161	283
Total	42	303	3,047	12,859	1,855	4,062	28,736	96,729	28,550	70,111

[a] Total Population within 80 km of Los Alamos National Laboratory is 246,294.

7. Collective Dose

The collective EDE from Laboratory operations is the sum of the estimated dose received by each member of the population within an 80-km (50-mi) radius of LANL. Over 99% of this Laboratory operation dose is expected to have resulted from airborne radioactive emissions. As a result, the collective dose was estimated by modeling radioactive air emissions, their transport off-site, and the potential radiation exposures. The population distribution given in Table 3-3 was used in the dose calculation. The collective dose was calculated with the CAP-88 collection of computer programs. Airborne radioactive emissions from all types of releases were included in the analysis. The same exposure pathways that were evaluated for the maximum individual dose were also evaluated for the collective dose; these pathways include inhalation of radioactive materials, external radiation from materials present in the atmosphere and deposited on the ground, and ingestion of radionuclides in meat, produce, and dairy products. The 1996 collective EDE attributable to Laboratory operations to persons living within 80 km (50 mi) of the Laboratory was calculated to be 1.2 person-rem.

B. Risk to an Individual from Laboratory Operations

1. Estimating Risk

Health effects from radiation exposure (primarily cancer) are observed in humans only at doses in excess of 10 rem delivered at high dose rates (HPS 1996). In past environmental surveillance reports, our practice has been to use the risk estimates, also called risk factors, presented in the Committee on the Biological Effects of Ionizing Radiation (BEIR) documents (most recently, BEIR V 1990) to quantify the cancer risks from exposure to Laboratory contributions to local radiation levels. Although it is important to address the potential risk from these radiation doses, it is also important not to mislead the reader into concluding that small radiation doses are more hazardous than they actually are.

The risk estimates in BEIR V were developed by the National Academy of Sciences and were based primarily on the dose-risk effects produced in survivors close to the Hiroshima and Nagasaki atomic bomb blasts. These calculations, however, overestimate actual risk for low linear energy transfer (low-LET, primarily gamma) radiation, which is the source of more than 95% of the dose to the maximum exposed individual from Laboratory operations. Summarizing from the NCRP (1975b) risk estimates that are based on high doses and high-dose rates cannot provide realistic estimates of radiogenic cancers that might result from low-level doses received at low-dose rates. The fundamental shortcoming of the BEIR V risk estimates for determining low-level radiation effects is that they are based, primarily, on the effects of doses of tens or hundreds of rem received over periods of seconds. Extrapolating these data linearly downward to the mrem or fractions of mrem annual doses from Laboratory operations almost certainly results in a great overestimation of risk.

As early as the 1920s, investigators concluded that low levels of radiation could not cause the mutations and other effects assigned to such doses (Muller and Mott-Smith 1935). More recently, Billen (1990) concluded that radiation-induced DNA damage is a small contributor to the ongoing, spontaneous DNA damage that occurs in mammalian cells. In Billen's discussion, he suggests that an annual dose in the range of less than or equal to 100 mrem can be considered a "negligible dose." In terms of DNA damage, this dose is so small as to provide no effect that could be discerned from other causes. Other researchers conclude that there is no scientific basis for the low-dose risk estimates recommended by the EPA and BEIR V, and instead, propose new risk assessment methodologies that involve defining minimum significant risk (Seiler and Alvarez 1994 and 1996).

Radiation hormesis (the concept that small radiation doses in the range of a few rem annually may be beneficial) should also be considered when evaluating radiation-induced risk. The following discussion is paraphrased from Gollnick (1994). The descriptor *beneficial* means that a population exposed to small amounts of radiation will experience fewer cancer deaths than a similar, unexposed population. Among the claimed effects of small radiation doses, in addition to the potential for reduced cancer risk, are increased life span, growth, and fertility. Gollnick describes possible biochemical bases for these effects including elevated antibody levels in irradiated animals and differential sensitivity of different types of lymphocytes to radiation that effectively increases the body's ability to attack tumors. Some population studies support the radiation hormesis concept. Recently, Cohen (1997) compared cancer incidence to mean radon level in homes in the US. After adjusting for cigarette smoking, the data clearly indicate that at radon levels up to approximately 4 pCi/L (approximately equivalent to 1 rem), cancer incidence decreases with increasing radon level. This argues strongly against the conclusion that any small increment of radiation implies an increment in cancer risk at low overall doses. Rather, the data indicate that low levels (<5 rem) of radiation may decrease cancer risk.

The Health Physics Society published a position statement on the risks of radiation exposures (HPS 1996). They concluded that below an individual dose of 5 rem in one year "risk estimates should not be used; expressions of risk should only be qualitative emphasizing the inability to detect any increased health detriment (i.e., zero health effects is the most likely outcome)."

Estimates range from 1 in 50 million excess risk of cancer death per mrem dose to a member of the public (EPA 1994) to a beneficial, although unquantified, risk as described above. We present the range of risk estimates in this section to allow readers to draw their own conclusions regarding the dangers of Laboratory radiation. If one chooses to use the BEIR or EPA risk estimates (factors) to calculate the potential excess cancer rates from a radiation dose, a sizable body of research indicates that the calculation will overestimate the actual risk. The potential excess cancer deaths may be calculated according to the following equation:

$R = D \times RF$ where

R = incremental (or decremental) risk of cancer death expected from a radiation dose to an individual,

D = effective dose equivalent (mrem), and

RF = risk factor (excess cancer deaths/mrem).

As noted previously, RFs range from 5×10^{-7}/mrem to negative, as yet unquantified values. In the following section, we do not report the potential risks associated with the reported doses, but the reader may calculate these according to the above equation, using whichever risk factors are believed to be appropriate.

2. Risk from Laboratory Operations

The risks calculated from natural background radiation and medical and dental radiation can be compared with the incremental risk caused by radiation from Laboratory operations. The average doses to individuals in Los Alamos and White Rock from 1996 Laboratory activities were 0.2 and 0.1 mrem, respectively. The exposure to Los Alamos County residents from Laboratory operations is well within variations in exposure of these people to natural cosmic and terrestrial sources and global fallout. For example, variation in the amount of snow cover and in the solar sunspot cycle can cause a 10-mrem difference from year to year (NCRP 1975a).

For Americans, the average lifetime risk is a 1-in-4 chance of contracting cancer and a 1-in-5 chance of dying of cancer (EPA 1979). Assuming one accepts the most conservative risk estimates (BEIR V 1990 and EPA 1994), the incremental risk from exposure to Laboratory operations is negligible.

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4. Air Surveillance

primary authors:

Stephanie A. Archuleta, Dennis R. Armstrong, Jeffrey A. Baars, Patrick L. Beaulieu, Craig F. Eberhart, Ernest S. Gladney, Keith W. Jacobson, David H. Kraig, Scott A. Miller

Highlights from 1996

Los Alamos National Laboratory (LANL or the Laboratory) discontinued operation of 5 of its 58 air monitoring stations during 1996. The remaining 53 stations operated throughout 1996 and collected air samples that were analyzed for tritium, americium-241, plutonium-238, plutonium-239 ,-240, uranium-234, uranium-235, and uranium-238 to determine air concentrations of these radionuclides in the ambient air near the samplers. Air monitoring network (AIRNET) data indicate that at all locations, air concentrations were well below applicable guides and limits.

Air concentration data were analyzed to identify concentrations above those normally seen. These data analyses and follow-up assessments revealed an increasing trend in air concentrations of americium-241 and plutonium-239, -240 at one station location at TA-54, Area G, the waste disposal area at LANL. The air concentrations increased somewhat during the first quarter of 1995, and then again, to a significantly higher level during the second quarter of 1996. These increases were seen only at one station and suggested that the source of contamination was very small and very close to the station. A ground survey of the vicinity revealed a small area a few tens of meters from the station that had soil contaminated at levels about 100 times the average concentrations nearby.

We found that trenching had occurred next to the sampler during 1995 and 1996 and that the nearby road had been rerouted during early 1996. Our conclusion is that trenching or road work may have brought some contaminated material to the surface of the road and that heavy vehicle traffic associated with the Transuranic Waste Inspectable Storage Project operations provided an efficient mechanism to get the contamination airborne in the immediate vicinity. Because these concentrations were found to be localized and within a controlled area, a resulting dose would not have been experienced by a member of the public and are orders of magnitude below applicable exposure limits for workers.

To Read About . . . Turn to Page . . .

A. Ambient Air Sampling

1. Introduction

The radiological air sampling network at Los Alamos National Laboratory (LANL or the Laboratory) is designed to measure environmental levels of airborne radionuclides that may be released from Laboratory operations. Laboratory emissions include microcurie (μCi) quantities of plutonium and americium, millicurie (mCi) quantities of uranium, and curie (Ci) quantities of tritium and activation products. Each station collects both a total particulate matter sample and a water vapor sample for analysis.

Natural atmospheric and fallout radioactivity levels fluctuate and affect measurements made by the Laboratory's air sampling program. Regional airborne radioactivity is largely composed of fallout from past atmospheric nuclear weapons tests by several countries, natural radioactive constituents from the decay of thorium and uranium attached to dust particles, and materials resulting from interactions with cosmic radiation (for example, natural tritiated water vapor produced by interactions of cosmic radiation and stable water). Regional levels of radioactivity in the atmosphere, which are useful in interpreting air sampling data, are summarized in Table 4-1. Note that the measurements taken in Santa Fe by the US Environmental Protection Agency (EPA) are similar to those taken by the Laboratory as regional background values and are significantly lower than EPA concentration limits for the general public.

Particulate matter in the atmosphere is primarily caused by the resuspension of soil, which is dependent on meteorological conditions. Windy, dry days can increase the soil resuspension, but precipitation (rain or snow) can wash particulate matter out of the air. Consequently, there are often large daily and seasonal fluctuations in airborne radioactivity concentrations caused by changing meteorological conditions. The measured airborne concentrations are less than the EPA concentration limit for the general public. The EPA limit represents a concentration that would result in an annual dose of 10 mrem.

2. Air Monitoring Network

During 1996, ambient air sampling for airborne radioactivity was conducted at more than 50 locations. Stations are categorized as regional, pueblo, perimeter, or on-site. Three regional monitoring stations, 28 to 44 km (18 to 28 mi) from the Laboratory, are located in Española, Pojoaque, and Santa Fe. The data from these stations are used as reference points for determining regional background and fallout levels of atmospheric radioactivity. The pueblo monitoring stations are located at the Pueblos of San Ildefonso, Taos, and Jemez. There are now more than 20 perimeter stations located within 4 km (2.5 mi) of the Laboratory boundary (Figures 4-1 through 4-3).

Because maximum concentrations of airborne releases of radionuclides would most likely occur on-site, more than 30 stations are within the Laboratory boundary. For quality assurance (QA) purposes, two samplers are co-located as duplicate samplers, one at station #27 at Technical Area (TA) 54 and one at station #26 at TA-49. Also, there is a backup station located at East Gate. In addition to the three categories mentioned previously, stations can also be classified as being inside or outside a controlled area. A controlled area is defined as having possibly radioactive materials or elevated radiation fields and are clearly posted as such (DOE 1988). The active waste site TA-54 Area G is an example of a controlled area.

3. Sampling Procedures, Data Management, and Quality Assurance

a. Sampling Procedures. The Laboratory operates a network of more than 50 environmental air stations (called AIRNET) to sample radionuclides in ambient air (Figures 4-1 through 4-3). Each sampler is equipped with a filter to collect a particulate matter sample for gross alpha/beta and radiochemical determinations and a silica gel cartridge to collect moisture for tritium determination. The particulate filter and the gel cartridge are collected and are typically analyzed biweekly. To increase our ability to detect radionuclides, the particulate filters are accumulated for three months, composited, split, and then sent to commercial analytical laboratories for radiochemical analyses. Details about the sample collection, sample management, chemical analysis, and data management activities are provided in the project plan (ESH-17 1995) and in the numerous procedures through which the plan is implemented.

b. Data Management. The 1996 field data, including timer readings, readings for the flow in the sampling trains at the start and stop of the sampling period, and comments pertaining to these data, were recorded electronically in the field on a palm-top microcomputer. These data were later transferred to a table format within the ESH-17 AIRNET Microsoft Access database.

c. Analytical Chemistry. The 1996 particulate filters were analyzed biweekly by the Health Physics Measurements Group (ESH-4) Health Physics Analytical Laboratory (HPAL), using analytical procedures that meet the requirements of 40 Code of Federal Regulations (CFR) 61, Appendix B, Method 114, for gross alpha, gross beta, and tritium. A composite was prepared quarterly for each station by combining the filters from the six or seven sampling periods during the quarter. The composites (one for each station) were split, and the first half submitted to a commercial laboratory for analyses that conformed to EPA requirements. The second half of each composite was temporarily retained for reanalysis, if needed. Every two weeks, Air Quality Group (ESH-17) staff distilled the moisture from the silica gel cartridges and submitted the distillate to the ESH-4 HPAL for tritium determination by liquid scintillation spectrometry. A summary of the target miniumum detectable amount for the biweekly and quarterly samples is provided in the QA Project Plan for Radiological Air Sampling Network (ESH-17 1995).

d. Laboratory Quality Control Samples. For 1996, ESH-17 maintained a program of blank, spike, duplicate, and replicate analyses, which was designed to provide information on the quality of the data received from analytical chemistry suppliers. The chemistry met QA requirements for the Air Quality programs. Comprehensive data for the 1996 analytical quality assurance program are being prepared for publication in a separate report.

4. Radiochemical Analytical Results

a. Gross Alpha and Beta Radioactivity. Gross alpha and gross beta analyses are used primarily to evaluate general radiological air quality and to identify potential trends. If gross activity in a sample is consistent with past observations and background, immediate special analyses for specific radionuclides are not necessary. If the gross analytical results appear to be elevated, then immediate analyses for specific radionuclides may be performed to investigate whether a problem, such as an unplanned release, has occurred. Gross alpha and beta activity in air exhibit considerable environmental, especially seasonal, variability as shown in Figures 4-4 and 4-5.

The National Council on Radiation Protection and Measurements (NCRP) estimated the average concentration of long-lived gross alpha activity in air to be 2.0 fCi/m^3. The primary alpha activity is due to polonium-210 (a decay product of radon gas) and other naturally occurring radionuclides (NCRP 1987). The NCRP also estimated average concentration levels of long-lived gross beta activity in air to be 20.0 fCi/m^3. This activity is primarily due to the presence of lead-210 and bismuth-210 (decay products of radon) and other naturally occurring radionuclides.

More than 1,000 air samples were collected in 1996 and analyzed for gross alpha and gross beta activity. As shown in Table 4-2, the annual averages for all of the stations were within two standard deviations of the NCRP's estimated average (2 fCi/m^3) for gross alpha concentrations. Gross alpha activity is almost entirely from the decay of natural radionuclides, primarily radon, and is dependent on variations in natural conditions such as atmospheric pressure, temperature, and soil moisture. The differences among the groups are most likely attributable to these factors (NCRP 1987).

Table 4-3 shows gross beta concentrations within and around the Laboratory. These data show variability similar to the gross alpha. All group averages are below 20 fCi/m^3, the NCRP estimated national average for gross beta concentrations.

b. Tritium. Laboratory operations released 680 curies of tritium during 1996. In addition, tritium is present in the environment as the result of nuclear weapons tests and is also produced naturally by the cosmogenic process (Kathern 1984). Sampling results are presented in Table 4-4. As a group, the perimeter stations seemed to show higher tritium concentrations than the regional or pueblo stations. The perimeter station average was 1.3 ± 1.2 pCi/m^3 compared to 0.3 ± 0.8 for the regional stations. The maximum off-site mean annual concentration of 2.2 pCi/m^3 was recorded at stations #8 and #16. The uncertainty (two standard deviations) of each perimeter, regional, and pueblo station is greater than the measured air concentration. The calculated gross tritium dose (no background subtraction) based on the mean air concentration at stations #8 and #16 was 0.15% of the EPA's public dose limit (PDL) of 10 mrem per year.

Elevated concentrations were observed at a number of on-site stations, with the highest maximum and annual mean concentration at station #35 (Area G). Elevated mean air concentrations were also seen at other Area G stations and one non-Area G station (#25). Station #35 is located at Area G in the TA-54 waste site (a radiological control area) near shafts where tritium-contaminated waste is disposed, and station #25 is located near a tritium facility. However, the annual mean gross (no background subtraction) concentration, which was observed at station #35, is approximately 0.002% of the Department of Energy (DOE) derived air concentration (DAC) for controlled areas (20×10^6 pCi/m^3). All annual mean concentrations were well below the applicable EPA and DOE guidelines.

c. Plutonium. Plutonium is released by the Laboratory in microcurie amounts. In addition, plutonium is present in the environment because of fallout from past nuclear weapons testing and, in some isolated cases, from natural sources (Kathern 1984).

Sampling results for plutonium-238 are presented in Table 4-5. The table shows that the highest group summary mean was for the category decontamination and decommissioning (D&D) stations at TA-21, with an annual mean of 6.5 ± 13.3 aCi/m^3. This corresponds to approximately 0.3% of the EPA public dose limit. The highest annual mean for an individual station was at station #27 on the north perimeter of TA-54, Area G, with an annual mean activity of 19.8 ± 10.0 aCi/m^3. This corresponds to approximately 0.94% of the EPA's public dose limit, or about 0.094 mrem. Analysis of data from this station indicates an increasing trend for this and other isotopes (plutonium-239) and radionuclides (americium-241) as discussed further below.

Sampling results for plutonium-239 are presented in Table 4-6. The regional, pueblo, and perimeter station group summaries all indicate annual means near zero, as we would expect. The highest annual mean at any off-site station occurred at Station #9, Los Alamos Airport and was 2.9 ± 1.4 aCi/m^3 of plutonium-239, -240. This annual mean concentration corresponds to approximately 0.15% of the EPA's public dose limit, or about 0.015 mrem (this is a gross dose with no background subtraction). The Los Alamos Airport is the nearest air monitoring station downwind of the decontamination and decommissioning operations at TA-21. The stations at TA-21 have an annual group mean that is higher than the other groups, with the exception of the Area G stations discussed below. The somewhat elevated concentrations at TA-21 may have resulted from increased ground-level emissions associated with the demolition and related activities that occurred at this site during 1996.

The maximum on-site station mean (706.6 ± 369.9 aCi/m^3) was recorded at Station #27, TA-54, Area G. Station #27 was the highest on-site station last year also (ESP 1996), and we believe there has been a significant increase in the air concentration of plutonium-239 (and americium-241) at this location beginning during the second quarter of 1995 and continuing at least through the final quarter of 1996. The mean air concentration of plutonium isotopes at Station #30 (near Area G) appears to have been elevated because of high second quarter values as discussed further in Section 4.A.5.e.

d. Americium. Because americium often occurs along with plutonium, plutonium samples are also submitted for americium analysis. Results are presented in Table 4-7. As described for plutonium-238, americium is present in very low concentrations in the environment, and this is indicated by the low annual mean concentrations seen at the regional, pueblo, and perimeter station summaries. The elevated mean of 7.3 ± 27.1 aCi/m^3 for the on-site station group is due primarily to a single high value at station #30 (Pajarito Booster). The slightly elevated americium concentrations at the D&D sites (TA-21) may be due to increased ground-level emissions resulting from D&D activities. The elevated annual mean at the Area G stations is significant and is discussed in Section 4.A.5.

e. Uranium. Uranium is released from the Laboratory in microcurie amounts and occurs naturally in rocks and soil (please refer to a general discussion regarding uranium in the environment in a previous annual report [ESP 1995]). Tables 4-8, 4-9, and 4-10 present radioisotopic results for uranium-234, uranium-235, and uranium-238, respectively. The highest on- or off-site annual mean concentration for uranium-234 was at station #78, in the vicinity of firing sites where depleted uranium has been dispersed in explosive experiments. The maximum annual mean concentration at the perimeter stations was recorded at station #61; Los Alamos Hospital. The gross (not corrected for background) activity of 20.2 aCi/m^3 corresponds to approximately 0.036 mrem according to the EPA's PDL. The annual means of both the regional and the pueblo stations were higher than the on-site stations. This indicates the overwhelming importance of high background levels of natural uranium in the soils in these areas compared to Laboratory contributions. The highest uranium-235 concentration was at station #78. The maximum off-site value was 3.1 ± 2.3 aCi/m^3 at Española. All annual mean concentrations of uranium-238 were well below the applicable EPA and DOE guidelines.

In addition to releases of uranium from some Laboratory facilities, depleted uranium (consisting primarily of uranium-238) is dispersed by experiments that use conventional high explosives. About 176 kg of depleted uranium containing about 0.124 Ci of radioactivity was used in such experiments in 1996. Most of the debris from these experiments was deposited on the ground in the vicinity of the firing sites. Limited experimental data show that no more than about 10% of the uranium becomes airborne in a high-explosive test (Dahl and Johnson 1977). Dispersion calculations indicate that the resultant maximum airborne concentrations would be greater than concentrations attributable to the natural abundance of uranium that is resuspended in dust particles; however, the predicted values were not detected at on- or off-site stations.

5. Investigation of Elevated Air Concentration

In 1996, a number of air sampling values exceeded investigation levels established by ESH-17. A discussion of how investigation levels are determined can be found in the QA Plan for Radiological Air Sampling Network (ESH-17 1995). When a measured air concentration exceeds an investigation level, ESH-17 verifies that the calculations were done correctly and that the sampled air concentrations are likely to be representative, i.e., that no cross contamination has taken place. Next, we work with personnel from the appropriate operations to assess potential sources for the elevated concentrations. The following sections identify four incidences of elevated air concentrations that warrant further discussion.

a. Technical Area 54, Area G. Recently, the Laboratory initiated a formal ongoing review process of air monitoring data to assess whether ambient air concentrations of radionuclides are above what we have seen in recent history. As a result of that review, the Laboratory identified elevated air concentrations at station #27, on-site at Area G. By constructing a trend of the plutonium-239 and americium-241 concentrations since the first quarter of 1991, we determined that these are not isolated high values but, rather an increasing trend (Figure 4-6). Other radionuclides are not elevated significantly. None of the other air monitoring stations at Area G showed evidence of this increasing trend, and neither did the nearby off-site stations, including those in White Rock.

Plutonium-239 and americium-241 increased somewhat during the first quarter of 1995. Before 1995, the average air concentrations of plutonium-239 and americium-241 were about 11 aCi/m^3. Beginning in the first quarter of 1995, plutonium-239 concentrations increased and remained at a plateau for approximately five quarters at an average concentration of 120 aCi/m^3 for plutonium-239 and 96 aCi/m^3 for americium-241. During the second quarter of 1996, a much larger increase occurred at both stations for the same radionuclides. A higher plateau was reached and the concentrations have remained at these elevated levels of 900 aCi/m^3 for plutonium-239 and 600 aCi/m^3 for americium-241 throughout the remainder of 1996.

The Laboratory performed a survey of the adjacent road area using a “Violinist” (a scintillation detector with a multiple channel analyzer that is capable of discriminating the low levels of gamma radiation associated with the decay of plutonium-239 and americium-241). The survey was completed during May 1997 and showed one small area (approximately 10 m $\times$ 15 m) of americium-241 and plutonium-239 contamination significantly higher than adjacent areas.

The entire road area in the vicinity of the air monitoring station had been moved and reworked over the past year. Additionally, trenching for waterlines along the northern edge of the road passed within a couple of meters of station #27. Although the survey results are still under evaluation, a preliminary summary and conclusions appear to be warranted. A first trenching operation occurred in February 1995 and appears to have been synchronous with the initial small rise in air concentrations. Another trenching operation and a complete reworking of the road surface was begun during the spring of 1996, closely matched in time with the much more significant increase in air concentrations. The road was actually moved in early 1996 and that move appears to have taken the road path directly over the contaminated area. Our preliminary conclusion is that trenching or the road work may have brought some contaminated material to the surface of the road and that heavy vehicle traffic associated with the Transuranic Waste Inspectable Storage Project operations has provided an efficient mechanism to get the contamination airborne in the immediate vicinity of station #27.

During 1997, the Laboratory should complete a remediation of the problem by covering the contamination with approximately 30 cubic yards of clean dirt. We are having biweekly AIRNET samples from station #27 radiochemically analyzed for americium and plutonium isotopes to assess whether airborne concentration levels have dropped as a result of the dirt cover. Additionally, surface surveys similar to the original survey that identified the contamination are planned to evaluate the effectiveness of this remediation.

b. Technical Area 16. We believe that elevated tritium results observed at the TA-16-450 station are related to increased tritium activities (stack and non-stack emissions) by the Weapons Engineering Tritium Facility at TA-16, which became fully operational during 1995. Stack effluents from TA-16 totaled 99 Ci, with 66% as tritium oxide. Using the air sampler data, non-stack emissions are estimated at 1 to 10 Ci per year of tritium oxide. The maximum dose resulting to a member of the public from the release of these effluents is calculated to be 0.003 mrem/yr to 0.004 mrem/yr.

c. Technical Area 21. Concentrations of transuranic radionuclides exceeding the investigation levels have been observed at TA-21 (stations #19, and #71 through #75) in the past and are thought to have resulted from increased ground-level emissions associated with D&D activities during 1996.

d. Firing Sites. Elevated concentrations of isotopes of uranium observed at firing site stations are attributed to open air explosive testing at TA-15-PHERMEX.

e. Station #30. This station, located at the turn-off at Pajarito Road to TA-54, recorded elevated readings of plutonium-239 and americium-241 for the second quarter of 1996. Results from other sample periods were examined to see if an undesirable trend was occurring; no trend was found. At this time, the cause of the elevated readings remains unknown.

6. Long-Term Trends

Investigation of long-term trends can provide information about long-term impacts of the Laboratory on the environment and help us to reduce such impacts. Last year (ESP 1996), we explored trends in tritium concentrations and concluded that ambient concentrations have decreased significantly compared to those in the 1970s and early 1980s.

In the current report, we have identified an ongoing situation at one Area G location where air concentrations of americium-241 and plutonium-239 have been increasing since early 1995. This increasing trend is discussed above. General review of our monitoring data does not indicate any other significant trends at this time. We will continue to analyze these data and will report on significant trends as they emerge.

7. Dose Equivalents to Individuals from Ambient Air Monitoring Network

Inhalation dose resulting from exposure to airborne tritium (as tritiated water vapor); plutonium-238; plutonium-239, -240; americium-241; uranium-234; uranium-235; and uranium-238 was determined from samples collected by the AIRNET program. The background concentration values of these radionuclides, which includes natural radioactivity and worldwide fallout, were measured at selected locations and subtracted from the annual average concentrations values given in Tables 4-2 through Table 4-10 to determine net dose from LANL airborne effluents. The net dose measured by AIRNET in the townsites of Los Alamos and White Rock were 0.05 mrem and 0.04 mrem, respectively.

B. Stack Air Sampling for Radionuclides

1. Introduction

Radioactive materials are an integral part of many activities at the Laboratory, and some of these materials may be vented to the environment through a stack. These operations are evaluated to determine impacts on the public and the environment. If this evaluation shows that emissions from a stack may potentially result in a member of the public receiving 0.1 mrem in a year, this stack must be sampled in accordance with 40 CFR 61, subpart H, “National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities” (EPA 1989). As of the end of 1996, 28 stacks were identified as meeting this criterion. An additional four sampling systems were in place to meet DOE requirements for nuclear facilities prescribed in technical or operational safety requirements. Where sampling is not required, emissions are estimated using engineering calculations and radionuclide inventory information.

2. Sampling Methodology

As of the end of 1996, LANL was continuously sampling 32 stacks for the emission of radioactive material to the ambient air. LANL has identified four types of radioactive stack emissions: (1) particulate matter, (2) vaporous activation products (VAP), (3) tritium, and (4) gaseous/mixed air activation products (G/MAP). For each of these emission types, the Laboratory employs an appropriate sampling method.

3. Sampling Procedure and Data Management

a. Sampling and Analysis. Analytical methods were chosen for compliance with EPA requirements (40 CFR 61, Appendix B, [EPA 19] Method 114). These requirements were derived during 1995, as part of the development of QA project plans for tritium, particulate, and vapor sampling.

b. Laboratory Quality Control Performance. Groups of discrete samples were submitted to commercial laboratories for radiochemical analyses. For these analyses, the Laboratory maintained a program of blanks and spikes consistent with EPA guidelines (EPA 1991). These EPA guidelines call for a frequency of 1 blank and 1 duplicate for every 20 samples. For the tritium analyses for the stack program, the HPAL maintained a program of blanks and duplicates analyses that was more frequent than EPA guidelines. Comprehensive data for the 1996 analytical quality assurance program are being prepared for publication in a separate report.

4. Analytical Results

Measurements of Laboratory stack emissions during 1996 totaled 13,790 Ci. Of this total, tritium emissions comprised 680 Ci, and air activation products from the Los Alamos Neutron Science Center (LANSCE) contributed 13,110 Ci. Combined airborne emissions of materials such as plutonium, uranium, americium, and particulate/vapor activation products were less than 0.5 Ci.

As in 1995, radioactive particulate source terms were developed using radionuclide specific analyses rather than process knowledge. In an effort to provide better data, the identities of radionuclides emitted from Laboratory stacks were determined through the use of radioanalytical chemistry in 1995 and 1996. For this reason, emissions of americium-241 are now presented separately from emissions of plutonium. Where sampling was discontinued or analyses were added during the year, calculated emissions are not representative of annual emissions. To account for this, incomplete emissions were scaled to reflect an entire year.

5. Long-Term Trends

Radioactive emissions from sampled Laboratory stacks are presented in Figures 4-7 through 4-10. These figures illustrate trends in measured emissions for plutonium, uranium, tritium, and G/MAP emissions, respectively. As the figures demonstrate, no increases in emissions from 1995 to 1996 were measured. The major decrease in emissions occurs for LANSCE. This decrease in emissions is primarily due to the operation of the delay line (described below), a decreased run time, and to the facility configuration during 1996.

Figure 4-11 shows the total contribution of each of these emission types to the total Laboratory emissions. It clearly shows that G/MAP emissions and tritium emissions comprise the vast majority of radioactive stack emissions.

Because G/MAP emissions account for most of the airborne radioactivity, and because the FE-3 stack at LANSCE is the primary source of G/MAP isotopes, LANSCE operating personnel have developed and implemented a delay line to reduce these emissions. The delay line operates by removing a large part of the concentrated activated air from the production point at the LANSCE beam stop. This air is passed through a 1,200-m tube, allowing approximately 100 minutes of additional decay time (Fuehne 1996). Because of the short half-lives of the G/MAP isotopes, carbon-10 (19.5 s), carbon-11 (20 min), nitrogen-13 (10 min), nitrogen-16 (7 s), oxygen-14 (71 s), oxygen-15 (123 s), and argon-41 (1.8 h), this delay is sufficient to significantly reduce the total activity before returning the air to the stack. A recent study shows that, with the delay line operating, G/MAP emissions were reduced by 28.8%, as compared to similar operations without the benefit of the delay line (Fuehne 1996). Through such efforts, emissions of airborne radioactivity can be reduced while limiting the impact on the operating schedule.

C. Cosmic and Gamma Radiation Monitoring Program

1. Introduction

Naturally occurring external penetrating radiation originates from terrestrial and cosmic sources in the form of gamma rays, neutral particles, charged particles, and heavy nuclei. Man-made radiation consists of the same types of radioactive materials with the exception of the heavy nuclei. To evaluate natural and man-made radiation, the Laboratory's environmental monitoring program uses thermoluminescent dosimeters (TLDs) and a high-pressure ion chamber (HPIC) which is part of the Neighborhood Environmental Watch Network (NEWNET) community monitoring network operated by the Laboratory's Instrumentation and Control group. Because the natural background from terrestrial and cosmic sources are much larger than those from man-made sources, it is extremely difficult to distinguish man-made sources from the natural background. There are several environmental mechanisms that contribute to this difficulty.

The terrestrial component results primarily from naturally occurring potassium-40, the thorium and uranium decay chains, and radionuclides deposited as a result of nuclear atmospheric testing (e.g., strontium-90, cesium-137, and small amounts of plutonium). Terrestrial radiation varies diurnally, seasonally, and geographically. External penetrating radiation levels can vary from 15% to 25% at a given location because of changes in soil moisture and snow cover that reduces or blocks the radiation from terrestrial sources (NCRP 1975). There is also spatial variation that is a result of the soil type and the placement of the dosimeters. For example, those dosimeters that are placed in a narrow canyon will receive radiation from the sidewalls and the floor of the canyon as well as from the cosmic sources (ESP 1978).

Naturally occurring ionizing radiation from cosmic sources increases with elevation because of reduced atmospheric shielding. At sea level, cosmic sources yield between 25 and 30 mrem/yr. Los Alamos, with a mean elevation of about 2.2 km (1.4 mi), receives about 75 mrem/yr from cosmic sources. However, different locations in the region range in elevation from about 1.7 km (1.1 mi) at Española to 2.7 km (1.7 mi) at Fenton Hill, resulting in a corresponding range of 45 to 90 mrem/yr from cosmic sources. This component can also vary ±10% because of solar modulations (NCRP 1987). These fluctuations along with those from terrestrial sources make it difficult to detect an increase in radiation levels from man-made sources, especially when the increase is small relative to the magnitude of natural fluctuations.

2. Monitoring Network

a. Laboratory and Regional Areas (TLDNET). In an attempt to be able to distinguish any impact from Laboratory operations, 58 thermoluminescent dosimeter (TLD) stations are placed around the Laboratory and in the surrounding communities. This network of dosimeters is divided into three groups. (1) The off-site regional group has six locations ranging from 28 to 117 km (17 to 73 mi) from the Laboratory boundary. These regional stations are located at Fenton Hill and in the neighboring communities of Española, Pojoaque, Santa Fe, and the Pueblos of San Ildefonso and Jemez. Taos Pueblo was part of this network in 1995, but was dis-continued in 1996 because of repeated loss of measurements. (2) The off-site perimeter group has 25 locations within 4 km (2.5 mi) of the Laboratory boun-dary (see Figure 4-12). These stations are placed in residential areas surrounding the Laboratory and in locations where people work. (3) The on-site group has 27 locations within Laboratory boundaries, generally around operations that may produce ionizing radiation. Four new on-site stations were added in 1996: East Gate (#56); TA-54 West at the TLD Lab (#57); TA-54 Lagoon on Pajarito Road (#58); and Los Alamos Canyon between the Ice Rink and TA-2 (#59).

b. Technical Area 53 Network (LANSCENET). To monitor external penetrating radiation from airborne gases, particles, and vapors resulting from LANSCE operations at TA-53, a network of 24 TLD stations is used. Twelve of these monitoring locations are approximately 800 m (0.5 mi) north of and downwind from the LANSCE stack. The other 12 TLD stations are located about 9 km (5.5 mi) from LANSCE, near the southern boundary of the Laboratory and are used as a background measurement. Both sets of 12 monitoring locations are placed at approximately the same elevations to help eliminate elevation effects from the cosmic component of the natural radiation.

c. Low-Level Radioactive Waste Management Areas Network (WASTENET). The Laboratory has 10 inactive and 1 active (TA-54, Area G) low-level radioactive waste management areas. To monitor any external penetrating radiation from these areas, 86 dosimeters are placed around the perimeter of these waste management areas. Of these 86 dosimeters, Area G at TA-54 has 25 dosimeters placed at strategic locations around the facility. All waste management areas are controlled-access areas and are not accessible to the general public. The average annual dose at each waste area is calculated from a set of TLDs located around each site.

d. High-Pressurized Ion Chamber. In addition to the LANSCENET, the Laboratory operates a HPIC-NEWNET station (#1707) at the Laboratory boundary immediately downwind from the LANSCE facility. In the past, station readings were used to estimate dose to a member of the public in the East Gate area. Two problems affecting the quality and usefulness of the data from the station occurred in 1996: (1) the detector's calibration period expired, and (2) the power failed in mid-November through the end of the year. An analysis of the data demonstrated that up until the time the station failed, useable data was being recorded despite the instrument being out of calibration. However, this data is not used to determine the dose equivalent at this location (see Section 3.A.4.a for an estimate of the dose equivalent for East Gate). More information about NEWNET and this station (#1707) is available on the World Wide Web at *http://newnet.jdola.lanl.gov/newnet.html.*

3. Sampling Procedures, Data Management, and Quality Assurance

Environmental TLDs used at the Laboratory are composed of natural lithium fluoride (LiF:Mg,Ti) crystals containing 7.4% lithium-6 in the form of 3.2-mm^2 by 0.9-mm-thick chips, referred to as TLD-100. After exposure to x- and gamma radiation, the TLD chips are collected and heated in a laboratory setting to measure the energy stored in the crystal. This stored energy is released in the form of light that is proportional to the amount of radiation absorbed by the TLD. The TLD-100 over responds to and is extremely sensitive to thermal neutrons, but is insensitive to fast or high energy neutrons. These neutrons must be moderated before they can be measured by TLD-100 chips.

A newly designed dosimeter was introduced for field monitoring in 1996 and was used for all monitoring locations except for the inactive material disposal areas in the WASTENET. This new dosimeter was used at TA-54, Area G. The dosimeter used in the previous years in the environmental TLD program were used at the inactive material disposal areas. This new dosimeter uses the same type of “acorn” holder as the old dosimeter, but utilizes five, 1/8 in. TLD-100 chips instead of the four, 1/4 in. TLD-100 chips used in the old dosimeter. (For a complete description of this dosimeter, see Archuleta 1997.) American National Standards Institute (ANSI) N545 performance testing of this newly designed dosimeter was accomplished in 1996, and the dosimeter passed all performance tests (ANSI 1966).

Procedures that outline the QA/quality control (QC) protocols; placement and retrieval of the dosimeters; reading of the dosimeters; and data handling, validation and tabulation can be found in operating procedures maintained by the Laboratory's Air Quality Group.

4. Analytical Results

a. Laboratory and Regional Areas (TLDNET). Results from the environmental monitoring networks are presented in Table 4-11. Some of the TLD stations are lacking one or more quarters of data as a result of dosimeter loss, animals damage, processing error, removal requests by the public, as well as new station installation after the beginning of the monitoring year.

The dose equivalent ranges observed in 1996 within each network are consistent with natural background radiation and the 1995 measurements. Only one off-site regional station, Pueblo of Jemez (station #54), had a complete set of data in 1996 (i.e., data for each quarterly monitoring period) and had an annual dose equivalent of 119 mrem without any background subtraction. The average quarterly dose equivalents at the other off-site regional stations ranged from 27 to 35 mrem, corresponding to an approximate annual dose equivalent of 108 to 140 mrem. The annual measurements at off-site perimeter stations having complete data sets ranged from 95 to 176 mrem. Annual measurements at on-site stations ranged from 111 to 241 mrem. The 241 mrem measurement observed at station #28 (TA-18) is not representative of a dose to a member of the public because it contains operational exposures when public access was restricted. (See Section 4.C.5.b for an estimate of the maximum dose equivalent to a member of the public from TA-18 operations.)

b. Technical Area 53 Network (LANSCENET). The TLD measurements collected at the 12 stations located directly to the north of LANSCE were statistically compared to the 12 background stations located at TA-49. During the fourth quarter of 1996, two elevated measurements were observed at two separate locations at East Gate, north of LANSCE. After a thorough investigation of these elevated measurements, which included evaluation of LANSCE emissions, air monitoring data, radiographer activities for county utilities and a review of internal QC, a specific source of exposure to yield these high measurements could not be identified. In addition, DOE's Agreement in Principle program has a duplicate monitoring station near one of these monitoring locations. Their dosimeter did not indicate any increase in the ambient dose equivalent for the fourth quarter 1996. It is possible, however unlikely, that an irradiated field fade or a QC dosimeter may have inadvertently been placed at these monitoring locations. The reason for these elevated readings is not known, but they do not represent a valid dose to the public. The effective dose equivalent (EDE) as measured at East Gate with these two values eliminated is at 168 ± 36.8 mrem; whereas the background as measured at TA-49 is 164 ± 20.4 mrem. There is no significant difference ($p>.05$) between these TLD measurements observed at East Gate and those observed at the background locations. If the two values remain, the EDE at East Gate increases to 184 ± 86.8 mrem with TA-49 value remaining the same. Even with the two higher readings remaining, there is still no significant difference ($p>.05$) between the TLD measurements observed at East Gate and those observed at the background locations.

c. Low-Level Radioactive Waste Management Areas Network (WASTENET). Annual doses at the waste management areas are presented in Table 4-12. Among the sites with a complete data set, the annual average doses at all waste management areas during 1996 ranged from 119 to 173 mrem. Exposure data for TA-6, Area F, are not available for first and second quarters of 1995 because extensive and detailed geophysical sampling and characterization of the site disrupted the monitoring program. The 1995 annual dose for TA-50, Area C, does not include second quarter measurements because the data were lost due to an equipment malfunction.

The highest WASTENET annual average dose for 1996 was measured at TA-54, Area G, LANL's only active low-level radioactive waste area. The 25 environmental surveillance TLDs at TA-54, Area G, are located within the waste site and along the perimeter fence. The doses measured at this site are representative of storage and disposal operations that occur at the facility. Evaluation of this data is useful in minimizing occupational doses. However, this is a controlled-access area and these measurements are not representative of a potential public dose. One monitoring site at TA-21, Area T had an elevated reading of 267 ± 10 mrem in 1996. This value is consistent with values observed at this location in the past and is attributed to cesium-137 on the ground at that location. Discussions on potential dose equivalent to a member of the public from this location are discussed in Section 4.C.5.b below.

5. Dose Equivalents to Individuals from External Penetrating Radiation

a. Airborne Emissions. The major source of external penetrating radiation to an off-site location from LANL operations is airborne emissions from LANSCE. Nuclear reactions with air in the beam target areas at LANSCE (TA-53) cause the formation of air activation products, principally carbon-10, carbon-11, nitrogen-13, oxygen-14, and oxygen-15. These radioisotopes are positron emitters and have 19-s, 20-min, 10-min, 71-s, and 122-s half-lives, respectively. These radioisotopes are sources of penetrating radiation resulting from the formation of two 511 keV photons through positron-electron annihilation (oxygen-14 also emits a 2.4-MeV gamma ray). These air activation products are primarily released from a 30-m stack, but an additional small percentage of the releases occur as diffuse emissions from LANSCE buildings. An HPIC, located near of the maximum exposed individual (MEI) along the Laboratory boundary known as East Gate, is normally used to record the total external penetrating dose from

LANSCE operations. However, the HPIC did not provide reliable data and is not used for dose estimates in 1996. Dose contributions from LANSCE emissions are not distinguishable from natural background radiation levels detected by the TLDNET monitoring locations at East Gate, in Los Alamos, or in White Rock. For an estimate of the dose equivalent from airborne emissions, see Section 3.A.4.

b. Direct Radiation. Because the background is so large and variable, no direct penetrating radiation dose to the public from Laboratory operations could be distinguished by direct TLD measurements in 1996. However, there are three areas of concern involving direct penetrating radiation: (1) experiments conducted at the Los Alamos Critical Experiments Facility, TA-18, (2) exposure to an inadvertent visitor along TA-21, Area T, and (3) exposure to an inadvertent visitor from cesium-137 in the sediments of Mortandad Canyon.

Measurements collected by TLDs at TA-18 reflect background and operational activities when there was no public access to the facility and do not represent a dose to the public. TA-18 administrative controls require operations to be conducted after hours with the closure of Pajarito Road from TA-51 to White Rock whenever the potential dose to a member of the public exceeds 1 mrem. During such operations, the roadside dosimeters at TA-18, intended to measure public dose, are usually removed. During 1996, there were three operations at TA-18 when the road was closed to the public and the dosimeters were not removed.

For TA-18, potential exposure is to users of Pajarito Road at times when low-level experiments are being conducted (the road is closed for higher level experiments). Because Laboratory controls prevent public members from remaining continuously in front of TA-18, the frequency and amount of time a public member may spend in the area of exposure was factored into the dose calculation through use of the binomial distribution. This distribution assumes that the individual is either present during an operation at TA-18 and receives an exposure, or the person is not present during an operation at TA-18. One calculates a probability factor that is coupled to the number of operations conducted at TA-18 in a year to determine the number of potential exposures an individual could receive during the year. The estimated maximum dose equivalent for each SHEBA assembly operation is based on radiation measurements taken before 1996; however, the estimated maximum dose equivalent for each GODIVA assembly operation is based on measurements collected during 1996. Two scenarios were developed to estimate this probability factor involving a person passing over the 0.5 mile length of the roadway during the year:

(1) An individual drives past the facility while it is operating 10 times a day for 250 days per year at 40 mph. This scenario yields a probability factor of 0.0156 (i.e., .5 miles per pass at 40 mph times 10 passes per day times 250 days per year divided by the number of operating hours of TA-18 (2000 h); and

(2) An individual jogs past the facility twice per day (i.e., down to the lagoons and back up the hill) for 250 days/yr. This yields a probability factor of 0.0427 (i.e., 1.5 mi jog in 30 min, 5 days/wk, 50 wk/yr, divided by the number of operating hours of TA-18).

The maximum dose equivalent to a member of the public, at the 95% level of confidence, from TA-18 operations in 1996 is 7 mrem (7% of the DOE PDL) using the driving scenario and 8 mrem (8% of the DOE PDL) using the jogger scenario. Because the jogger scenario has a larger probability factor for a potential exposure and the dose equivalent for this scenario was slightly larger, it was selected as the maximum potential dose equivalent from TA-18 operations in 1996. Applying this same process to the 1995 operations, the maximum potential dose equivalent in 1995 to a member of the public from TA-18 operations is 2 mrem (2% of the DOE PDL) using the driving scenario and 5 mrem (5% of the DOE PDL) using the jogger scenario.

TA-21, Area T, is located behind a control-access fence; however, an inadvertent individual could pass by this material disposal area while walking or jogging on the roadway around TA-21. Because there are no residential areas along DP road near TA-21, this area can be considered to be within the industrial complex of the Laboratory. Because of this, an occupancy factor of 0.01 can be applied to this continuous radiation source (Robinson and Thomas 1991). This brings the maximum potential dose equivalent to an inadvertent occupant to 2.9 mrem in a year at this location.

Mortandad Canyon has several radionuclides in the stream channel sediments that could potentially expose an inadvertent occupant (See Chapter 5 for a more detailed discussion). There are no dosimeters in Mortandad Canyon near GS-1, MCO-5, MCO-7 and MCO-9 where this contamination is the most prevalent. The scenario used to model the dose equivalent to an inadvertent occupant, has this individual walking or jogging down the middle of the stream channel approximately 87 hours per year (i.e., the occupancy factor in the canyon is 0.01 part of a year [Robinson and Thomas 1991]). Using this scenario, the estimated external penetrating dose equivalent as modeled with RESRAD, version 5.61, is 24 mrem with the majority of this exposure from cesium-137 in the stream channel sediments of the canyon. This can be modified because the walking or jogging path from the middle stream channel is approximately 3 meters away. Because penetrating radiation falls off with distance from the source, the estimated EDE at 3 meters from the stream channel is estimated at 2.7 mrem in a year. This EDE must be added to the CEDE presented in Section 5.C.3.a to obtain an estimated total EDE (TEDE) of 6 mrem in a year.

D. Nonradioactive Emissions Monitoring

1. Introduction

Emissions from ‘industrial’ sources are calculated annually because these sources are responsible for over 90% of all the nonradiological air pollutant emissions at the Laboratory. Research sources vary continuously and have very low emissions. As such, they are not calculated annually; instead, each new or modified research source is addressed in the new source review process.

Ambient monitoring for nonradioactive air pollutants was limited to particulate matter sampling as discussed below.

2. Particulate Matter Sampling

PM-10 samples (particles less than 10 μm in aerodynamic diameter) were collected for two events during 1996: the Dome Fire from April 26 through May 2 and a controlled burn on Laboratory property in November. The Dome Fire samples were collected at the TA-49 air monitoring compound near the entrance to Bandelier National Monument. The controlled burn samples were collected downwind from the fire in the northwest part of Pajarito Acres.

During the Dome Fire, the PM-10 concentrations averaged 17 $\mu g/m^3$. This concentration is well below the federal PM-10 ambient air quality standards given in Table A-3 of this report. The highest one-day concentration was 32 $\mu g/m^3$ which is well below the federal standard of 150 $\mu g/m^3$. These concentrations are typical values for the dry windy conditions present during the Dome Fire. Even though the fire was close to the monitoring site, the winds during the Dome Fire generally dispersed the smoke away from the sampler.

PM-10 samples were collected before, during, and after the controlled burn. The measured concentrations both before and after the fire were 12 $\mu g/m^3$. The sample collected during the fire was 30 $\mu g/m^3$. These data indicate that the fire seemed to have a measurable impact on local air quality. However, this value, which indicates that the fire did temporarily increase PM-10 concentrations, is still well below the federal 24-h standard of 150 $\mu g/m^3$.

3. Detonation and Burning of Explosives

The Laboratory conducts explosive testing by detonating explosives at firing sites operated by the Dynamic Testing Division. The Laboratory maintains monthly shot records that include the type of explosives used as well as other material expended at each mound. Table 4-13 summarizes the explosives detonations conducted at the Laboratory during 1996. The Laboratory also burns scrap and waste explosives because of treatment requirements and safety concerns. In 1996, the Laboratory burned 3,482 lb of high explosives.

4. Emissions Calculations

The 1996 estimated emissions are shown in Table 4-14. These are typical industrial-type sources. LANL nonradiological emissions from research operations are small when compared with these listed sources.

The NO_x emissions from the TA-3 power plant were calculated using an emissions factor of 163 lb/million cubic feet (MMCF), which was obtained from a stack test and is adjusted for 20% uncertainty. The particulate matter emission factor of 5 lb/MMCF for the asphalt plant represents the maximum emission factor listed in AP-42 (EPA 1995). For volatile organic compounds, an emission factor of 1.4 was used, which is corrected for 17% methane as specified in AP-42. The emission factor for SO_x is 0.6 lb/MMCF, as specified in AP-42.

The three power plants, the largest sources of nonradioactive emissions, are used to supply steam for heating. The steam plant at TA-3 also produces electricity when sufficient power from outside sources is not available; approximately one-third of the emissions from this steam plant results from electricity production. The plants are primarily operated on natural gas but can use fuel oil as a backup.

E. Meteorological Monitoring

1. Introduction

Meteorological data obtained from the meteorological monitoring network support many Laboratory activities, including emergency management and response, regulatory compliance, safety analysis, and engineering studies. To accommodate the broad demands for weather data at the Laboratory, a wide variety of meteorological variables are measured across the network, including wind, temperature, pressure, relative humidity and dew point, and solar and terrestrial radiation. Details of the meteorological monitoring program are available through the World Wide Web at *http://weather.lanl.gov/monplan/mmp96.html* and are discussed in Stone et al., (1996).

2. Climatology

Los Alamos has a temperate, semiarid mountain climate. However, its climate is strongly influenced by elevation, and large temperature and precipitation differences are observed in the area because of the 300-m change in elevation across the site.

Four distinct seasons occur in Los Alamos. Winters are generally mild, but occasionally winter storms dump large snows and cause frigid temperatures. Spring is the windiest season of the year. Summer is the rainy season, when afternoon convective-type thunderstorms and associated hail and lightning are common. Fall marks the end of the rainy season and a return to drier, cooler, and calmer weather. The climate statistics given below summarize analyses given in Bowen (1990 and 1992).

Several factors influence the temperature in Los Alamos. An elevation of 7,400 ft helps to counter its southerly location, making for cooler summers than nearby locations at lower elevations. The sloping nature of the Pajarito Plateau causes cooled air to drain off the plateau at night; thus, nighttime temperatures on the plateau are often warmer than those at lower elevations. Also, the Sangre de Cristo mountains to the east act as a barrier to arctic air masses affecting the central United States. The temperature does occasionally drop well below freezing, however. Another factor affecting the temperature is the lack of moisture in the atmosphere. With less moisture, there is less cloud cover, which allows a significant amount of solar heating during the daytime and radiative cooling during the nighttime. This heating and cooling often causes a wide range of daily temperature (the average diurnal temperature range is 13˚C).

Winter temperatures range from –1˚C to 10˚C (30˚F to 50˚F) during the daytime, to –9˚C to –4˚C (15˚F to 25˚F) during the nighttime. The record low temperature recorded is –28˚C (–18˚F). Winter is usually not particularly windy, so extreme wind chills are uncommon.

Summer temperatures range from 21˚C to 31˚C (70˚F to 88˚F) during the daytime, to 10˚C to 15˚C (50˚F to 59˚F) during the nighttime. Temperatures occasionally will break 32˚C (90˚F). The highest temperature ever recorded is 35˚C (95˚F).

The average annual precipitation (including both rain and water equivalent of frozen precipitation) is 47.57 cm (18.73 in.). The average snowfall for a year is 149.6 cm (58.9 in.). Freezing rain and sleet are rare.

Winter precipitation in Los Alamos is often caused by storms entering the US from the Pacific Ocean, or by cyclones forming or intensifying in the lee of the Rockies. When these storms cause upslope flow over Los Alamos, large snowfalls can occur. The record snowfall for one day is 56 cm (22 in.), and the record snowfall in one season is 389 cm (153 in.). The snow is usually a dry, fluffy powder, with an average equivalent water to snowfall ratio of 1:20.

The summer rainy season accounts for 37% of the annual precipitation. During the July to August period, afternoon thunderstorms form as a result of the flow of moist air from the Gulf of Mexico and from the Pacific Ocean, and because of convection and the orographic uplift as air flows up the sides of the Jemez mountains. These thunderstorms can bring large downpours, but sometimes they only cause strong winds and dangerous lightning. Hail frequently occurs from these rainy-season thunderstorms.

Winds in Los Alamos are also affected by the complex topography, particularly in the absence of a large-scale disturbance affecting the area. Often a distinct daily cycle of the winds can be seen. During the daytime, upslope flow sometimes exists on the Pajarito Plateau, causing an southeasterly component to the winds on the plateau (see Figure 4-13). During the nighttime, as the mountain slopes and plateau cool, the flow becomes downslope, causing light westerly and northwesterly flow (see Figure 4-14). Cyclones moving through the area disturb and override the cycle. Flow within the canyons of the Pajarito Plateau is quite complex and very different from flow over the plateau.

3. Monitoring Network

A meteorological network of five towers was used to gather data at the Laboratory during 1996 (see Fig. 13.1 in the Meteorological Monitoring Plan [Stone et al., 1996] or access through the World Wide Web at *http://weather.lanl.gov/monplan/mmp96.html*). A sodar (sonic detection and ranging) and three precipitation measurement sites also supplemented the data collected. The towers are located at TA-6 (the official measurement site of the Laboratory), TA-49, TA-53, TA-54, and TA-41 (located in Los Alamos Canyon). The sodar is located at TA-6, and the precipitation measurement sites are located at TA-74, North Community in the Los Alamos townsite, and TA-16.

4. Sampling Procedures, Data Management, and Quality Assurance

Instruments in the meteorological network are located in areas where there is adequate exposure to the elements being measured and in open fields to avoid wake effects from trees and buildings on measurements of wind and precipitation. The open fields also provide an unobstructed view of the sky for the upward-directed radiometers that measure longwave radiation and solar radiation.

Temperature and wind are measured at multiple levels on open-lattice towers, with instruments positioned on west-pointing booms having a length of two times the tower width. The length of the boom helps to decrease wake effects from the tower, as do the west-pointing direction of the booms, because winds from the east are uncommon. The multiple levels give duplicate measurements for QA. Temperature sensors are shielded and aspirated with small fans to minimize radiative heating effects.

Most of the meteorological variables are sampled every 3 s, and the results are averaged every 15 min to give a sample size of 300 (for each of the 15-min periods). The data are stored by data loggers located at the tower sites and then fed to a Hewlett Packard worstation through telephone lines. At the workstation, automatic range checking is performed on the data, and data edits are automatically performed on variables falling outside of preset ranges. Next, time-series plots are constructed. These plots are used by a meteorologist to perform quality checking on the data. Daily statistical quantities are also included on the time-series plots (such as daily maximum and minimum temperature, total solar radiation, maximum wind gust, etc.) and are also checked for quality.

All meteorological instruments are audited twice a year. An internal audit is performed in the winter, and an external audit is conducted during the summer. All instrument calibrations are traceable to the National Institute of Standards and Technology standards. No significant problems were found during either audit in 1996 (Waldron 1996).

5. Analytical Results

A graphical summary of the weather at Los Alamos (TA-6) for 1996 is presented in Figure 4-15. This figure shows the average temperature range and precipitation by month, compared with the normals, which are averages based on a 30-year record (1961 to 1990). From this figure it can be seen that from January through June, temperatures were warmer than normal. May was unusually warm. The average temperature in May was 62.9˚F, which set a new record for the warmest May on record. Temperatures in July through December were near normal to below normal. For the year, temperatures were warmer than normal.

The total precipitation for the year was 95% of normal. Only 0.52 in. of precipitation fell during the spring (March to May), making it the driest spring on record. This dry spell was followed by a June precipitation total three times the normal amount, making it the fifth wettest June on record. October was also a wet month, with a total of more than two and a half times the normal value. December was quite dry, with only 0.09 in. of precipitation being recorded, or 8% of normal. The annual snowfall in 1996 was 57.6 in., which is 97% of normal. Spring snowfall totals were very low, but 21.2 in. of snow fell in October, setting a monthly snowfall record. Only 10% of normal snowfall fell during December. Precipitation data for 1996 for all recording sites are listed in Table 4-15.

Wind statistics based on 15-min average wind observations at the four towers on the Pajarito Plateau are shown in the form of wind roses Figures 4-13, 4-14, and 4-16. Wind roses show the percentage of the time the wind blows from each of 16 different wind directions. Also shown in the wind roses are the distributions of wind speed for each of the 16 directions; these are displayed by the shading of the wind rose barbs, as shown in the legend. For example, at TA-49 (Figure 4-13), the most frequent wind direction during the daytime is from the south, which occurs 18% of the time. The wind speed for that direction is most often in the 2.5 to 5.0 m/s category, followed by the 5.0 to 7.5 m/s category, the 0.5 to 2.5 m/s category, and the 7.5 + m/s category. Winds were calm 0.8% of the time at TA-49 during the daytime in 1996.

During the daytime (Figure 4-13), winds were predominately southerly at all four towers. Looking at the nighttime wind roses (Figure 4-14), it can be seen that the winds were more westerly and northwesterly, and that the winds are generally weaker. Wind roses for all times are given in Figure 4-16.

F. Quality Assurance Program in the Air Quality Group

1. Quality Assurance Program Development

During 1996, ESH-17 continued to maintain and to improve upon the QA program developed in recent years. This program includes a group quality management plan, project plans, and implementing procedures. QA plans for sampling systems follow the EPA QA-R/5 data quality objective process. Required elements of DOE QA programs are incorporated.

Together, these plans and procedures describe or prescribe all the planned and systematic activities believed necessary to provide adequate confidence that ESH-17 processes perform satisfactorily. The following highlights of 1996 accomplishments are presented to demonstrate the vitality of the QA Program in the ESH-17, Air Quality Group.

Component: Highlights

Documentation: At the end of 1996, the ESH-17 QA document system included 8 QA Plans and 43 procedures, which are reviewed periodically to see if revision is needed. Of the plans, one was a new issue, and five QA Plans were updated. Of the 43 procedures, 16 were new procedures, and 13 were revised.

Distribution: At the end of 1996, 40 persons had been issued QA binders with multiple plans and procedures. An additional 13 persons held 1 or more procedures or plans. Distribution details are maintained in a log by the custodian.

Training: During 1996, ESH-17 implemented a computerized training database, which is maintained by the group training coordinator. Training plans are documented, training is logged as completed, and reminders are issued. Statistics compiled late in the year indicated that approximately 6 persons were trained to each plan or procedure, and the average person has completed training to 7 plans or procedures.

Assessments: DOE completed an assessment of the Rad-NESHAP program and LANL considers itself in compliance with the Clean Air Act as of June of 1996.

A management self-assessment was completed as an informal survey in October. The group leader used the information to improve the group management.

In October, the Federal Facilities Compliance Agreement-required external assessment of Rad-NESHAP management systems was completed by a team from Northern Arizona University College of Engineering and Institute for Tribal Environmental Professionals. There were no findings. Responses or action plans have been written for the 8 recommendations made by the audit team and sent to DOE for EPA approval.

An internal assessment of the group was conducted by a contractor employee in late 1996. The assessment evaluated the compliance with 40 CFR 61, Subpart H (Rad-NESHAP) and found the group in full compliance with the regulation. Several opportunities for improvement were identified.

During 1996, ESH-17 teams (led by an ISO-9000 Certified Lead Assessor) performed assessments of the 3 laboratories that supply analytical data. One was a follow-up visit to verify that recommended improvements had been completed. After the visits, assessment reports were written that included quality improvement needs.

Quality Improvement: The ESH-17 quality improvement system includes a computerized database used to track findings from internal and external assessments, and any equipment or process breakdowns that affect quality. In 1996, 49 reports of such deficiencies were made and 30 were closed out and verified.

2. Analytical Laboratory Assessments

During 1996, gross alpha, gross beta, and tritium analytical chemistry services were supplied by the Laboratory’s HPAL. Analytical chemistry services for alpha-emitting isotopes (uranium, plutonium, and americium) on quarterly composite samples were provided by the Grand Junction Rust-GeoTech (now Wastran—Grand Junction) Project Office (GJPO) of Grand Junction, Colorado. Application of the data quality objective (DQO) process led to definition of analytical chemistry DQOs. These DQOs were summarized as purchase requirements in statements of work used for procurement of chemical analyses from the commercial laboratories. Before awarding the purchases, ESH-17 evaluated the lab procedures, quality plans, and national performance evaluation program results of these suppliers and found that they met purchase requirements. ESH-17 also performed formal on-site assessments at the Grand Junction and HPAL laboratories during 1996 and a follow-up reassessment at Paragon (formerly ATI). Quality control aspects of the analytical chemistry will be presented in later sections of this document.

Both Paragon and the Grand Junction analytical laboratory participated in national performance evaluation studies during 1996. Two federal agencies, EPA and DOE, sponsor intercomparison studies: the EPA Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, and the DOE Environmental Measurements Laboratory in New York, New York. The DOE laboratory sends spiked air filters twice a year to the participating laboratories. The EPA laboratory sends one type of spiked media from one to three times a year that is of interest to ESH-17's QA program.

G. Special Studies

1. Comparison of Thermoluminescent Dosimeters

A special intercomparison study initiated in 1990 to compare results of the Laboratory's TLDs with TLDs obtained from a commercial vendor was concluded in 1996. Because the newly designed dosimeter passed the ANSI N545-1975 tests and performed well in the Eleventh International Intercom-parison for Environmental Dosimeter, the Laboratory did not feel the need to continue this intercomparison study. Intercomparisons are still being conducted with the New Mexico Environment Department (NMED) DOE Oversight Bureau that has duplicate dosimeters placed at select locations near Laboratory dosimeters (NMED 1997).

2. Eleventh International Intercomparison of Environmental Dosimeters

LANL participated in the Eleventh International Intercomparison of Environmental Dosimeters coordinated by the Environmental Measurements Laboratory (EML), US Department of Energy, in collaboration with the National Institute of Standards & Technology and Idaho State University. The purpose of the intercomparison program is to assess the performance of environmental dosimeters by comparing the overall distribution of results with reference measurements of the delivered doses and generally accepted performance standards. At the same time, this program furthers research in environmental dosimetry by giving participants an opportunity to evaluate their own performance or to test new dosimeters, and by incorporating special conditions designed to investigate problems associated with environmental dosimetry. It also provides useful data for performance standards under development. For the Eleventh International Intercomparison, participants submitted dosimeters for a three-month field test and for irradiations to americium-241 and cesium-137 in the laboratory.

Three dosimeters (1/4-in. LiF, 1/8-in. LiF, and Al_2O_3 dosimeters) used at various times for environmental monitoring at the Laboratory were submitted for this intercomparison. The results for the dosimeters containing the 1/4-in. TLD-100 chips was –25% for the field exposure, –28% for the americium-241 exposure, and –30% for the cesium-137 exposure. The new dosimeters with the 1/8 in. TLD-100 chips were –6%, –5% and –12% respectively. The Al_2O_3 dosimeter response was +7%, +58%, and +6%, respectively. The negative values indicate an under response, and positive values indicate an over response. The intercomparison confirmed much of what was suspected: the 1/4-in. TLD response was not as accurate as the newly designed 1/8-in. dosimeter. The newly designed dosimeters have a slight negative bias in their response when compared to an HPIC, and the Al_2O_3 dosimeter is not acceptable for environmental monitoring, especially because of their over response to the americium-241 exposure.

3. Performance Evaluation of Los Alamos National Laboratory's Environmental Dosimeter

The Laboratory's environmental dosimeter was tested against specific portions of the ANSI N545-1975 standard for environmental TLD applications. The dosimeters were evaluated for uniformity, reproducibility, energy response, angular response, light dependence, moisture dependence, an evaluation of the field fade, self-irradiation, lower limit of detection, and neutron response. In addition, before placing dosimeters in the field population, each dosimeter was evaluated against a stringent testing and acceptance process. Those dosimeters failing this acceptance testing were eliminated from the general field population. This field population was subjected to the performance testing protocols outlined in ANSI N545-1975. The newly designed environmental dosimeters satisfy all of the ANSI N545-1975 performance requirements for environmental radiation monitoring (Archuleta 1997).

4. Neighborhood Environmental Watch Network Community Monitoring Stations

NEWNET is a LANL Dynamic Experiment Division program focused on establishing a partnership with communities, state and tribal governments, and the DOE to address concerns about radiological monitoring in local communities. It establishes meteorological and external penetrating radiation monitoring stations in local communities and around radiological sources. These stations are the responsibility of a station manager from the local community. The stations have a local readout, and the data can be downloaded into a personal computer at the station if this process is coordinated with the station manager.

The data from these stations are transmitted via satellite communications to a downlink station at LANL. The data are converted to engineering units, checked and annotated for transmission errors or station problems, and stored in a public access database.

The data from all the stations are available to the public with, at most, a 24-h delay. Methods to decrease this period to near real time are being developed.

Station measurements include wind speed and wind direction, ambient temperature, relative humidity, barometric temperature, and gross gamma radiation using a pressurized ion chamber. The radiation sensors are sampled at 5-s intervals and averaged every 15 min. These values are transmitted every 4 h.

More information about NEWNET and the data is available on the World Wide Web at *http://newnet.jdola.lanl.gov/newnet.html*.

5. Compliance Program for 40 CFR 61, Subpart H, at Los Alamos National Laboratory

Effective on March 15, 1990, EPA established regulations controlling the emission of radionuclides to the air from DOE facilities to limit the dose to the public to 10 mrem/yr. These regulations are detailed in 40 CFR 61, Subpart H (EPA 1993). Part of these regulations require the operation of sampling systems on stacks meeting certain requirements. Although LANL has a long history of stack sampling, the systems in place at the time the regulation became effective did not meet the specific design requirements of the new regulation. In addition, certain specific program elements did not exist or were not adequately documented.

LANL has undertaken a major effort to upgrade its compliance program to meet these EPA requirements. This effort involved developing new and technically superior sampling methods and obtaining approval from the EPA for their use; negotiating specific methodologies with the EPA to implement certain requirements of the regulation; implementing a complete, quality assured, compliance program; and upgrading sampling systems. After several years of effort, the Laboratory sampling on stack emissions now meets all requirements of 40 CFR 61, Subpart H.

6. 1996 Los Alamos National Laboratory Radionuclide Air Emissions, Environmental Protection Agency Reporting

Information on radioactive effluents released to the air by the Laboratory is published in the DOE certified report “1996 LANL Radionuclide Air Emissions.” This information is required under the Clean Air Act and is reported to the EPA. The EDE to a hypothetical MEI of the public was calculated, using procedures specified by the EPA and described in this report. That dose for 1996 was 1.93 mrem. Emissions of carbon-11, nitrogen-11, and oxygen-15 from a 1-mA, 800-MeV proton accelerator contributed over 92% of the EDE to LANL’s MEI. Using CAP88, EPA’s dose assessment model, more than 86% of the total dose received by the MEI was through the air immersion pathway.

H. Tables

Table 4-1. Average Background Concentrations of Radioactivity in the Regional Atmosphere

	Units	Santa Fe (EPA)[a] 1990–1995	Northern New Mexico (LANL)[b] 1996	EPA Concentration Limit[c]
Gross Alpha	fCi/m^3	NA[d]	0.8	NA
Gross Beta	fCi/m^3	10	10.2	NA
^{234}U	aCi/m^3	14	35.6	7,700
^{235}U	aCi/m^3	0.6	2.2	7,100
^{238}U	aCi/m^3	13	24.7	8,300
^{238}Pu	aCi/m^3	0.2	0.1	2,100
$^{239,240}Pu$	aCi/m^3	0.3	0.7	2,000
Tritium	pCi/m^3	NA	0.3	1,500
^{241}Am	aCi/m^3	NA	2.1	1,900

[a] EPA (1991–1997), Reports 63 through 82. Data are from the EPA Santa Fe, New Mexico, sampling location and were taken from July 1990 through July 1995. Data for 1996 were not available at time of publication.
[b] Data from regional air sampling stations operated by LANL at Santa Fe, Pojoaque, and Española.
[c] Each EPA limit equals 10 mrem/yr.
[d] NA = not available.

Table 4-2. Airborne Long-Lived Gross Alpha Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s (fCi/m^3)
Regional Stations						
01 Española	26	0	2.8	0.2	0.9	1.2
02 Pojoaque	26	0	2.8	0.5	0.8	0.9
03 Santa Fe	26	0	2.7	0.3	0.8	1.1
Group Summary	78	0	2.8	0.2	0.8	0.0[a]
Pueblo Stations						
41 San Ildefonso Pueblo	26	0	3.4	0.3	0.8	1.1
42 Taos Pueblo	26	0	1.5	0.3	0.7	0.6
48 Jemez Pueblo-Riverside	26	0	2.0	0.2	0.7	0.7
Group Summary	78	0	3.4	0.2	0.7	0.1[a]
Perimeter Stations						
04 Barranca School	26	0	2.6	0.3	0.8	0.9
05 Urban Park	26	1	3.2	0.3	0.8	1.2
06 48th Street	26	2	1.4	0.3	0.6	0.6
07 Gulf/Exxon/Shell Station	26	1	4.6	0.2	1.0	1.7
08 McDonalds Restaurant	25	2	3.3	0.1	0.8	1.2
09 Los Alamos Airport	25	0	2.1	0.4	0.8	0.7
10 East Gate	26	3	4.4	0.0	0.8	1.7
11 Well PM-1 (E. Jemez Road)	26	1	2.2	0.2	0.7	0.8
12 Royal Crest Trailer Court	26	0	1.8	0.3	0.7	0.7
13 Piñon School	26	1	5.3	0.2	0.9	2.1
14 Pajarito Acres	24	2	2.9	0.2	0.7	1.0
15 White Rock Fire Station	25	0	4.0	0.3	1.0	1.6
16 White Rock Church of the Nazarene	26	1	1.2	0.2	0.7	0.6
17 Bandelier Entrance (Lookout) (Rim)	26	2	4.2	0.2	0.9	1.5
60 LA Canyon	26	1	1.7	0.2	0.7	0.6
61 LA Hospital	26	0	1.5	0.5	0.9	0.6
62 Trinity Bible Church	25	0	1.8	0.3	0.8	0.6
63 Monte Rey South	25	0	2.7	0.3	0.8	0.9
Group Summary	461	17	5.3	0.0	0.8	0.2[a]
On-Site Stations						
19 TA-21 DP Site	2	0	2.0	1.7	1.9	0.5
20 TA-21 Area B	26	0	2.7	0.3	0.9	0.9
21 TA-6	2	0	1.5	1.0	1.3	0.6
22 TA-53	2	0	1.5	0.8	1.1	0.9
23 TA-52 Beta Site	26	0	1.8	0.4	0.7	0.5
25 TA-16-450	26	0	1.3	0.3	0.6	0.5
26 TA-49	25	1	1.3	0.2	0.8	0.6
28 TA-33 HP Site	2	0	1.5	0.9	1.2	0.8
30 Pajarito Booster 2 (P-2)	26	2	3.8	0.1	1.0	1.4
31 TA-3	26	1	1.7	0.1	0.8	0.7
32 County Landfill	27	1	2.8	0.2	0.7	1.0
49 Pajarito Rd (TA-36) Sludge Pond	26	1	2.0	0.3	0.7	0.7
Group Summary	216	6	3.8	0.1	1.0	0.7[a]

Table 4-2. Airborne Long-Lived Gross Alpha Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s (fCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	26	0	3.1	0.8	1.5	1.2
34 TA-54 Area G-1 (behind trailer)	26	0	1.7	0.3	0.8	0.6
35 TA-54 Area G-2 (back fence)	25	1	1.4	0.3	0.7	0.6
36 TA-54 Area G-3 (by office)	26	0	2.1	0.5	0.9	0.6
37 TA-54 Area G-4 (water tank)	20	1	1.7	0.2	0.8	0.6
45 Area G (Southeast Perimeter)	26	2	2.0	0.0	0.7	0.8
47 Area G (North Perimeter)	22	1	1.7	0.2	0.7	0.7
50 TA-54 Area G	26	0	2.4	0.4	0.8	0.8
51 TA-54 Area G	26	0	2.6	0.2	0.9	0.8
Group Summary	223	5	3.1	0.0	0.9	0.5[a]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	26	0	2.0	0.4	0.8	0.7
72 TA-21.02 (N Bldg. 344)	23	0	1.8	0.3	0.8	0.6
73 TA-21.03 (NE Bldg. 344)	25	1	2.3	0.0	0.7	0.9
74 TA-21.04 (SE Bldg. 344)	25	1	1.6	0.1	0.7	0.7
75 TA-21.05 (S Bldg. 344)	25	0	2.0	0.3	0.8	0.7
Group Summary	124	2	2.3	0.0	0.8	0.1[a]
TA-15 Firing Sites						
76 TA-15-NNW	25	0	1.3	0.2	0.6	0.5
77 TA-15-NNE	24	3	1.4	0.1	0.6	0.6
78 TA-15-N	26	2	5.1	0.2	0.9	2.5
Group Summary	75	5	5.1	0.1	0.7	0.4[a]

Concentration Guidelines are not available for gross alpha concentrations.

[a] This is two times the standard deviation of the mean value for the group.

Table 4-3. Airborne Long-Lived Gross Beta Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s (fCi/m^3)
Regional Stations						
01 Española	26	0	19.1	4.0	11.4	6.2
02 Pojoaque	26	0	15.2	3.5	10.2	6.2
03 Santa Fe	26	0	15.9	1.7	8.9	7.5
Group Summary	78	0	19.1	1.7	10.2	2.5[a]
Pueblo Stations						
41 San Ildefonso Pueblo	26	0	19.2	4.1	10.5	5.7
42 Taos Pueblo	26	0	16.1	5.8	10.5	5.4
48 Jemez Pueblo-Riverside	26	0	15.1	3.5	9.4	6.6
Group Summary	78	0	19.2	3.5	10.2	1.3[a]
Perimeter Stations						
04 Barranca School	26	0	19.3	2.5	10.4	6.3
05 Urban Park	26	2	17.0	1.4	9.0	6.1
06 48th Street	26	0	15.8	3.0	9.6	5.6
07 Gulf/Exxon/Shell Station	26	0	18.1	2.9	11.8	6.8
08 McDonalds Restaurant	26	2	19.4	1.1	9.8	7.3
09 Los Alamos Airport	26	0	19.3	3.5	10.9	6.3
10 East Gate	26	0	17.6	2.5	10.7	6.0
11 Well PM-1 (E. Jemez Road)	26	0	17.5	3.4	9.9	6.0
12 Royal Crest Trailer Court	26	0	16.5	2.0	9.5	5.6
13 Piñon School	26	0	19.1	3.5	10.3	6.5
14 Pajarito Acres	24	0	16.0	2.1	9.7	5.9
15 White Rock Fire Station	25	0	17.9	2.3	9.9	6.5
16 White Rock Church of the Nazarene	26	0	17.6	2.6	11.7	6.9
17 Bandelier Entrance (Lookout) (Rim)	26	0	20.2	3.8	12.0	6.4
60 LA Canyon	26	0	17.2	4.5	10.4	5.9
61 LA Hospital	26	0	22.4	4.9	12.4	7.9
62 Trinity Bible Church	25	0	19.9	4.0	10.8	6.6
63 Monte Rey South	25	0	20.8	5.1	11.9	7.7
Group Summary	463	4	22.4	1.1	10.6	2.0[a]
On-Site Stations						
19 TA-21 DP Site	2	0	7.3	3.6	5.4	5.3
20 TA-21 Area B	26	0	17.9	3.2	10.6	5.9
21 TA-6	2	0	3.5	2.2	2.9	1.9
22 TA-53	2	0	7.0	3.7	5.4	4.7
23 TA-52 Beta Site	26	0	17.5	3.1	9.9	5.9
25 TA-16-450	26	0	18.9	2.5	10.3	6.7
26 TA-49	26	0	15.1	2.8	10.7	6.1
28 TA-33 HP Site	2	0	7.5	2.3	4.9	7.3
30 Pajarito Booster 2 (P-2)	26	0	18.7	5.9	12.2	6.9
31 TA-3	26	0	22.8	2.3	10.3	9.2
32 County Landfill	27	0	43.9	2.9	10.8	14.1
49 Pajarito Rd (TA-36) Sludge Pond	26	0	21.1	4.0	11.9	6.7
Group Summary	217	0	43.9	2.2	8.8	6.4[a]

Table 4-3. Airborne Long-Lived Gross Beta Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s (fCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	26	0	18.2	3.4	9.8	6.0
34 TA-54 Area G-1 (behind trailer)	26	0	17.5	4.2	10.5	5.1
35 TA-54 Area G-2 (back fence)	25	0	19.0	2.5	10.0	6.4
36 TA-54 Area G-3 (by office)	26	0	18.7	3.6	10.6	5.9
37 TA-54 Area G-4 (water tank)	20	0	18.7	2.4	10.0	6.6
45 Area G (Southeast Perimeter)	26	0	18.3	3.4	10.0	5.8
47 Area G (North Perimeter)	22	0	19.8	2.5	10.7	6.8
50 TA-54 Area G	26	0	17.4	2.3	9.6	6.7
51 TA-54 Area G	26	0	19.3	3.8	11.1	6.3
Group Summary	223	0	19.8	2.3	10.2	1.0[a]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	26	0	22.0	2.1	11.1	7.5
72 TA-21.02 (N Bldg. 344)	23	0	18.2	5.1	9.9	5.9
73 TA-21.03 (NE Bldg. 344)	25	0	18.8	5.2	10.6	5.7
74 TA-21.04 (SE Bldg. 344)	25	0	20.8	4.2	11.0	6.0
75 TA-21.05 (S Bldg. 344)	25	0	19.0	4.1	11.3	6.2
Group Summary	124	0	22.0	2.1	10.8	1.1[a]
TA-15 Firing Sites						
76 TA-15-NNW	25	0	17.2	3.6	10.2	5.8
77 TA-15-NNE	24	0	19.2	4.6	11.2	6.4
78 TA-15-N	26	0	15.5	3.0	10.1	5.9
Group Summary	75	0	19.2	3.0	10.5	1.2[a]

Concentration Guidelines are not available for gross beta concentrations.

[a] This is two times the standard deviation of the mean value for the group.

Table 4-4. Airborne Tritium as Tritiated Water Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (pCi/m^3)	Minimum (pCi/m^3)	Mean (pCi/m^3)	2s (pCi/m^3)
Regional Stations						
01 Española	26	21	11.0	–1.1[a]	0.8	4.7
02 Pojoaque	26	20	2.0	–1.7	0.3	1.6
03 Santa Fe	26	23	1.0	–1.3	0.0	1.1
Group Summary	78	64	11.0	–1.7	0.3	0.8[b]
Pueblo Stations						
41 San Ildefonso Pueblo	26	16	1.9	–0.4	0.5	1.1
42 Taos Pueblo	24	20	1.5	–0.3	0.3	0.8
48 Jemez Pueblo-Riverside	26	18	2.7	–0.8	0.4	1.5
Group Summary	76	54	2.7	–0.8	0.4	0.1[b]
Perimeter Stations						
04 Barranca School	26	19	3.4	–0.5	0.6	1.7
05 Urban Park	26	22	1.8	–1.1	0.2	1.3
06 48th Street	26	16	1.9	–0.3	0.5	1.1
07 Gulf/Exxon/Shell Station	26	15	2.7	–0.2	0.8	1.4
08 McDonalds Restaurant	26	7	7.5	–0.0	2.2	3.4
09 Los Alamos Airport	24	6	3.4	–0.4	1.4	1.7
10 East Gate	26	2	3.5	0.5	1.8	1.7
11 Well PM-1 (E. Jemez Road)	26	12	2.6	–0.6	0.9	1.9
12 Royal Crest Trailer Court	26	9	15.0	–0.6	1.5	5.7
13 Piñon School	26	10	5.4	–0.5	1.8	2.8
14 Pajarito Acres	25	11	6.5	–0.6	0.9	2.6
15 White Rock Fire Station	25	12	4.6	–0.1	1.2	2.3
16 White Rock Church of the Nazarene	26	5	5.7	0.3	2.2	2.7
17 Bandelier Entrance (Lookout) (Rim)	26	14	7.3	–0.6	1.1	3.1
60 LA Canyon	26	6	4.9	–0.2	1.7	2.5
61 LA Hospital	26	17	5.5	–0.7	1.1	2.7
62 Trinity Bible Church	26	11	12.4	–0.3	1.6	5.3
63 Monte Rey South	26	14	4.1	–0.9	1.0	2.5
Group Summary	459	208	15.0	–1.1	1.3	1.2[b]
On-Site Stations						
19 TA-21 DP Site	2	0	4.4	4.3	4.4	0.1
20 TA-21 Area B	26	5	4.5	0.4	1.8	2.0
21 TA-6	2	2	0.4	–0.4	0.0	1.2
22 TA-53	2	1	1.7	–0.2	0.8	2.6
23 TA-52 Beta Site	26	10	3.0	–1.1	1.1	1.8
25 TA-16-450	26	0	49.7	10.6	23.8	20.6
26 TA-49	26	11	9.1	–0.8	1.7	4.0
28 TA-33 HP Site	2	1	2.5	0.3	1.4	3.2
30 Pajarito Booster 2 (P-2)	26	14	13.6	–0.2	1.3	5.2
31 TA-3	26	7	3.2	0.3	1.3	1.5
32 County Landfill	27	12	6.9	0.0	1.3	2.8
49 Pajarito Rd (TA-36) Sludge Pond	26	13	7.5	–0.2	1.4	3.9
Group Summary	217	76	49.7	–1.1	3.4	13.0[b]

Table 4-4. Airborne Tritium as Tritiated Water Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (pCi/m^3)	Minimum (pCi/m^3)	Mean (pCi/m^3)	2s (pCi/m^3)
TA-54, Area G	21	1	57.6	1.7	18.4	31.2
27 TA-54 Area G (by QA)	26	0	52.3	3.2	18.5	26.2
34 TA-54 Area G-1 (behind trailer)	25	1	20.2	0.6	7.4	10.9
35 TA-54 Area G-2 (back fence)	25	0	1167.1	93.0	400.3	688.2
36 TA-54 Area G-3 (by office)	26	3	7.2	0.0	2.4	3.3
37 TA-54 Area G-4 (water tank)	20	0	12.6	1.1	5.5	5.8
45 Area G (Southeast Perimeter)	26	1	20.3	–0.6	7.7	9.1
47 Area G (North Perimeter)	20	1	28.3	0.7	12.2	18.0
50 TA-54 Area G	26	3	15.9	0.5	5.6	8.3
51 TA-54 Area G	26	6	7.5	0.3	2.6	3.3
Group Summary	220	15	1167.1	–0.6	51.4	261.9[b]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	25	4	5.1	–0.1	2.1	2.7
72 TA-21.02 (N Bldg. 344)	24	3	7.2	0.5	2.3	3.2
73 TA-21.03 (NE Bldg. 344)	26	0	12.5	1.0	4.0	5.5
74 TA-21.04 (SE Bldg. 344)	26	2	11.3	0.1	3.6	4.6
75 TA-21.05 (S Bldg. 344)	26	2	8.8	0.8	3.6	3.7
Group Summary	127	11	12.5	–0.1	3.1	1.8[b]
TA-15 Firing Sites						
76 TA-15-NNW	26	14	8.9	–0.8	1.3	4.0
77 TA-15-NNE	26	17	4.8	–1.4	0.8	2.5
78 TA-15-N	26	15	6.8	–0.6	0.9	2.8
Group Summary	78	46	8.9	–1.4	1.0	0.6[b]

Concentration Guidelines

Controlled Area DOE Derived Air Concentration Guide 20,000,000 pCi/m^3. See Appendix A.
Uncontrolled Area DOE Derived Air Concentration Guide 100,000 pCi/m^3. See Appendix A.
EPA 40 CFR 61 Concentration Guide 1,500 pCi/m^3.

[a] See Appendix B for an explanation of the presence of negative numbers.
[b] This is two times the standard deviation of the mean value for the group.

Table 4-5. Airborne Plutonium-238 Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Regional Stations						
01 Española	4	4	0.3	–0.4[a]	–0.1	0.3
02 Pojoaque	4	4	0.3	–0.2	0.0	0.2
03 Santa Fe	4	3	0.6	0.0	0.4	0.3
Group Summary	12	11	0.6	–0.4	0.1	0.5[b]
Pueblo Stations						
41 San Ildefonso Pueblo	4	4	0.5	0.0	0.2	0.2
42 Taos Pueblo	4	3	1.2	–0.5	0.1	0.7
48 Jemez Pueblo-Riverside	4	4	0.7	–0.1	0.3	0.4
Group Summary	12	11	1.2	–0.5	0.2	0.1[b]
Perimeter Stations						
04 Barranca School	4	4	0.0	–0.3	–0.1	0.2
05 Urban Park	4	2	1.7	–0.3	0.7	0.8
06 48th Street	4	4	0.3	–0.6	–0.1	0.4
07 Gulf/Exxon/Shell Station	4	4	1.0	–0.5	0.3	0.7
08 McDonalds Restaurant	4	4	0.6	–0.3	0.1	0.5
09 Los Alamos Airport	4	4	0.2	0.0	0.2	0.1
10 East Gate	4	4	0.3	–0.1	0.1	0.2
11 Well PM-1 (E. Jemez Road)	4	4	0.4	–0.2	0.1	0.3
12 Royal Crest Trailer Court	4	3	2.8	0.1	1.0	1.2
13 Piñon School	4	3	0.7	–0.2	0.1	0.4
14 Pajarito Acres	4	4	0.1	–0.4	–0.2	0.2
15 White Rock Fire Station	4	4	0.5	–0.1	0.3	0.2
16 White Rock Church of the Nazarene	4	4	0.1	–0.5	–0.2	0.3
17 Bandelier Entrance (Lookout) (Rim)	4	4	0.2	–0.7	–0.1	0.4
60 LA Canyon	4	4	0.9	0.0	0.2	0.4
61 LA Hospital	4	3	1.5	–0.1	0.4	0.7
62 Trinity Bible Church	4	4	0.3	0.1	0.2	0.1
63 Monte Rey South	4	4	0.1	–0.1	0.0	0.1
Group Summary	72	67	2.8	–0.7	0.2	0.6[b]
On-Site Stations						
20 TA-21 Area B	4	3	1.2	0.1	0.6	0.5
23 TA-52 Beta Site	4	3	0.5	0.1	0.3	0.2
25 TA-16-450	4	4	0.4	–0.2	0.1	0.3
26 TA-49	4	3	1.2	0.2	0.6	0.4
30 Pajarito Booster 2 (P-2)	4	2	6.8	0.1	2.1	3.2
31 TA-3	4	2	5.2	0.1	1.7	2.4
32 County Landfill	4	3	3.0	–0.1	0.9	1.4
49 Pajarito Rd (TA-36) Sludge Pond	4	4	0.4	–0.1	0.2	0.2
Group Summary	32	24	6.8	–0.2	0.8	1.5[b]

Table 4-5. Airborne Plutonium-238 Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	4	0	26.1	4.9	19.8	10.0
34 TA-54 Area G-1 (behind trailer)	4	2	3.7	0.2	1.8	1.6
35 TA-54 Area G-2 (back fence)	4	3	0.7	–0.1	0.2	0.4
36 TA-54 Area G-3 (by office)	4	4	0.7	0.0	0.3	0.3
37 TA-54 Area G-4 (water tank)	2	2	0.1	–0.3	–0.1	0.3
45 Area G (Southeast Perimeter)	4	4	0.4	–0.3	0.1	0.3
47 Area G (North Perimeter)	4	4	0.9	0.0	0.3	0.4
50 TA-54 Area G	4	3	0.7	0.3	0.5	0.2
51 TA-54 Area G	4	3	2.2	–0.3	0.8	1.0
Group Summary	34	25	26.1	–0.3	2.6	12.9[b]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	4	3	1.2	–0.6	0.4	0.8
72 TA-21.02 (N Bldg. 344)	4	1	33.2	1.0	11.2	14.9
73 TA-21.03 (NE Bldg. 344)	4	0	52.0	2.1	15.9	24.1
74 TA-21.04 (SE Bldg. 344)	4	2	6.3	0.7	2.2	2.7
75 TA-21.05 (S Bldg. 344)	4	2	8.6	0.8	3.0	3.7
Group Summary	20	8	52.0	–0.6	6.5	13.3[b]
TA-15 Firing Sites						
76 TA-15-NNW	4	3	2.2	–0.2	0.5	1.1
77 TA-15-NNE	4	4	0.2	–0.1	0.0	0.1
78 TA-15-N	4	4	0.3	–0.6	–0.0	0.4
Group Summary	12	11	2.2	–0.6	0.2	0.6[b]

Concentration Guidelines
Controlled Area DOE Derived Air Concentration Guide 3,000,000 aCi/m^3. See Appendix A.
Uncontrolled Area DOE Derived Air Concentration Guide 30,000 aCi/m^3. See Appendix A.
EPA 40 CFR 61 Concentration Guide 2,100 aCi/m^3.

[a] See Appendix B for an explanation of the presence of negative numbers.
[b] This is two times the standard deviation of the mean value for the group.

Table 4-6. Airborne Plutonium-239 Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Regional Stations						
01 Española	4	3	1.1	–0.4[a]	0.6	0.7
02 Pojoaque	4	4	0.7	–0.3	0.2	0.4
03 Santa Fe	4	3	2.2	0.4	1.2	0.8
Group Summary	12	10	2.2	–0.4	0.7	1.0[b]
Pueblo Stations						
41 San Ildefonso Pueblo	4	3	1.4	0.2	0.6	0.5
42 Taos Pueblo	4	4	1.6	–0.2	0.9	0.8
48 Jemez Pueblo-Riverside	4	3	1.7	0.4	1.0	0.6
Group Summary	12	10	1.7	–0.2	0.9	0.4[b]
Perimeter Stations						
04 Barranca School	4	4	1.1	0.4	0.7	0.3
05 Urban Park	4	2	2.1	–0.4	1.0	1.1
06 48th Street	4	4	0.7	–0.5	–0.1	0.5
07 Gulf/Exxon/Shell Station	4	3	2.0	–0.6	1.0	1.3
08 McDonalds Restaurant	4	3	2.9	0.1	1.1	1.2
09 Los Alamos Airport	4	1	4.0	0.8	2.9	1.4
10 East Gate	4	2	1.7	0.5	1.2	0.6
11 Well PM-1 (E. Jemez Road)	4	3	0.9	0.2	0.5	0.3
12 Royal Crest Trailer Court	4	2	2.3	0.2	1.5	0.9
13 Piñon School	4	3	2.0	0.3	1.1	0.7
14 Pajarito Acres	4	4	0.9	0.4	0.6	0.2
15 White Rock Fire Station	4	4	1.3	0.2	0.8	0.5
16 White Rock Church of the Nazarene	4	3	2.4	0.3	1.2	0.9
17 Bandelier Entrance (Lookout) (Rim)	4	2	1.7	0.1	0.8	0.7
60 LA Canyon	4	3	1.8	0.6	1.2	0.5
61 LA Hospital	4	3	1.0	0.1	0.6	0.4
62 Trinity Bible Church	4	3	1.9	0.3	1.0	0.7
63 Monte Rey South	4	3	0.9	0.3	0.5	0.3
Group Summary	72	52	4.0	–0.6	1.0	1.2[b]
On-Site Stations						
20 TA-21 Area B	4	2	1.9	1.3	1.6	0.3
23 TA-52 Beta Site	4	2	2.0	0.2	0.9	0.8
25 TA-16-450	4	4	0.8	–0.2	0.3	0.4
26 TA-49	4	2	14.6	0.5	4.6	6.7
30 Pajarito Booster 2 (P-2)	4	1	235.3	1.0	60.8	116.4
31 TA-3	4	3	1.9	0.6	1.0	0.6
32 County Landfill	4	0	6.9	3.6	5.0	1.6
49 Pajarito Rd (TA-36) Sludge Pond	4	3	1.2	0.7	1.0	0.2
Group Summary	32	17	235.3	–0.2	9.4	41.7[b]

Table 4-6. Airborne Plutonium-239 Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	4	0	932.6	154.6	706.6	369.9
34 TA-54 Area G-1 (behind trailer)	4	1	8.3	1.4	3.6	3.2
35 TA-54 Area G-2 (back fence)	4	2	2.1	0.7	1.5	0.6
36 TA-54 Area G-3 (by office)	4	2	4.1	0.7	2.0	1.6
37 TA-54 Area G-4 (water tank)	2	1	1.0	0.9	0.9	0.1
45 Area G (Southeast Perimeter)	4	1	5.9	0.1	3.0	2.5
47 Area G (North Perimeter)	4	0	30.1	6.9	14.1	10.9
50 TA-54 Area G	4	1	11.0	1.2	4.4	4.4
51 TA-54 Area G	4	0	10.8	1.7	4.5	4.3
Group Summary	34	8	932.6	0.1	82.3	468.3[b]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	4	2	5.5	0.2	2.4	2.2
72 TA-21.02 (N Bldg. 344)	4	0	40.9	7.5	18.2	15.6
73 TA-21.03 (NE Bldg. 344)	4	0	34.5	7.0	19.4	11.8
74 TA-21.04 (SE Bldg. 344)	4	0	33.3	7.6	15.0	12.2
75 TA-21.05 (S Bldg. 344)	4	1	32.4	3.0	13.5	13.2
Group Summary	20	3	40.9	0.2	13.7	13.5[b]
TA-15 Firing Sites						
76 TA-15-NNW	4	2	3.5	0.3	1.4	1.5
77 TA-15-NNE	4	2	2.2	0.5	0.9	0.8
78 TA-15-N	4	3	2.4	0.0	0.9	1.0
Group Summary	12	7	3.5	0.0	1.1	0.6[b]

Concentration Guidelines
Controlled Area DOE Derived Air Concentration Guide 2,000,000 aCi/m^3. See Appendix A.
Uncontrolled Area DOE Derived Air Concentration Guide 20,000 aCi/m^3. See Appendix A.
EPA 40 CFR 61 Concentration Guide 1,900 aCi/m^3.

[a] See Appendix B for an explanation of the presence of negative numbers.
[b] This is two times the standard deviation of the mean value for the group.

Table 4-7. Airborne Americium-241 Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Regional Stations						
01 Española	4	1	4.2	1.2	2.3	1.3
02 Pojoaque	4	0	2.1	1.2	1.6	0.4
03 Santa Fe	4	1	3.3	1.5	2.5	0.8
Group Summary	12	2	4.2	1.2	2.1	1.0[a]
Pueblo Stations						
41 San Ildefonso Pueblo	4	0	2.2	1.4	1.7	0.3
42 Taos Pueblo	4	0	2.9	1.9	2.4	0.5
48 Jemez Pueblo-Riverside	4	2	2.2	1.1	1.7	0.5
Group Summary	12	2	2.9	1.1	2.0	0.8[a]
Perimeter Stations						
04 Barranca School	4	1	2.1	0.4	1.3	0.7
05 Urban Park	4	2	2.1	1.2	1.6	0.4
06 48th Street	4	1	2.3	0.7	1.6	0.7
07 Gulf/Exxon/Shell Station	4	2	2.5	1.0	1.6	0.7
08 McDonalds Restaurant	4	0	3.1	1.3	2.4	0.8
09 Los Alamos Airport	4	0	3.3	1.5	2.2	0.8
10 East Gate	4	1	2.2	1.0	1.8	0.6
11 Well PM-1 (E. Jemez Road)	4	1	3.1	0.6	1.8	1.1
12 Royal Crest Trailer Court	4	1	3.3	1.0	2.1	0.9
13 Piñon School	4	1	3.3	1.2	2.2	1.1
14 Pajarito Acres	4	0	2.7	0.7	1.9	0.8
15 White Rock Fire Station	4	0	2.6	1.9	2.3	0.3
16 White Rock Church of the Nazarene	4	1	1.9	1.1	1.7	0.4
17 Bandelier Entrance (Lookout) (Rim)	4	0	2.7	1.2	1.8	0.7
60 LA Canyon	4	1	2.2	1.3	1.7	0.5
61 LA Hospital	4	2	2.6	1.1	1.7	0.7
62 Trinity Bible Church	4	2	2.2	0.5	1.3	0.8
63 Monte Rey South	4	1	2.6	1.2	1.8	0.6
Group Summary	72	17	3.3	0.4	1.8	0.6[a]
On-Site Stations						
20 TA-21 Area B	4	0	2.8	1.9	2.3	0.4
23 TA-52 Beta Site	4	0	3.6	1.8	2.5	0.8
25 TA-16-450	4	0	2.8	1.2	1.8	0.7
26 TA-49	4	1	12.1	1.4	4.8	5.0
30 Pajarito Booster 2 (P-2)	4	1	153.0	1.8	40.7	74.9
31 TA-3	4	2	2.7	0.7	1.5	0.8
32 County Landfill	4	0	4.7	2.8	3.6	0.8
49 Pajarito Rd (TA-36) Sludge Pond	4	3	2.9	0.4	1.4	1.1
Group Summary	32	7	153.0	0.4	7.3	27[a]

Table 4-7. Airborne Americium-241 Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	4	0	716.9	95.5	478.2	267.4
34 TA-54 Area G-1 (behind trailer)	4	0	7.2	2.3	4.2	2.1
35 TA-54 Area G-2 (back fence)	4	0	4.3	1.9	3.1	1.2
36 TA-54 Area G-3 (by office)	4	0	5.4	1.9	2.8	1.7
37 TA-54 Area G-4 (water tank)	2	1	2.1	1.0	1.6	0.8
45 Area G (Southeast Perimeter)	4	0	3.9	2.2	3.1	0.7
47 Area G (North Perimeter)	4	0	19.2	5.0	10.5	6.1
50 TA-54 Area G	4	0	3.9	1.9	2.5	0.9
51 TA-54 Area G	4	0	4.7	2.1	3.1	1.2
Group Summary	34	1	716.9	1.0	56.6	316.3[a]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	4	1	3.4	1.2	2.4	0.9
72 TA-21.02 (N Bldg. 344)	4	0	6.0	2.5	4.4	1.6
73 TA-21.03 (NE Bldg. 344)	4	0	14.8	4.0	9.0	4.4
74 TA-21.04 (SE Bldg. 344)	4	0	4.2	1.4	3.2	1.3
75 TA-21.05 (S Bldg. 344)	4	0	5.4	2.0	3.7	1.8
Group Summary	20	1	14.8	1.2	4.5	5.2[a]
TA-15 Firing Sites						
76 TA-15-NNW	4	2	2.7	1.2	1.6	0.7
77 TA-15-NNE	4	2	2.5	0.7	1.6	0.7
78 TA-15-N	4	0	4.0	1.7	2.9	0.9
Group Summary	12	4	4.0	0.7	2.0	1.5[a]

Concentration Guidelines
Controlled Area DOE Derived Air Concentration Guide 2,000,000 aCi/m^3. See Appendix A.
Uncontrolled Area DOE Derived Air Concentration Guide 20,000 aCi/m^3. See Appendix A.
EPA 40 CFR 61 Concentration Guide 1,900 aCi/m^3.

[a] This is two times the standard deviation of the mean value for the group.

Table 4-8. Airborne Uranium-234 Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Regional Stations						
01 Española	4	0	131.2	15.7	49.1	55.4
02 Pojoaque	4	0	43.4	18.1	28.6	11.8
03 Santa Fe	4	0	47.6	16.7	29.1	14.8
Group Summary	12	0	131.2	15.7	35.6	23.3[a]
Pueblo Stations						
41 San Ildefonso Pueblo	4	0	27.1	13.6	17.6	6.3
42 Taos Pueblo	4	0	42.8	15.0	25.9	12.0
48 Jemez Pueblo-Riverside	4	0	58.7	22.2	35.5	16.0
Group Summary	12	0	58.7	13.6	26.3	17.9[a]
Perimeter Stations						
04 Barranca School	4	0	21.0	5.6	11.8	6.5
05 Urban Park	4	2	14.1	2.6	7.3	5.4
06 48th Street	4	0	25.3	5.7	11.8	9.2
07 Gulf/Exxon/Shell Station	4	1	15.9	2.4	9.5	5.7
08 McDonalds Restaurant	4	1	14.5	2.9	8.9	4.9
09 Los Alamos Airport	4	0	12.3	7.4	10.1	2.1
10 East Gate	4	1	14.9	3.8	10.0	5.5
11 Well PM-1 (E. Jemez Road)	4	1	16.1	3.4	8.8	5.6
12 Royal Crest Trailer Court	4	0	14.4	7.4	9.3	3.4
13 Piñon School	4	0	14.9	5.6	10.1	3.8
14 Pajarito Acres	4	1	8.7	3.7	6.3	2.6
15 White Rock Fire Station	4	0	18.1	5.1	11.8	6.0
16 White Rock Church of the Nazarene	4	1	13.8	2.5	9.5	4.9
17 Bandelier Entrance (Lookout) (Rim)	4	1	12.1	3.8	8.0	3.5
60 LA Canyon	4	1	20.1	4.2	11.1	7.1
61 LA Hospital	4	0	27.7	14.4	20.2	5.9
62 Trinity Bible Church	4	1	17.6	4.3	10.7	5.4
63 Monte Rey South	4	0	11.7	4.0	8.0	3.2
Group Summary	72	11	27.7	2.4	10.2	5.9[a]
On-Site Stations						
20 TA-21 Area B	4	0	10.6	5.7	8.4	2.4
23 TA-52 Beta Site	4	0	36.5	10.4	26.7	11.3
25 TA-16-450	4	0	28.7	6.0	12.3	11.0
26 TA-49	3	0	14.9	11.2	12.7	1.9
30 Pajarito Booster 2 (P-2)	4	0	25.8	6.7	13.3	8.5
31 TA-3	4	0	16.3	7.2	11.8	3.8
32 County Landfill	4	0	67.0	28.6	43.6	17.7
49 Pajarito Rd (TA-36) Sludge Pond	4	0	29.2	4.3	20.0	10.9
Group Summary	31	0	67.0	4.3	18.6	23.2[a]

Table 4-8. Airborne Uranium-234 Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	4	0	67.6	29.2	43.9	17.7
34 TA-54 Area G-1 (behind trailer)	4	0	40.7	7.3	19.6	15.3
35 TA-54 Area G-2 (back fence)	4	0	56.1	9.8	23.9	21.9
36 TA-54 Area G-3 (by office)	4	0	34.0	21.0	25.4	5.9
37 TA-54 Area G-4 (water tank)	2	1	21.9	3.3	12.6	13.2
45 Area G (Southeast Perimeter)	4	0	35.4	8.5	16.2	12.8
47 Area G (North Perimeter)	4	1	41.5	2.7	17.5	17.0
50 TA-54 Area G	4	0	112.6	23.5	50.8	41.7
51 TA-54 Area G	4	0	73.6	27.2	41.5	21.9
Group Summary	34	2	112.6	2.7	27.9	27.7[a]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	4	0	14.7	8.5	10.4	2.9
72 TA-21.02 (N Bldg. 344)	4	0	21.7	13.5	17.3	3.4
73 TA-21.03 (NE Bldg. 344)	4	0	20.3	8.2	13.5	5.0
74 TA-21.04 (SE Bldg. 344)	4	0	40.9	9.5	20.0	14.4
75 TA-21.05 (S Bldg. 344)	4	0	60.7	10.3	28.1	23.2
Group Summary	20	0	60.7	8.2	17.9	13.6[a]
TA-15 Firing Sites						
76 TA-15-NNW	4	1	15.6	3.8	11.4	5.4
77 TA-15-NNE	4	0	24.1	9.8	13.9	6.9
78 TA-15-N	4	0	235.7	4.1	64.5	114.2
Group Summary	12	1	235.7	3.8	30.0	59.9[a]

Concentration Guidelines
Controlled Area DOE Derived Air Concentration Guide 20,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 90,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 7,700 aCi/m^3.

[a] This is two times the standard deviation of the mean value for the group.

Table 4-9. Airborne Uranium-235 Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m³)	Minimum (aCi/m³)	Mean (aCi/m³)	2s (aCi/m³)
Regional Stations						
01 Española	4	2	6.4	1.3	3.1	2.3
02 Pojoaque	4	3	3.5	–0.1[a]	2.0	1.6
03 Santa Fe	4	3	4.0	0.0	1.6	1.7
Group Summary	12	8	6.4	–0.1	2.2	1.6[b]
Pueblo Stations						
41 San Ildefonso Pueblo	4	4	1.5	0.4	0.9	0.5
42 Taos Pueblo	4	2	2.3	1.5	1.8	0.4
48 Jemez Pueblo-Riverside	4	3	3.4	0.0	1.5	1.4
Group Summary	12	9	3.4	0.0	1.4	0.9[b]
Perimeter Stations						
04 Barranca School	4	4	3.0	–0.2	1.6	1.4
05 Urban Park	4	3	1.7	–1.5	0.4	1.5
06 48th Street	4	4	2.1	0.5	1.2	0.7
07 Gulf/Exxon/Shell Station	4	3	2.1	–0.5	1.0	1.1
08 McDonalds Restaurant	4	3	2.3	0.0	1.1	1.0
09 Los Alamos Airport	4	4	2.0	0.0	1.0	0.8
10 East Gate	4	4	1.9	0.0	0.9	1.0
11 Well PM-1 (E. Jemez Road)	4	4	0.9	0.0	0.5	0.4
12 Royal Crest Trailer Court	4	4	1.9	0.2	1.3	0.7
13 Piñon School	4	4	1.4	0.1	0.9	0.6
14 Pajarito Acres	4	4	2.4	0.1	1.0	1.1
15 White Rock Fire Station	4	4	1.3	–0.1	0.6	0.7
16 White Rock Church of the Nazarene	4	4	0.1	–0.3	–0.0	0.2
17 Bandelier Entrance (Lookout) (Rim)	4	4	1.5	–1.5	0.4	1.3
60 LA Canyon	4	4	1.8	1.1	1.4	0.3
61 LA Hospital	4	4	2.7	0.0	1.1	1.2
62 Trinity Bible Church	4	4	2.8	–0.7	0.7	1.5
63 Monte Rey South	4	4	1.1	0.0	0.7	0.5
Group Summary	72	69	3.0	–1.5	0.9	0.8[b]
On-Site Stations						
20 TA-21 Area B	4	4	1.6	–0.4	0.5	0.8
23 TA-52 Beta Site	4	2	3.0	0.0	1.8	1.3
25 TA-16-450	4	3	4.5	0.0	1.5	2.1
26 TA-49	3	3	1.5	0.1	0.6	0.8
30 Pajarito Booster 2 (P-2)	4	4	1.0	0.0	0.6	0.4
31 TA-3	4	3	2.7	–1.5	0.3	1.8
32 County Landfill	4	3	2.7	0.1	1.4	1.0
49 Pajarito Rd (TA-36) Sludge Pond	4	4	1.6	–0.1	0.9	0.8
Group Summary	31	26	4.5	–1.5	0.9	1.1[b]

Table 4-9. Airborne Uranium-235 Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	4	3	3.4	1.4	2.4	1.1
34 TA-54 Area G-1 (behind trailer)	4	3	3.1	0.3	1.3	1.4
35 TA-54 Area G-2 (back fence)	4	4	1.5	0.7	1.0	0.3
36 TA-54 Area G-3 (by office)	4	4	1.5	1.1	1.3	0.2
37 TA-54 Area G-4 (water tank)	2	2	0.7	0.7	0.7	0.0
45 Area G (Southeast Perimeter)	4	3	2.2	0.0	1.1	1.0
47 Area G (North Perimeter)	4	3	4.2	0.2	1.7	1.8
50 TA-54 Area G	4	2	6.0	1.3	3.4	2.2
51 TA-54 Area G	4	2	4.1	1.2	2.6	1.5
Group Summary	34	26	6.0	0.0	1.7	1.8[b]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	4	3	1.2	–0.2	0.6	0.7
72 TA-21.02 (N Bldg. 344)	4	3	2.6	0.0	1.1	1.1
73 TA-21.03 (NE Bldg. 344)	4	4	1.4	0.0	1.0	0.7
74 TA-21.04 (SE Bldg. 344)	4	4	1.2	0.0	0.6	0.6
75 TA-21.05 (S Bldg. 344)	4	2	2.8	0.0	1.8	1.3
Group Summary	20	16	2.8	–0.2	1.0	1.0[b]
TA-15 Firing Sites						
76 TA-15-NNW	4	4	1.8	–0.1	1.1	0.8
77 TA-15-NNE	4	4	1.4	0.2	0.7	0.5
78 TA-15-N	4	3	12.6	0.0	3.7	6.0
Group Summary	12	11	12.6	–0.1	1.8	3.3[b]

Concentration Guidelines
Controlled Area DOE Derived Air Concentration Guide 20,000,000 aCi/m^3. See Appendix A.
Uncontrolled Area DOE Derived Air Concentration Guide 100,000 aCi/m^3. See Appendix A.
EPA 40 CFR 61 Concentration Guide 7,100 aCi/m^3.

[a] See Appendix B for an explanation of the presence of negative numbers.
[b] This is two times the standard deviation of the mean value for the group.

Table 4-10. Airborne Uranium-238 Concentrations for 1996

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Regional Stations						
01 Española	4	0	30.9	12.9	18.5	8.4
02 Pojoaque	4	0	38.4	16.8	28.6	11.0
03 Santa Fe	4	0	46.4	13.9	27.1	15.6
Group Summary	12	0	46.4	12.9	24.7	10.9[a]
Pueblo Stations						
41 San Ildefonso Pueblo	4	0	25.5	10.8	17.2	6.1
42 Taos Pueblo	4	0	42.9	16.5	26.4	12.5
48 Jemez Pueblo-Riverside	4	0	63.4	20.7	38.3	18.7
Group Summary	12	0	63.4	10.8	27.3	21.1[a]
Perimeter Stations						
4 Barranca School	4	0	19.9	8.2	12.8	5.1
5 Urban Park	4	0	16.5	3.9	8.5	5.5
6 48th Street	4	1	8.6	1.0	5.5	3.2
7 Gulf/Exxon/Shell Station	4	0	15.8	5.1	11.2	4.:
8 McDonalds Restaurant	4	0	17.1	4.6	10.7	5.6
9 Los Alamos Airport	4	0	19.6	5.9	12.2	5.6
10 East Gate	4	0	14.9	9.1	11.5	2.7
11 Well PM-1 (E. Jemez Road)	4	1	16.7	2.0	11.2	6.8
12 Royal Crest Trailer Court	4	0	16.6	3.3	8.5	5.7
13 Piñon School	4	0	14.7	8.7	10.9	2.7
14 Pajarito Acres	4	0	8.7	3.6	6.1	2.4
15 White Rock Fire Station	4	0	21.3	6.6	11.6	6.6
16 White Rock Church of the Nazarene	4	1	13.8	1.6	7.0	5.3
17 Bandelier Entrance (Lookout) (Rim)	4	0	19.2	3.7	10.4	6.7
60 LA Canyon	4	0	20.1	5.2	11.0	7.2
61 LA Hospital	4	0	29.1	7.4	19.0	9.1
62 Trinity Bible Church	4	0	18.1	4.3	12.4	5.9
63 Monte Rey South	4	1	11.7	3.1	8.8	3.9
Group Summary	72	4	29.1	1.0	10.5	6.0[a]
On-Site Stations						
20 TA-21 Area B	4	0	14.1	10.2	11.6	1.7
23 TA-52 Beta Site	4	0	34.9	11.9	27.5	10.6
25 TA-16-450	4	0	30.7	7.5	13.6	11.4
26 TA-49	3	0	12.0	9.8	11.0	1.1
30 Pajarito Booster 2 (P-2)	4	0	25.6	13.5	19.3	6.3
31 TA-3	4	0	13.3	10.0	11.0	1.5
32 County Landfill	4	0	68.9	26.8	44.7	17.9
49 Pajarito Rd (TA-36) Sludge Pond	4	0	30.5	9.8	16.2	9.6
Group Summary	31	0	68.9	7.5	19.3	23.4[a]

Table 4-10. Airborne Uranium-238 Concentrations for 1996 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s (aCi/m^3)
Area G Stations						
27 TA-54 Area G (by QA)	4	0	69.2	24.0	41.5	19.9
34 TA-54 Area G-1 (behind trailer)	4	0	45.6	4.7	19.5	18.8
35 TA-54 Area G-2 (back fence)	4	0	18.8	6.1	10.8	5.6
36 TA-54 Area G-3 (by office)	4	0	34.0	13.5	23.3	9.0
37 TA-54 Area G-4 (water tank)	2	0	19.1	5.5	12.3	9.6
45 Area G (Southeast Perimeter)	4	0	35.1	9.6	16.8	12.2
47 Area G (North Perimeter)	4	1	37.1	3.3	18.0	14.1
50 TA-54 Area G	4	0	104.2	28.2	50.6	36.1
51 TA-54 Area G	4	0	66.8	24.1	41.5	19.0
Group Summary	34	1	104.2	3.3	26.0	29.2[a]
Decontamination and Decommissioning						
71 TA-21.01 (NW Bldg. 344)	4	0	17.5	5.9	12.3	4.8
72 TA-21.02 (N Bldg. 344)	4	0	15.3	8.8	11.2	2.8
73 TA-21.03 (NE Bldg. 344)	4	0	13.7	4.5	10.4	4.1
74 TA-21.04 (SE Bldg. 344)	4	0	14.4	7.3	11.0	3.2
75 TA-21.05 (S Bldg. 344)	4	0	15.8	10.3	12.5	2.6
Group Summary	20	0	17.5	4.5	11.5	1.8[a]
TA-15 Firing Sites						
76 TA-15-NNW	4	0	18.5	6.3	11.9	5.1
77 TA-15-NNE	4	0	63.9	28.3	45.6	15.2
78 TA-15-N	4	0	20.8	4.3	11.6	7.8
Group Summary	12	0	63.9	4.3	23.0	39.0[a]

Concentration Guidelines
Controlled Area DOE Derived Air Concentration Guide 20,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 100,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 8,300 aCi/m^3.

[a] This is two times the standard deviation of the mean value for the group.

Table 4-11. Thermoluminescent Dosimeter (TLD) Measurements of External Radiation 1994–1996

	TLD Station ID #	Location	1996 Annual Dose (mrem)[a]	1995 Annual Dose (mrem)	1994 Annual Dose (mrem)
Regional	01	Española	98 ± 11[c]	100 ± 12[b]	76 ± 13[b,c]
	02	Pojoaque	90 ± 9[c]	114 ± 10	118 ± 13
	03	Santa Fe	105 ± 9[c]	105 ± 10[c]	122 ± 13
	04	Fenton Hill (TA-57)	166 ± 10[c]	51 ± 9[d]	152 ± 13
	52	West Taos Pueblo	Discontinued	30 ± 10[e]	Not Operational
	53	Pueblo of San Ildefonso	82 ± 16[c]	104 ± 12	113 ± 13
	54	Jemez Pueblo	119 ± 11	114 ± 12	110 ± 13
Perimeter	05	Barranca School, Los Alamos	104 ± 10[c]	139 ± 10	118 ± 13
	06	Arkansas Avenue, Los Alamos	Discontinued 4th Quarter of 1992		
	07	Cumbres School, Los Alamos	130 ± 12	131 ± 10	125 ± 10
	08	48th Street, Los Alamos	144 ± 11	135 ± 8	132 ± 10
	09	Los Alamos Airport	131 ± 11	114 ± 9	110 ± 10
	10	Bayo Canyon, Los Alamos	170 ± 12	149 ± 11	145 ± 13
	11	Shell Station, Los Alamos	142 ± 11	137 ± 9	140 ± 10
	12	Royal Crest Trailer Court, Los Alamos	140 ± 11	127 ± 11	133 ± 13
	13	White Rock	134 ± 11	118 ± 9	124 ± 10
	14	Pajarito Acres, White Rock	130 ± 11	127 ± 11	122 ± 14
	15	Bandelier National Monument Lookout Station	149 ± 12	131 ± 9	143 ± 11
	16	Pajarito Ski Area	114 ± 10[c]	122 ± 12	118 ± 13
	20	Well PM-1 (SR4 and Truck Rt.)	167 ± 12	157 ± 12	148 ± 13
	41	McDonald’s Restaurant, Los Alamos	78 ± 8[d]	134 ± 9	128 ± 10
	42	Los Alamos Airport-South	147 ± 11	125 ± 12	123 ± 13
	43	East Gate Business Park, Los Alamos	145 ± 11	126 ± 12	114 ± 13
	44	Big Rock Loop, Los Alamos	176 ± 12	142 ± 10	165 ± 13
	45	Cheyenne Street, Los Alamos	165 ± 12	83 ± 9[d]	160 ± 13
	46	Los Pueblos Street, Los Alamos	161 ± 12	156 ± 12	139 ± 13
	47	Urban Park, Los Alamos	144 ± 12	130 ± 11	135 ± 13
	48	Los Alamos County Landfill	135 ± 11	130 ± 12	122 ± 13
	49	Piñon School, White Rock	103 ± 10[c]	132 ± 12	124 ± 13
	50	White Rock Church of the Nazarene	95 ± 10	93 ± 12	101 ± 13
	51	Bayo Canyon Well, Los Alamos	162 ± 12	155 ± 10	103 ± 12
	55	Monte Rey South	128 ± 11	73 ± 8[d]	Not Operational
On-Site	17	TA-21 (DP West)	155 ± 12	142 ± 11	153 ± 10
	18	TA-6 (Two Mile Mesa)	142 ± 11	128 ± 9	134 ± 10
	19	TA-53 (LANSCE)	159 ± 12	142 ± 9	152 ± 12
	21	TA-16 (S-Site)	141 ± 11	140 ± 12	99 ± 12[c]
	22	Booster P-2	179 ± 12	185 ± 12	144 ± 13
	23	TA-3 East Gate of SM 43	125 ± 11	105 ± 12	132 ± 13
	24	State Highway 4	178 ± 13	135 ± 11	98 ± 11[c]
	25	TA-49 (Frijoles Mesa)	135 ± 11	135 ± 9	119 ± 10
	26	TA-2 (Omega Stack)	148 ± 12	168 ± 12	135 ± 13
	27	TA-2 (Omega Canyon)	173 ± 13	157 ± 12	159 ± 13
	28	TA-18 (Pajarito Site)	241 ± 13	378 ± 13[g]	127 ± 13
	29	TA-35 (Ten Site A)	92 ± 10	128 ± 12	114 ± 13

Table 4-11. Thermoluminescent Dosimeter (TLD) Measurements of External Radiation 1994–1996 (Cont.)

	TLD Station ID #	Location	1996 Annual Dose (mrem)[a]	1995 Annual Dose (mrem)	1994 Annual Dose (mrem)
On-Site (Cont.)	30	TA-35 (Ten Site B)	140 ± 12	98 ± 11[c]	140 ± 13
	31	TA-59 (Occupational Health Lab)	144 ± 12	128 ± 12	138 ± 13
	32	TA-3-16 (Van de Graaff)	153 ± 11	137 ± 12	145 ± 13
	33	TA-3-316 (Ion Beam Bldg.)	144 ± 12	118 ± 12	142 ± 13
	34	TA-3-440 (CAS)	113 ± 13	104 ± 11[c]	129 ± 13
	35	TA-3-420 (CMR Bldg. West Fence)	111 ± 11	123 ± 12	115 ± 13
	36	TA-3-102 (Shop)	115 ± 11	131 ± 12	119 ± 13
	37	TA-72 (Pistol Range)	142 ± 12	151 ± 12	146 ± 13
	38	TA-55 (Plutonium Facility South)	132 ± 14	107 ± 11[c]	133 ± 13
	39	TA-55 (Plutonium Facility West)	181 ± 12	160 ± 12	140 ± 14
	40	TA-55 (Plutonium Facility North)	154 ± 11	119 ± 11	135 ± 13
	56	East Gate Mid Station[f]	119 ± 10[c]	Not Operational	
	57	TA-54 West (TLD Lab)[f]	129 ± 11[c]	Not Operational	
	58	TA-54 Lagoon[f]	89 ± 9[d]	Not Operational	
	59	Los Alamos Canyon[f]	52 ± 8[e]	Not Operational	

[a] New environmental TLD system was introduced in second quarter 1996.
[b] The uncertainty of each measurement is the propagated error of the quarterly measurements.
[c] Annual dose is the sum of three quarters.
[d] Annual dose is the sum of two quarters.
[e] Data only available for one quarter.
[f] New stations placed into operation in 1996.
[g] Restricted-access operational measurements from quarter 2 were included in annual dose and does not reflect potential public dose resulting from controlled access.

Table 4-12. Waste Disposal Area Measured Dose

		Annual Dose (mrem)							
Waste Disposal Area	**Number of TLD Locations**	**1996 Minimum**	**1996 Maximum**	**1996 Mean**	**1996 Uncertainty[a]**	**1995 Mean**	**1995 Uncertainty[a]**	**1994 Mean**	**1994 Uncertainty[a]**
TA-21, Area A	5	114	127	119	9	133	11	129	13
TA-21, Area B	14	125	145	127	9	153	11	135	13
TA-50, Area C	10	125	140	132	10	118[b]	11	113	13
TA-33, Area E	4	132	143	138	9	147	11	139	13
TA-6, Area F	4	118	130	124	9	72[c]	9	N/A[d]	—
TA-54, Area G	25	124	222	173	10	161	12	160	13
TA-21, Area T	7	129	267	156	10	159	12	159	14
TA-21, Area U	4	127	136	132	9	128	11	131	14
TA-21, Area V	4	119	133	125	9	134	11	105	12
TA-35, Area W	3	114	138	123	9	125	11	110	13
TA-49, Area AB	10	112	138	126	10	141	12	126	13

[a]Uncertainty is the propagated error of the quarterly measurements.
[b]Annual Doses for only three quarters, second quarter data not available due to equipment malfunction.
[c]Only monitored 3rd & 4th quarter because of construction associated with a geophysical investigation.
[d]N/A = not available.

Table 4-13. Estimated Concentrations of Toxic Elements Released by Dynamic Experiments

Element[a]	Total Usage (kg)	Fraction Released (%)	Maximum Impact (2,767 m) ($\mu g/m^3$)	Nearest Public Access Point (1,500 m) ($\mu g/m^3$) 1 Hour Concentrations[b]	Nearest Off-Site Receptor (3,800 m) ($\mu g/m^3$)
Beryllium	.6	2	1×10^{-6}	6×10^{-7}	9×10^{-7}
Aluminum	430	100	4×10^{-2}	2×10^{-2}	3×10^{-2}
Tantalum	9.6	100	8×10^{-4}	5×10^{-4}	7×10^{-4}
Copper	505	100	4×10^{-2}	3×10^{-2}	4×10^{-2}
Molybdenum	.2	100	2×10^{-6}	1×10^{-5}	2×10^{-5}

[a] Usage and impact analysis performed on elements regulated under 20 NMAC 2.27 and 40 CFR 61, Subpart C.
[b] Currently, no impact standard exists for any of the elements detonated.

Table 4-14. Emissions by Source in 1996 (Tons)

Source	PM	CO	NO_X	SO_X	VOC
TA-3 Power Plant	1.5	11.7	47.5	.17	.40
TA-16 Power Plant	1.9	5.5	22.6	.08	.19
TA-21 Power Plant	.47	1.2	4.7	.02	.10
Asphalt Plant	.14	.07	.05	.001	.03
Total	3.01	18.47	74.85	.271	.73

Table 4-15. 1996 Precipitation (in.)

	North Community	TA-16	TA-6	TA-49	TA-53	TA-54	TA-74
January	1.05	1.35	1.29	0.97	1.09	0.80	0.86
February	0.59	0.76	0.69	0.55	0.49	0.46	0.46
March	0.57	0.47	0.39	0.21	0.23	0.15	0.17
April	0.10	0.18	0.11	0.07	0.08	0.07	0.05
May	0.03	0.00	0.02	0.00	0.00	0.00	0.07
June	3.35	4.07	3.83	3.77	2.97	3.32	2.95
July	2.64	4.91	2.96	3.01	2.52	3.52	2.26
August	3.63	3.39	2.25	2.33	2.06	1.50	2.34
September	1.38	3.86	2.20	2.06	1.49	1.36	1.37
October	3.26	4.17	3.37	4.02	3.26	3.62	3.09
November	0.71	0.76	0.64	0.55	0.52	0.53	0.43
December	0.12	0.10	0.09	0.06	0.02	0.01	0.01
Total	17.43	24.02	17.84	17.60	14.73	15.34	14.06

I. Figures

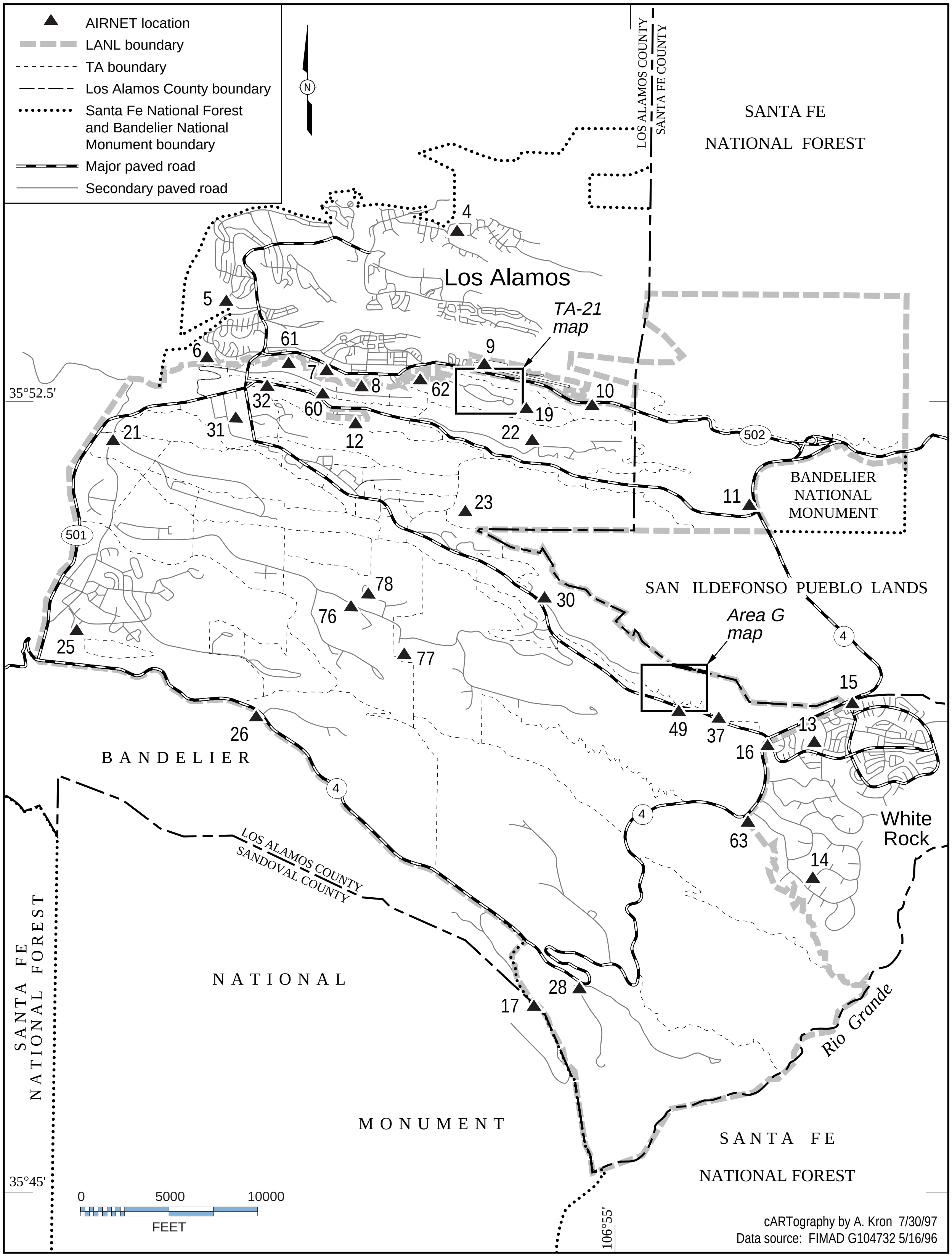

Figure 4-1. Off-site perimeter and on-site Laboratory AIRNET locations.

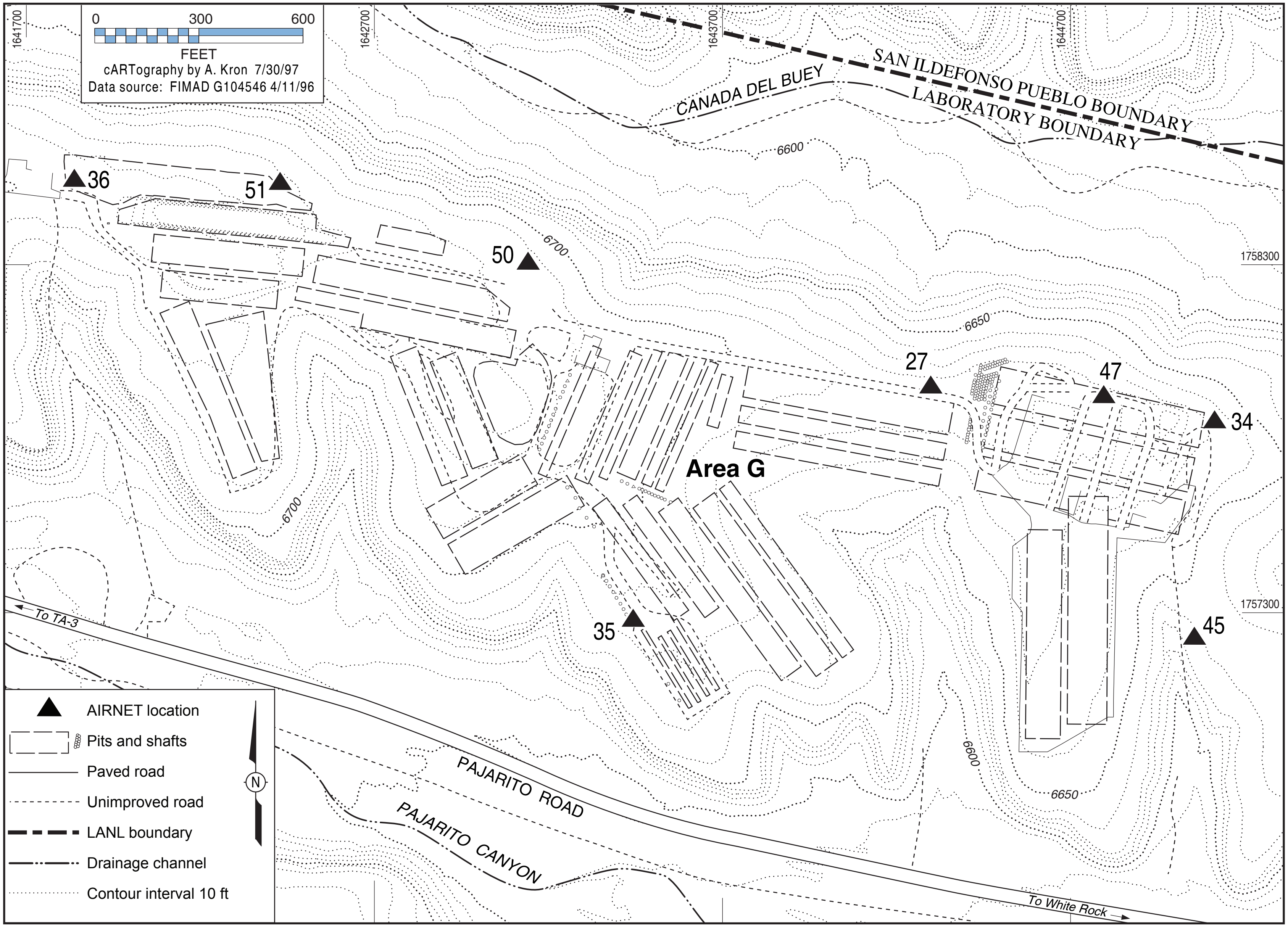

Figure 4-2. Technical Area 54, Area G map of AIRNET locations.

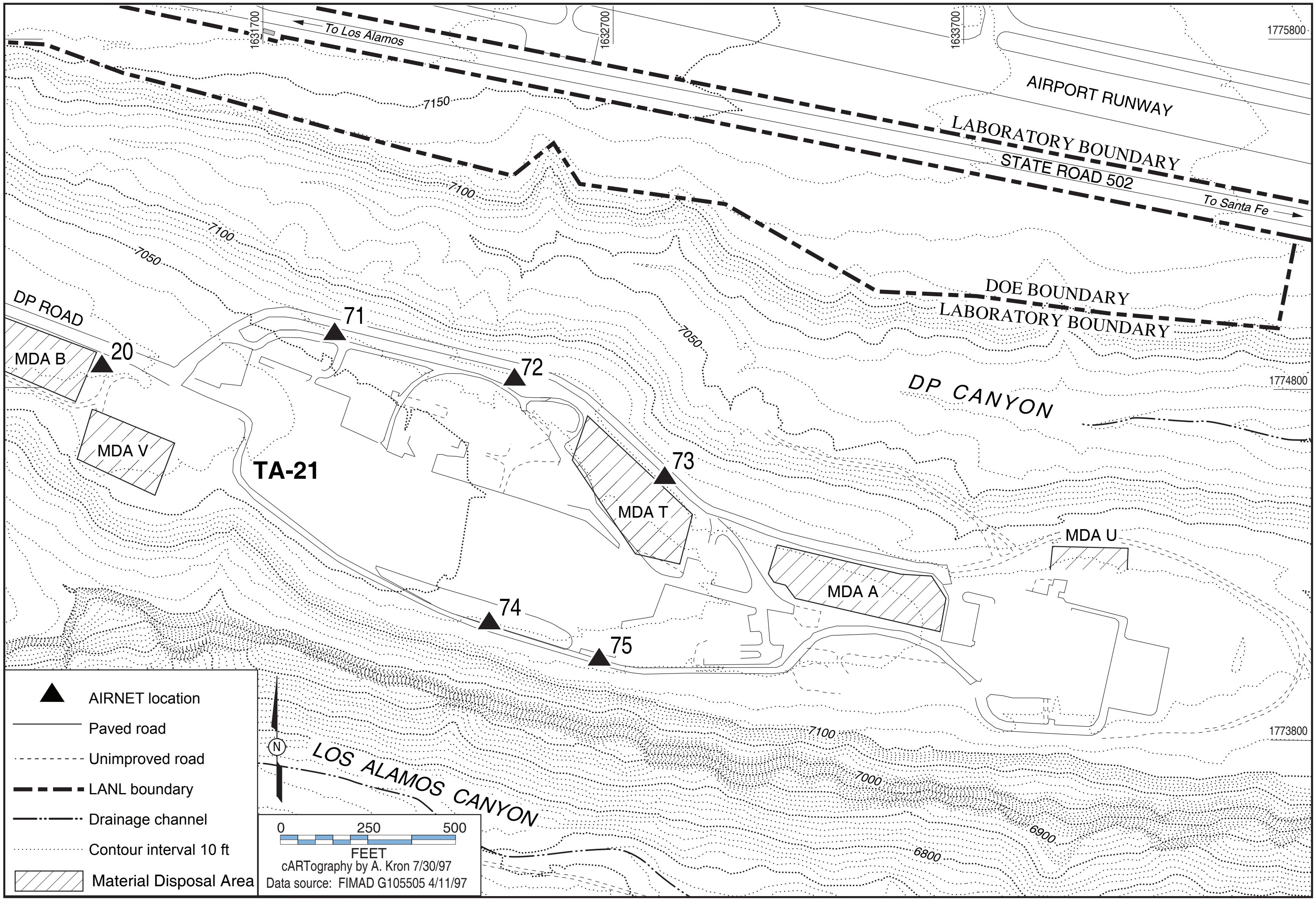

Figure 4-3. Technical Area 21 map of AIRNET locations.

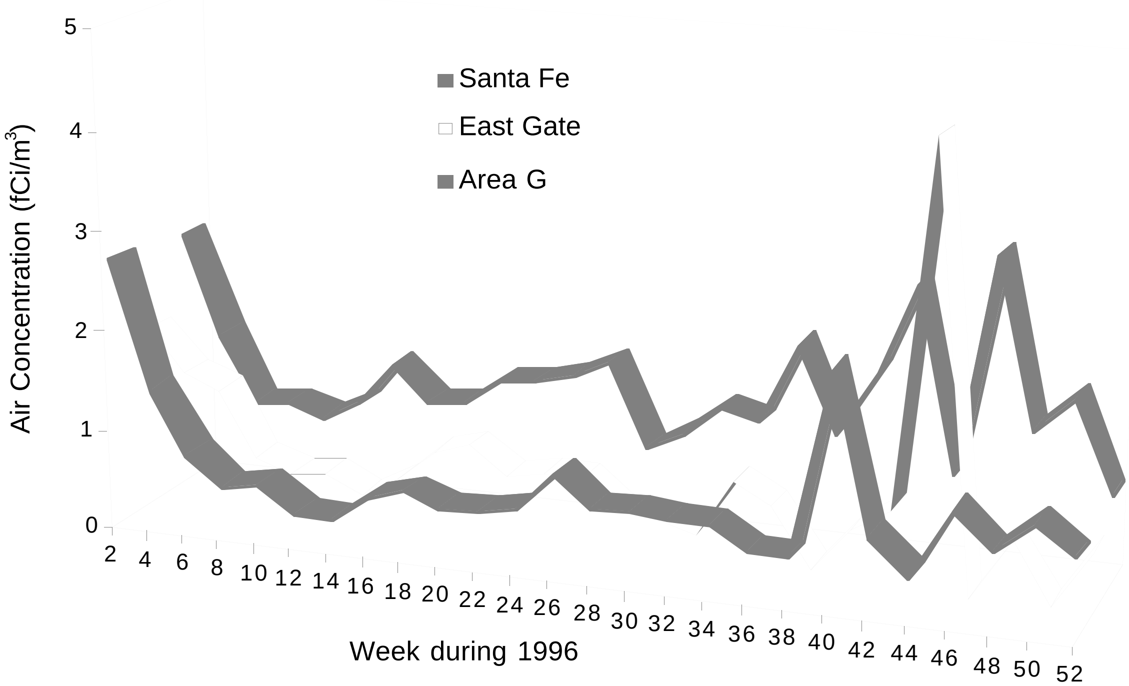

Figure 4-4. Comparison of gross alpha activity air concentrations at one regional, one perimeter, and one on-site station.

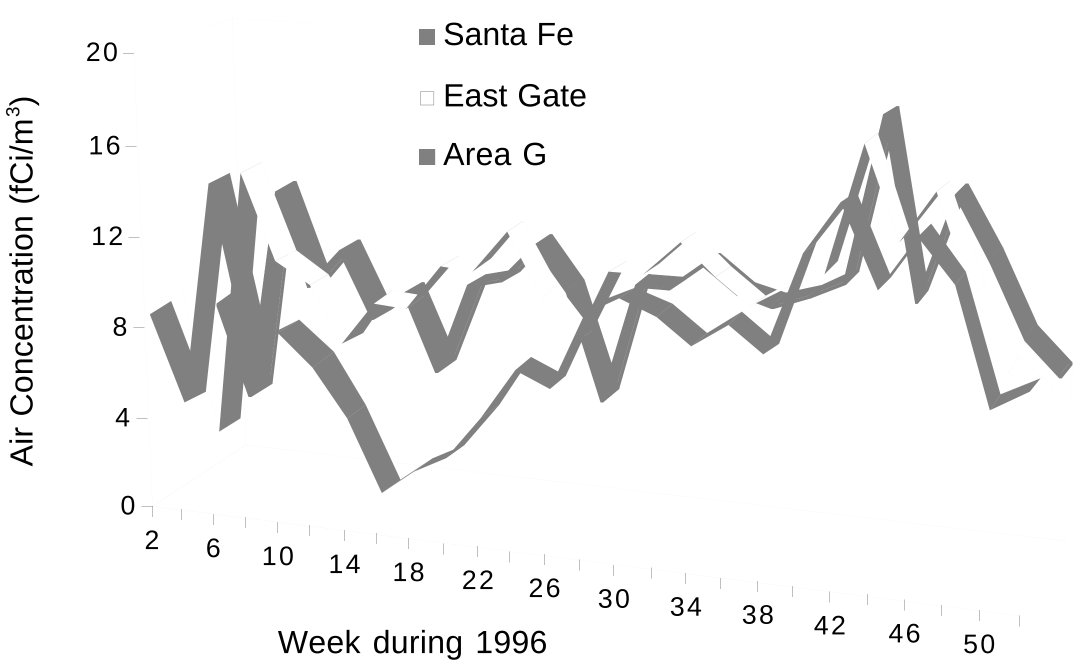

Figure 4-5. Comparison of gross beta activity air concentrations at one regional, one perimeter, and one on-site station.

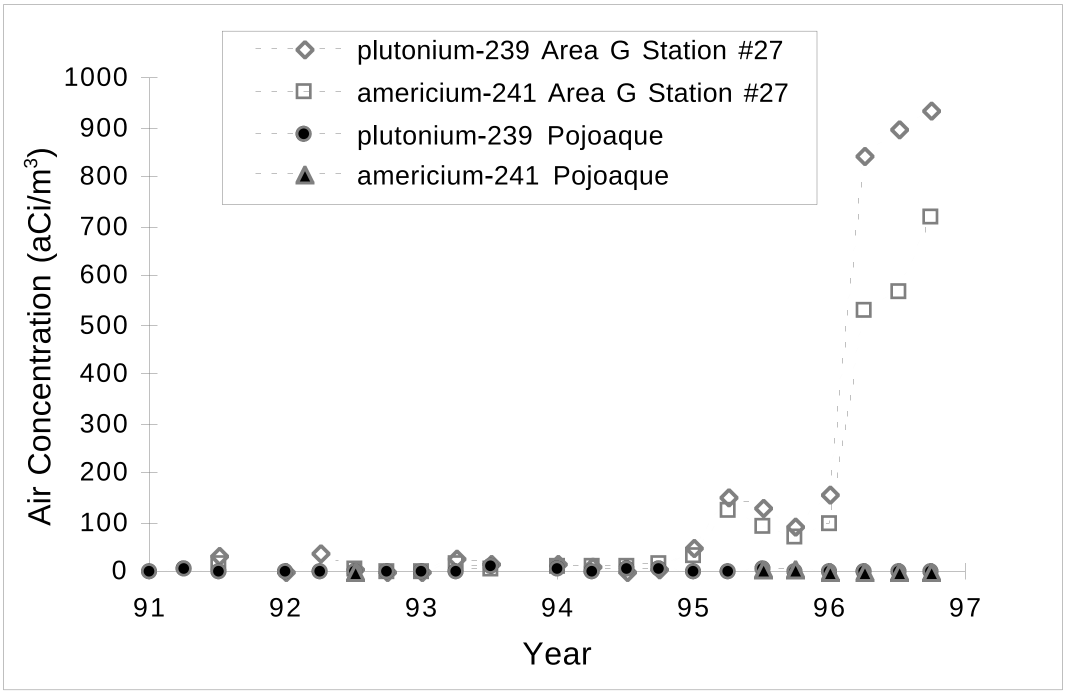

Figure 4-6. Comparison of plutonium-239 and americium-241 air concentrations at a regional station and Technical Area 54, Area G, Station #27.

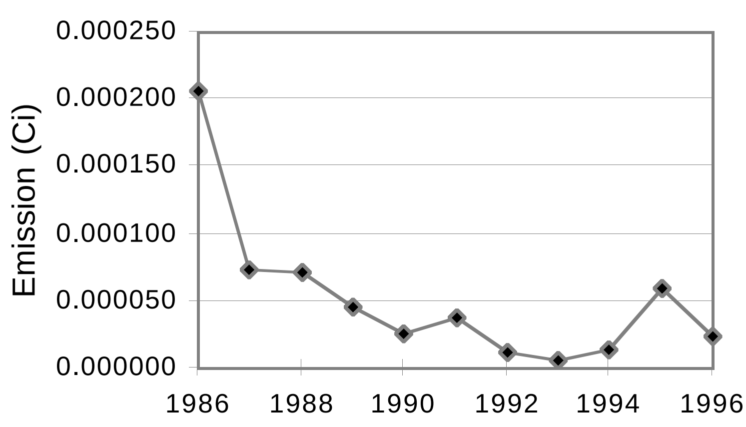

Figure 4-7. Plutonium emissions from Laboratory stacks since 1986.

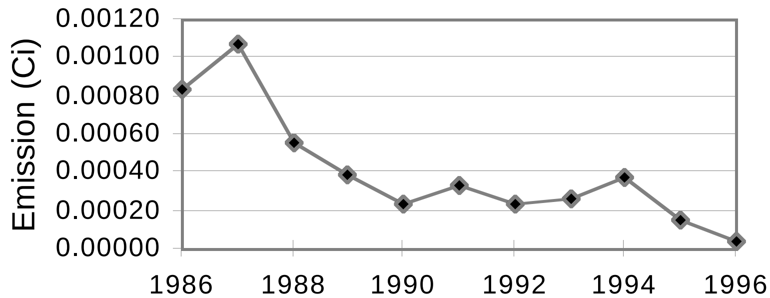

Figure 4-8. Uranium emissions from Laboratory stacks since 1986.

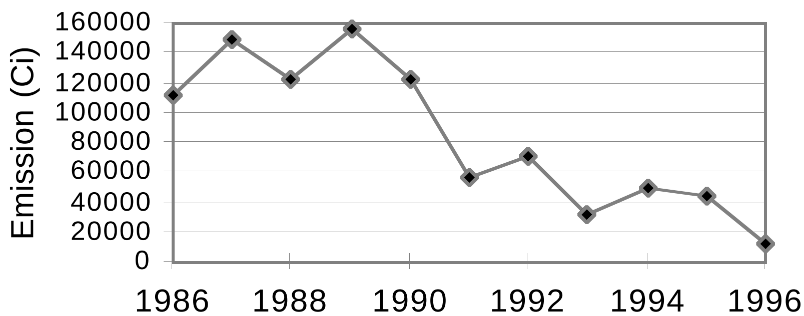

Figure 4-9. G/MAP emissions from Laboratory stacks since 1986.

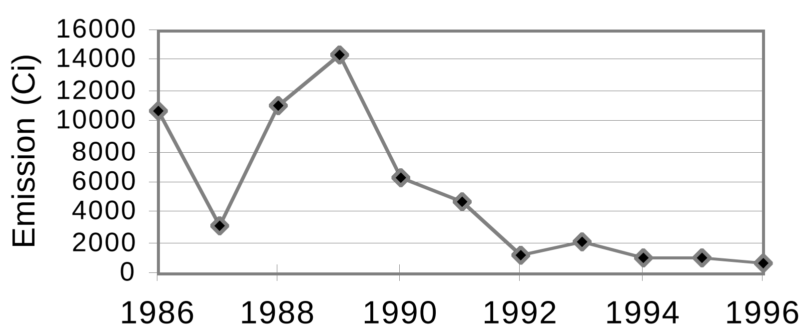

Figure 4-10. Tritium emissions from Laboratory stacks since 1986.

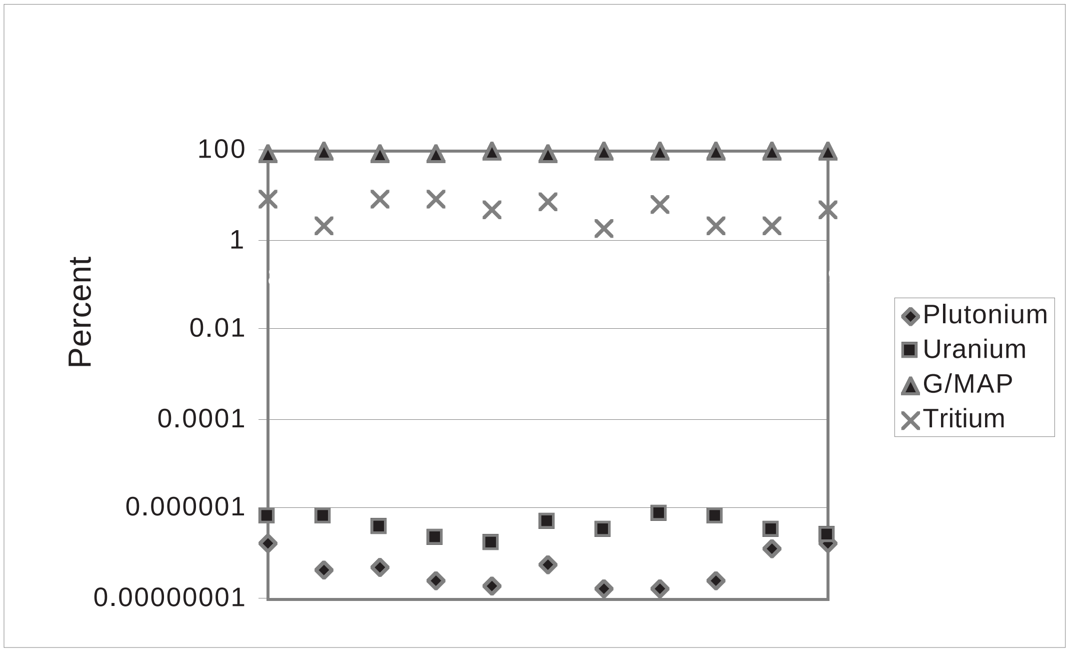

Figure 4-11. Percent of total emissions resulting from plutonium, uranium, tritium, and G/MAP.

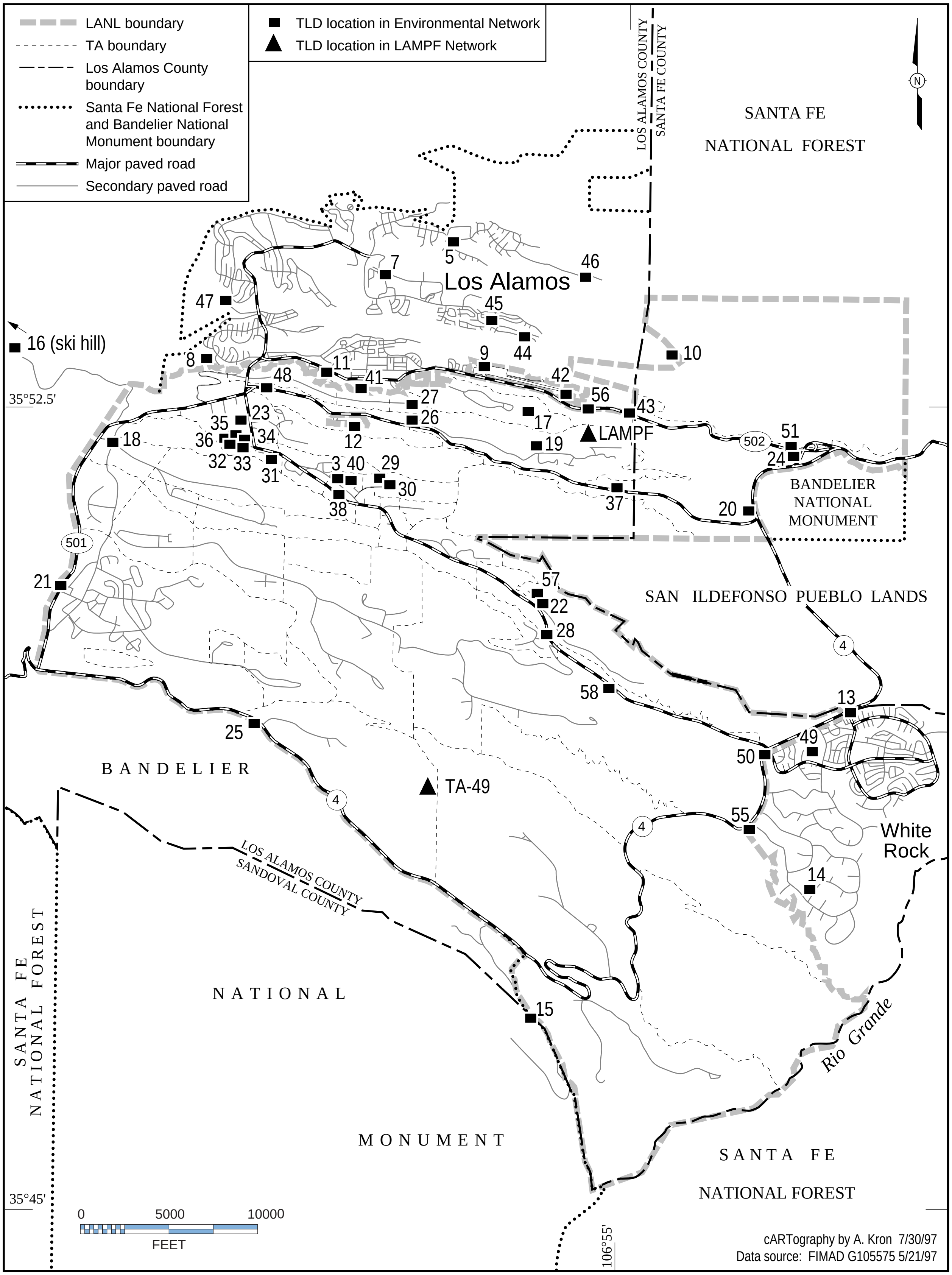

Figure 4-12. Off-site perimeter and on-site Laboratory TLD locations.

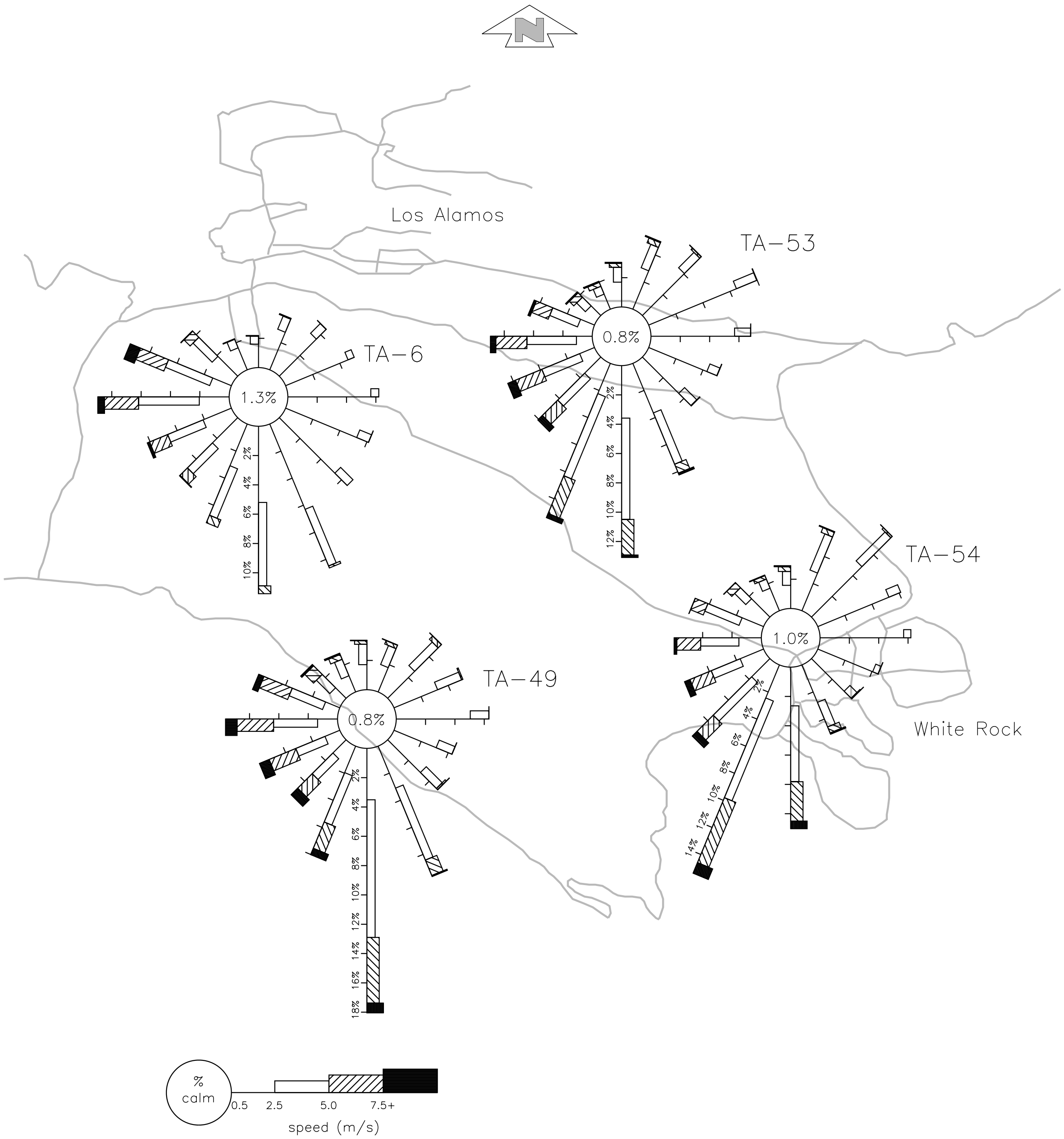

Figure 4-13. Wind roses for daytime winds observed at 11 m (36 ft) at TA-6, TA-49, TA-53, and TA-54 for 1996.

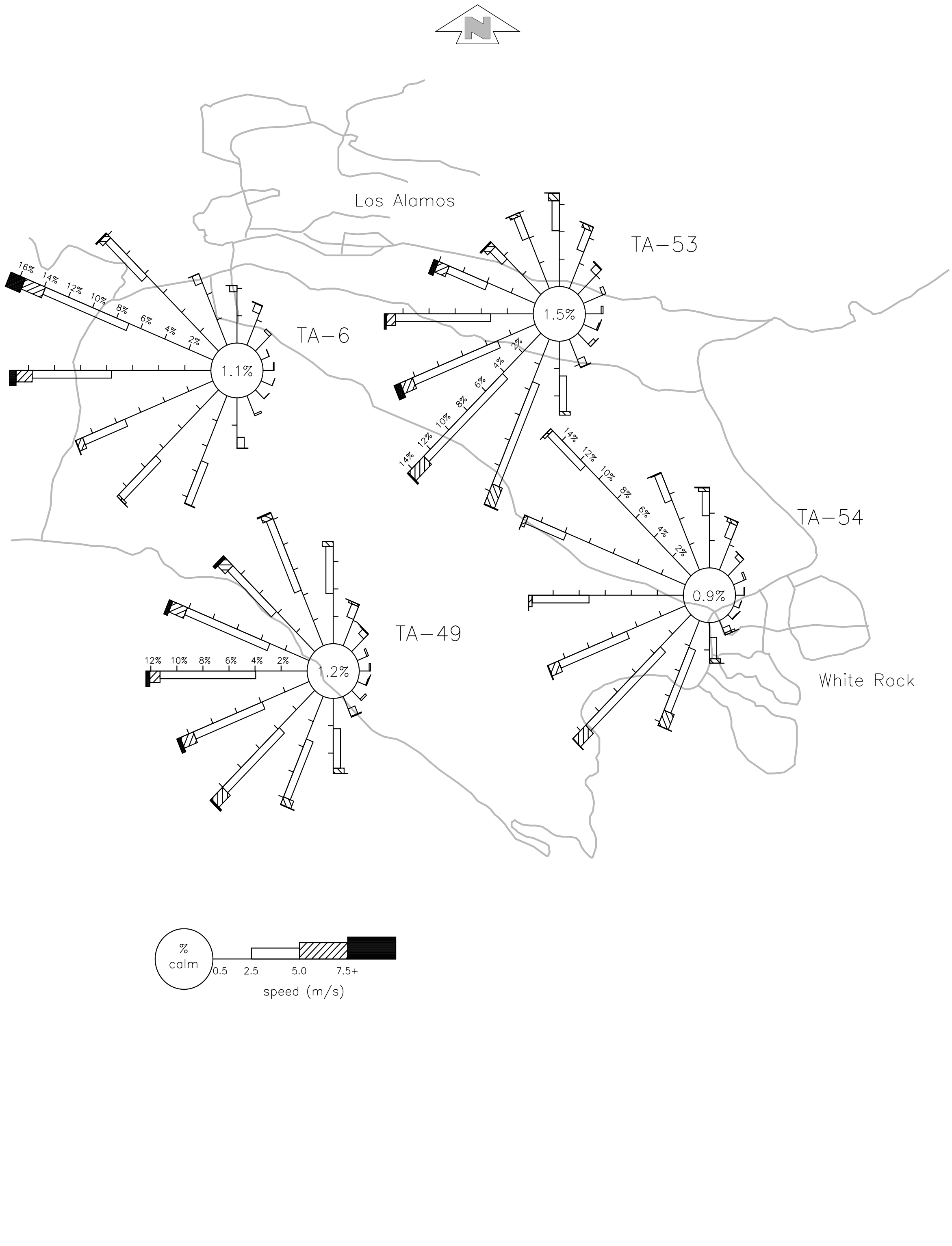

Figure 4-14. Wind roses for nighttime winds observed at 11 m (36 ft) at TA-6, TA-49, TA-53, and TA-54 for 1996.

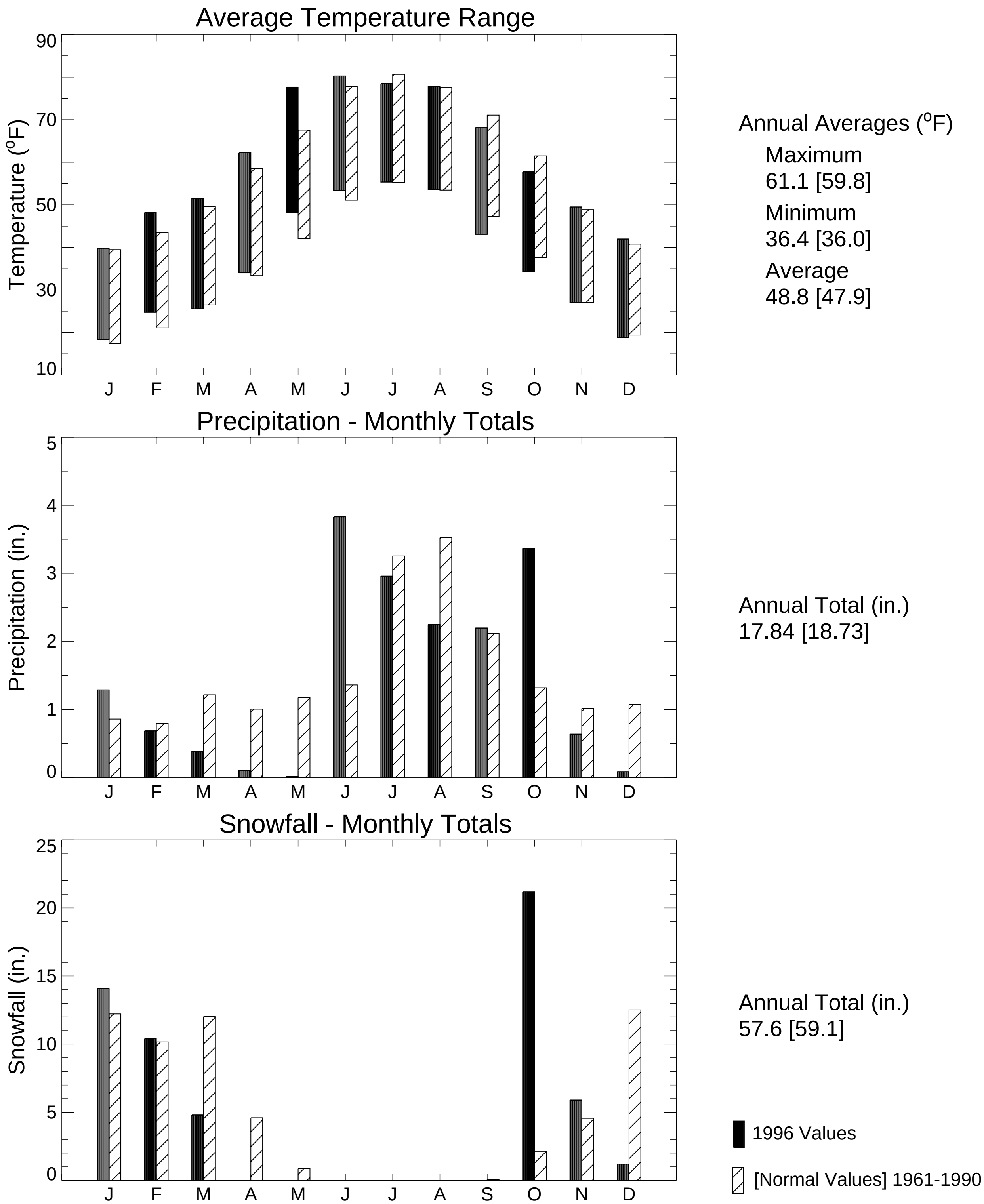

Figure 4-15. 1996 weather summary for Los Alamos (TA-6 station, elevation 7,424 ft.).

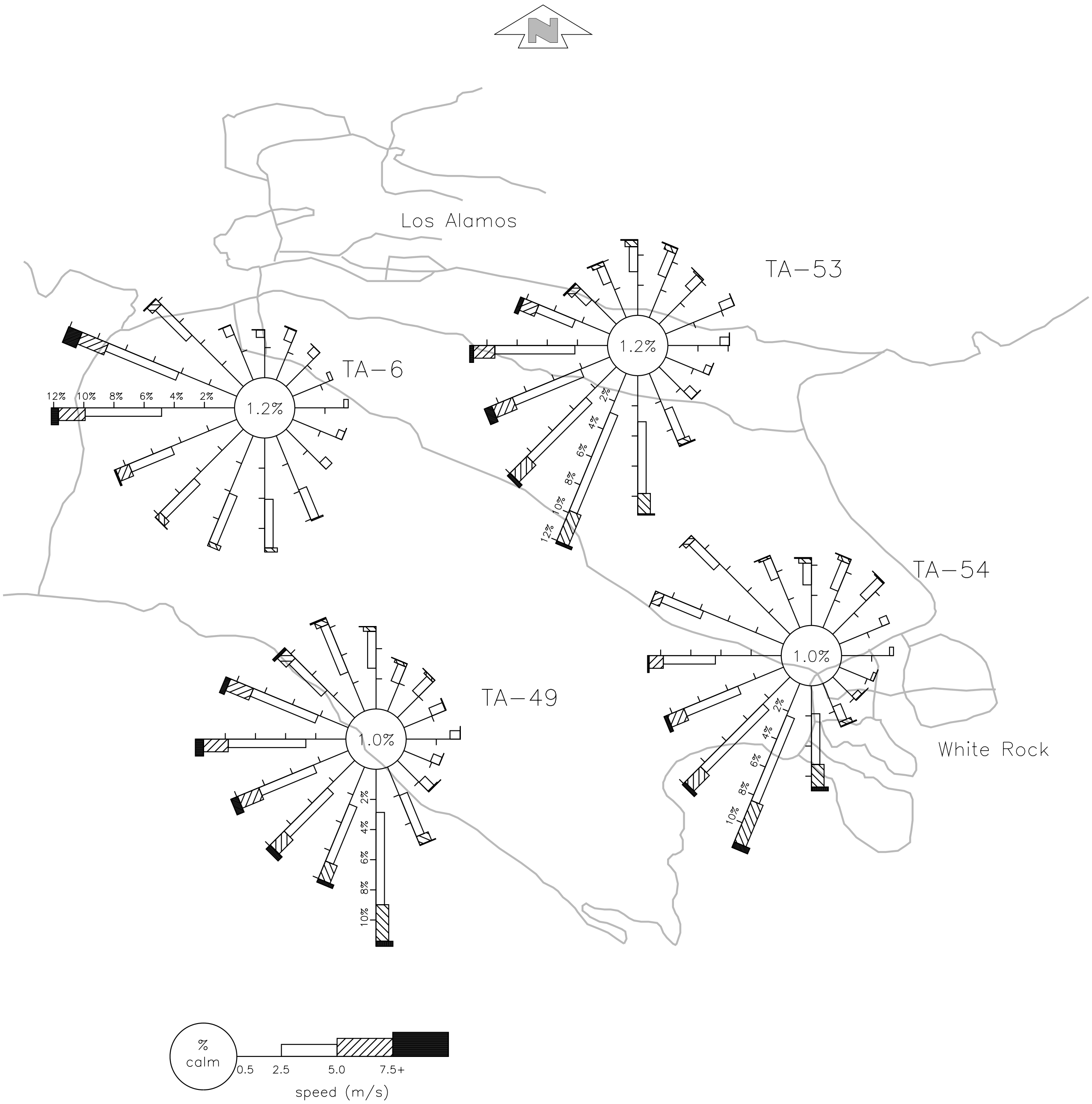

Figure 4-16. Wind roses for daytime and nighttime winds observed at 11 m (36 ft) at TA-6, TA-49, TA-53, and TA-54 for 1996.

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