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Environmental Monitoring Plan

R. C. Holland

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94551
for the United States Department of Energy
under Contract DE-AC04-94AL85000

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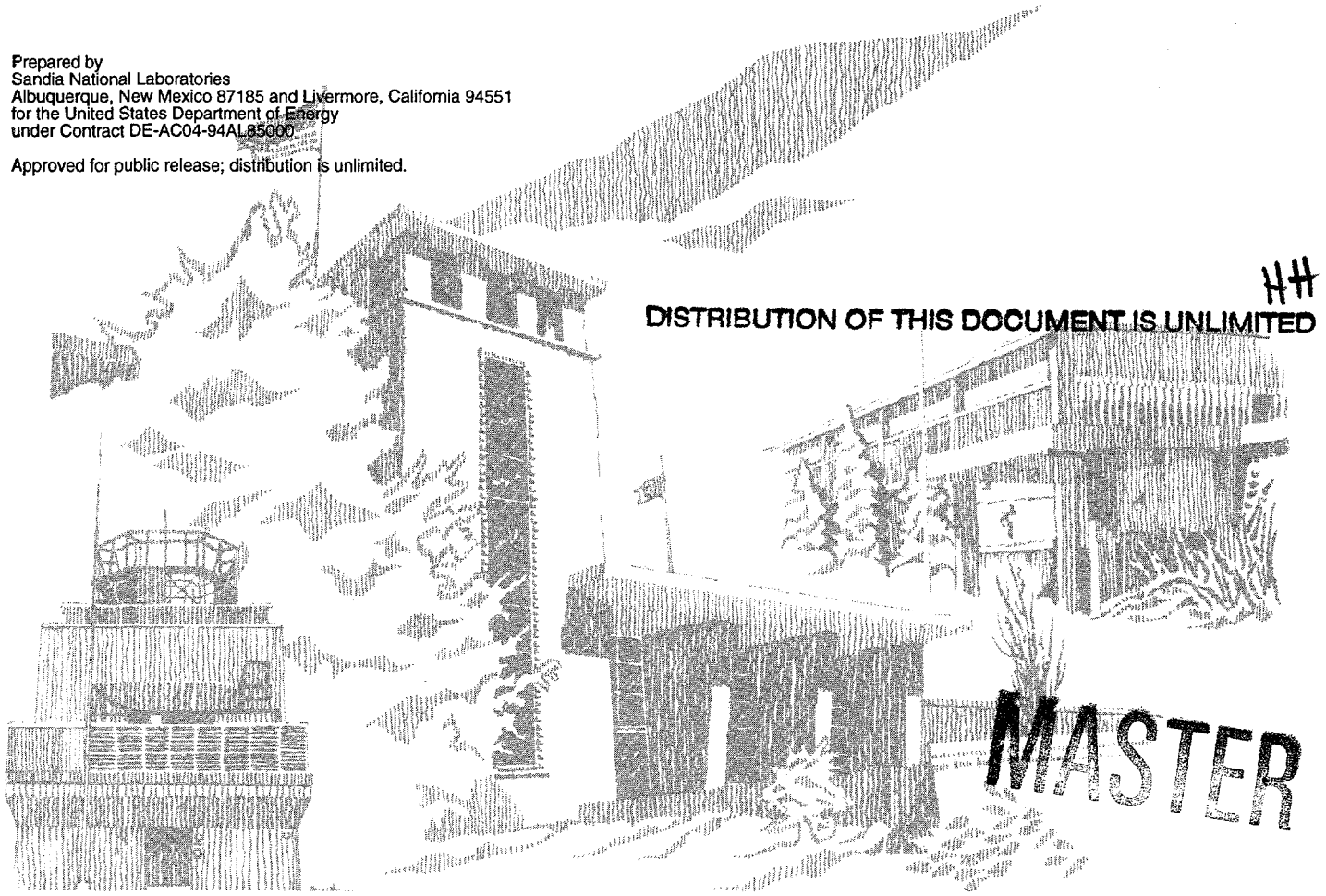

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ENVIRONMENTAL MONITORING PLAN

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ABSTRACT

This *Environmental Monitoring Plan* was written to fulfill the requirements of Department of Energy (DOE) Order 5400.1 and DOE Environmental Regulatory Guide DOE/EH 0173T. This Plan documents the background, organizational structure, and methods used for effluent monitoring and environmental surveillance at Sandia National Laboratories/California. The design, rationale, and historical results of the environmental monitoring system are discussed in detail. Throughout the Plan, recommendations for improvements to the monitoring system are made.

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Environmental Monitoring Plan
Sandia National Laboratories/California

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1.0 INTRODUCTION

Sandia National Laboratories (SNL)/California, is a prime contractor for the U.S. Department of Energy (DOE), operated by Sandia Corporation. SNL/California's primary mission is research and development in the interest of national security, with an emphasis on nuclear weapons development and engineering, excluding the nuclear components. More specifically, SNL/California performs weapons engineering for all phases of the nuclear weapons cycle; nuclear weapons safeguards and security; energy-related research; advanced manufacturing research; and fundamental research related to combustion, geosciences, fusion, and materials science.

SNL/California is committed to fulfilling this mission in an environmentally safe and sound manner. Corporate policy states that the protection of human health and the environment is Sandia's top priority. Accordingly, SNL designs products and conducts operations with the highest regard for the safety and health of its personnel and the public, and for the protection and preservation of the environment. SNL/California operates under the oversight of Federal, State, and local regulatory bodies, and DOE. Sandia is committed to operating in full compliance with the letter and spirit of applicable environmental laws, regulations, and standards. Moreover, SNL/California strives to go beyond simple compliance with legal requirements by making every effort practical to reduce impacts to the environment to the lowest levels possible.

DOE Orders 5400.1, 5400.5, and DOE/EH-0173T establish environmental protection program requirements, authorities, and responsibilities.[1–3] These Orders stipulate that all DOE facilities comply with Federal, State, and local environmental protection laws and regulations, and best management practices. They require an environmental monitoring plan to document how each facility will comply with these laws and regulations. This plan documents Sandia's efforts not only to comply with these laws and regulations but also to comply with DOE's policy to keep emissions to the environment as low as reasonably achievable (ALARA).

For many years, Lawrence Livermore National Laboratory (LLNL) has maintained an extensive environmental monitoring program near both LLNL and SNL/California. Because of the common location and similarity in operations of the two facilities, only one principal off-site monitoring program at the Livermore site is maintained. LLNL's larger environmental protection program and analytical capabilities make it best suited to this function. To avoid duplication of effort and maximize efficiency, SNL/California has used LLNL data to satisfy its requirements for off-site environmental monitoring. SNL/California also conducts its own on-site effluent monitoring and environmental surveillance program. The two laboratories have prepared a formal agreement defining their roles in the joint monitoring program to ensure a sound, comprehensive monitoring system.

Tritium operations ceased at SNL/California in 1994, and the site's tritium inventory was removed by October 1994. Therefore, SNL/California no longer has a need to report LLNL's off-site tritium monitoring data. SNL/California committed to one year of post-operational effluent and on-site environmental monitoring. This one-year period ended on October 1, 1996 (one year from clean-up of the former Tritium Research Laboratory). Therefore, this revision to SNL/California's *Environmental Monitoring Plan* no longer contains information on LLNL's off-site monitoring, and reflects a reduction in SNL/California's effluent and on-site environmental tritium monitoring. Some tritium monitoring will be continued, but at a reduced level (i.e., groundwater and storm water runoff). This revision will become

2.0 SCOPE

effective when SNL/California receives formal approval from DOE to reduce tritium monitoring.

This *Environmental Monitoring Plan* has been prepared in accordance with DOE Order 5400.1, DOE Order 5400.5, and DOE/EH-0173T.[1-3] The primary purpose of this plan is to formally document SNL/California's effluent monitoring and environmental surveillance system to ensure compliance with Federal, State, and local requirements, and DOE Orders. Furthermore, the plan assesses the monitoring program's adequacy to protect the public and the environment during operations at SNL/California through accurate measurements of contaminants in effluents and in the surrounding environment.

This monitoring plan covers only operations at the SNL/California facility. Therefore, it focuses only on the portions of the monitoring system that apply to SNL/California and does not address the portions specific to LLNL operations.

This Sandia report, SAND93-8011B, supersedes SAND93-8011, which documented the changes made to the Monitoring program during 1993. Sandia report SAND91-8013 documented the changes made in 1992.

3.0 PERFORMANCE OBJECTIVES

Environmental monitoring at SNL/California consists of two major parts:

1. liquid effluent monitoring, and
2. environmental surveillance.

Effluents are monitored at the point of discharge to measure the amount of pollutants released by SNL/California. Effluent monitoring data also allow SNL/California to evaluate the effectiveness of pollution control programs and to detect unplanned releases. DOE Orders 5400.1 and 5400.5, and DOE/EH-0173T contain the requirements for effluent monitoring.[1-3] The City of Livermore Wastewater Discharge Permit contains additional requirements for liquid effluent monitoring.

Environmental surveillance is done to assess the actual impact of pollutant releases on portions of the environment that may be important pathways of exposure to the local population. Environmental sampling also helps identify trends in the pollutant levels. Surveillance data provide a means of evaluating the effectiveness of pollution control measures and of assuring that SNL/California conducts operations so as to preserve the quality of the environment. DOE/EH-0173T includes the types of environmental surveillance to be done around DOE facilities.[3]

SNL/California has established criteria for the acceptability of environmental monitoring data in the *Operating Procedure for Data Validation and Verification for the Environmental Monitoring Program*.[4] This procedure contains methods for determining the accuracy, precision, completeness, comparability, and representativeness of the data. In general, the following methods apply:

- **Accuracy**—accuracy is assessed through analysis of samples that have been spiked with the analyte of interest (spiked samples), standard reference materials, or interlaboratory comparison samples. The analytical results are compared to the known value of the spiked sample or standard reference material.
- **Precision**—precision of the combined sampling and analysis effort is assessed through collection and analysis of duplicate samples. Data sets of routine samples are compared to data sets of duplicate samples. Recognizing that the uncertainty of analytical results increases as the detection limit is approached, we base the acceptance criteria, in part, on the pollutant concentration. Precision of the analytical effort only is assessed in the laboratory by the use of split samples.

Completeness of the data is assured by careful planning of the sampling locations and frequency. Close attention is also paid to the reliability of the sampling equipment used. Completeness is evaluated by comparison of the number of samples collected to the number planned to be collected.

To assure that the data generated by the monitoring system may be compared to data of other monitoring systems, EPA methods are used, when available, for collecting and analyzing samples. When EPA methods or guidance are not available, Sandia (or LLNL) develops its own methods. These methods are documented and provided, as requested, to the agencies receiving reports to aid in interpretation of the data.

Sample collection methods assure that the samples represent, as much as possible, the environmental medium being monitored. Considerations include the spatial and temporal variability of the medium or the pollutant of concern within the medium. If EPA- or DOE-approved criteria for sampler locations exist, they are used.

4.0 REQUIREMENTS

SNL/California is required to meet all Federal, State, and local regulations, and DOE Orders concerning protection of the environment. DOE Order 5400.1 establishes the requirement for a sound and effective environmental monitoring program at DOE sites handling hazardous materials.[1] The *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T) specifies the elements needed for an adequate environmental monitoring program at DOE sites.[3] This guide provides generic performance criteria for protecting the public and the environment. It specifies actions, equipment, and operating methods DOE facilities should use to assure compliance with Federal regulations and DOE policy.

The following sections list the rules and regulations governing environmental monitoring.

4.1 Department of Energy Requirements

The following DOE Orders apply to SNL/California's environmental monitoring activities:

1. Order 5400.1, *General Environmental Protection Program*—establishes environmental protection requirements, authorities, and responsibilities.[1]
2. Order 5400.5, *Radiation Protection of the Public and the Environment* (Jan. 1993, latest revision).[2]
3. DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*—establishes guidance and mandatory requirements for effluent monitoring and environmental surveillance.[3]
4. Order 0451.1, *National Environmental Policy Act Compliance Program*—establishes DOE internal responsibilities for implementing the National Environmental Policy Act.[5]
5. Order 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*—assigns the responsibilities for establishing and implementing environment, safety and health (ES&H) programs.[6]
6. Order 0232.1, *Occurrence Reporting and Processing of Operations Information*—establishes DOE policy and provides instructions for reporting, analyzing, and disseminating information on programmatically significant events.[7]
7. Order 0231.1 Chg. 1, *Environment, Safety, and Health Reporting*—ensures collection and reporting of information on environment, safety, and health that is required by law or regulation, or that is essential for evaluating DOE operations.[8]

4.2 Federal Regulations

The following Federal regulations apply to SNL/California's environmental monitoring activities:

Clean Air Act, as amended:

1. Title 40 CFR, Part 50, *National Ambient Air Quality Standards (NAAQS)*—limits the release of sulfur oxides, carbon monoxide, nitrogen oxides, ozone, hydrocarbons, lead, and total suspended particulates; provides guidance on sampler location.[9]
2. Title 40 CFR, Part 60, *Performance Standards for New Stationary Sources*—prescribes emission standards for new stationary sources of air pollution.[10]

Title 10, Energy:

1. Title 10 CFR, Part 835, *Radiological Protection*—regulates radiological dose to workers at DOE facilities.[11]
2. Title 10 CFR, Part 830.120, *Quality Assurance*—regulates quality assurance activities at DOE facilities.[12]

Clean Water Act, as amended:

1. Title 40 CFR, Parts 122–25, *National Pollutant Discharge Elimination System (NPDES)*—regulates the discharge of liquid effluents into bodies of water, including stormwater discharge.[13]

2. Title 40 CFR, Part 129, *Toxic Pollutant Effluent Standards and Prohibitions*—adds to the provisions of Title 40 CFR, Parts 122–25 by restricting the discharge of listed toxic pollutants.[14]
3. Title 40 CFR, Part 403, *General Pretreatment Regulations for Existing and New Sources of Pollution*—establishes the government's responsibility to prevent the discharge of waste that would reduce the treatment efficiency of a Publicly-Owned Treatment Works (POTW).[15]
4. Title 40 CFR, Parts 413 and 459, *Point Source Categories*—restricts the discharge of toxic organics, toxic metals, cyanide, silver, and excessive pH.[16]
5. Title 40 CFR, Part 433, *Metal Finishing Point Source Category*—establishes discharge standards for metal finishing operations; SNL/California has two processes that fall into this category, but only one has liquid discharges.[17]

4.3 California Regulations

The following State regulations, among others, apply to SNL/California's environmental monitoring activities:

1. Title 18 California Code of Regulations (CCR), *Air Toxics "Hot Spots" Information and Assessment Act*—requires facilities to submit a Comprehensive Emissions Inventory Plan identifying sources of toxic substances emitted into the air; defines a broad list of air toxics; and contains method for determining which facilities are subject to reporting under the regulation.[18]
2. Title 23 CCR, Division 3, Chapter 1, *State Water Resources Control Board and Regional Water Quality Control Boards*—establishes the authority and procedures of the boards; adopts EPA standards (Title 40 CFR, Part 122–125[13]) for NPDES permitting and reportable quantities of hazardous materials.[19]
3. Title 23 CCR, Division 3, Chapter 9, *Designation, Reportable Quantities, and Notification*—defines the standards for detection and monitoring associated with waste management units.[20]
4. Title 17 CCR, *Public Health*, Chapter 5, Subchapter 4, "Radiation"—covers the form and function of the California Department of Health Services (DHS), and regulations for the implementation of State environmental acts.[21]
5. *Safe Drinking Water and Toxic Enforcement Act of 1986*—prohibits any chemical that the State of California certifies as a known carcinogen or reproductive toxin from being discharged into an actual or potential source of drinking water; requires the Governor to publish and annually update a list of chemicals determined to cause cancer or reproductive toxicity; and requires employers to notify workers of the presence and potential exposure to chemicals on the list.[22]
6. *California Clean Air Act of 1988*—requires and empowers State air quality management districts to take all actions necessary to meet the State Air Quality Standards (which are more stringent than the Federal standards), with a goal of 5% annual reductions of district-wide emissions of each non-attainment pollutant or its precursors; the districts must submit annual Clean Air Plans to the State Air Resources Board to show how they plan to meet the requirements.[23]

4.4 Local Regulations

The following are the principal local regulations that apply to SNL/California's environmental monitoring activities:

1. The Bay Area Air Quality Management District (BAAQMD) holds the primary responsibility for implementing and enforcing the California Clean Air Act through its *Rules and Regulations*.[24]
2. City of Livermore, Municipal Code Section 13.32, *General Discharge Prohibitions*[25]—contains regulations concerning wastewater discharges to the sanitary sewer, including processes covered by the Federal Categorical Pretreatment Standards and groundwater discharges from site remediation activities.[17] This section also contains limitations of discharge of specific pollutants.
3. City of Livermore, Municipal Code Section 13.45, *Storm Water Management and Control Program*[26]—contains regulations controlling storm water discharge to the municipal storm drain system.

5.0 RESPONSIBILITIES AND AUTHORITY

Sandia National Laboratories' corporate policy regarding ES&H is established at the main SNL facility in Albuquerque, New Mexico (SNL/New Mexico). Site managers are responsible for establishing ES&H as a top priority at their sites and to assure that operations are conducted in accordance with SNL's ES&H programs and the requirements of Federal, State, and local government agencies. The vice president in charge of the SNL/California site has overall responsibility for ES&H at the site. Responsibility for implementing the ES&H Program lies with the Center for National Security & Environmental Technologies (8400). Figure 1 shows the organizational structure of ES&H at SNL/California.

The primary mission of the Center for National Security & Environmental Technologies is to ensure the safety and health of SNL/California employees and the general public, and to protect the environment. This mission is fulfilled by the Center's helping SNL/California line managers and employees understand and comply with DOE Orders and their legal responsibilities under Federal, State, and local laws and regulations. The ES&H policy, as stated in the *ES&H Manual*,[27] is as follows:

> *SNL considers the protection of the environment, as well as human life and health to be its top priority. Conflicts between ES&H requirements and other programmatic needs will be resolved to meet fully the ES&H requirements. Accordingly, SNL shall design products and conduct operations with the highest regard for the protection and preservation of the environment and safety and health of its personnel, contractors, and the public. SNL shall ensure the occupational health and safety of SNL personnel, as well as environmental protection and preservation throughout all operations by complying with applicable federal, state, and local laws and regulations, DOE Orders, permit agreements, orders, and consent decrees. SNL shall make sure that contractors and site visitors are fully informed of this Policy and of their obligation to comply with it. In addition, SNL shall continuously evaluate regulatory requirements, corporate policies, and customer needs, and shall adjust its operations to meet these changing needs through the Sandia Quality Improvement Plan. This includes a goal of continuous improvement in ES&H processes.*
>
> *Concern and conduct in matters pertaining to the environment, safety, and health are the responsibility of all SNL employees, on-site contractors and visitors.* ***NO JOB IS MORE IMPORTANT THAN YOUR HEALTH, YOUR SAFETY, AND THE PROTECTION OF OUR ENVIRONMENT.***

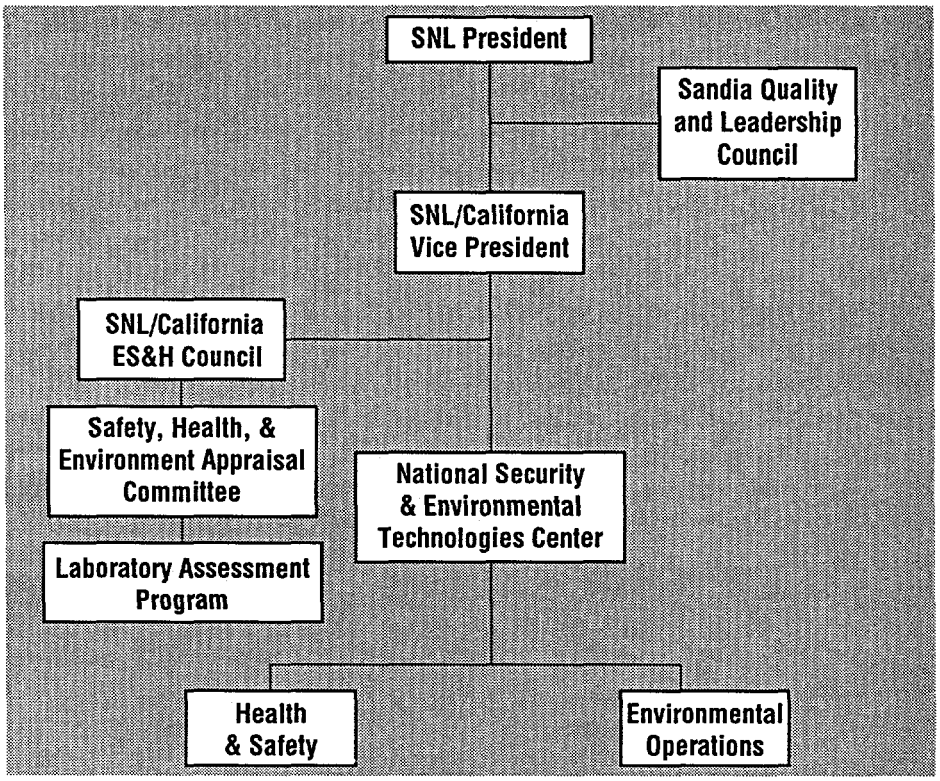
These responsibilities and authorities are detailed in the SNL/California *Environmental Protection Implementation Plan*.[28] This plan documents management directives to ensure that all Sandia operations are conducted so that human health and the environment are protected.

The Center for National Security and Environmental Technologies has two ES&H departments: Health & Safety Department (8421) and Environmental Operations (8418). The Health & Safety Department is responsible for industrial hygiene and health physics, and explosives control/storage, fire protection, pressure safety, occurrence reporting and tracking, ergonomics, and records management. The Environmental Operations Department is responsible for waste management, pollution prevention, environmental surveillance (including the preparation of this *Environmental Monitoring Plan*), air quality, environmental planning, and wastewater/storm water management and groundwater monitoring.

The Environmental Operations Department (see Fig. 2) is responsible for implementing the activities described in this plan. Therefore, the responsibilities of each group in each department are described briefly below.

5.0 RESPONSIBILITIES AND AUTHORITY

Figure 1. SNL/California organizational chart showing the responsibility and authority for ES&H.



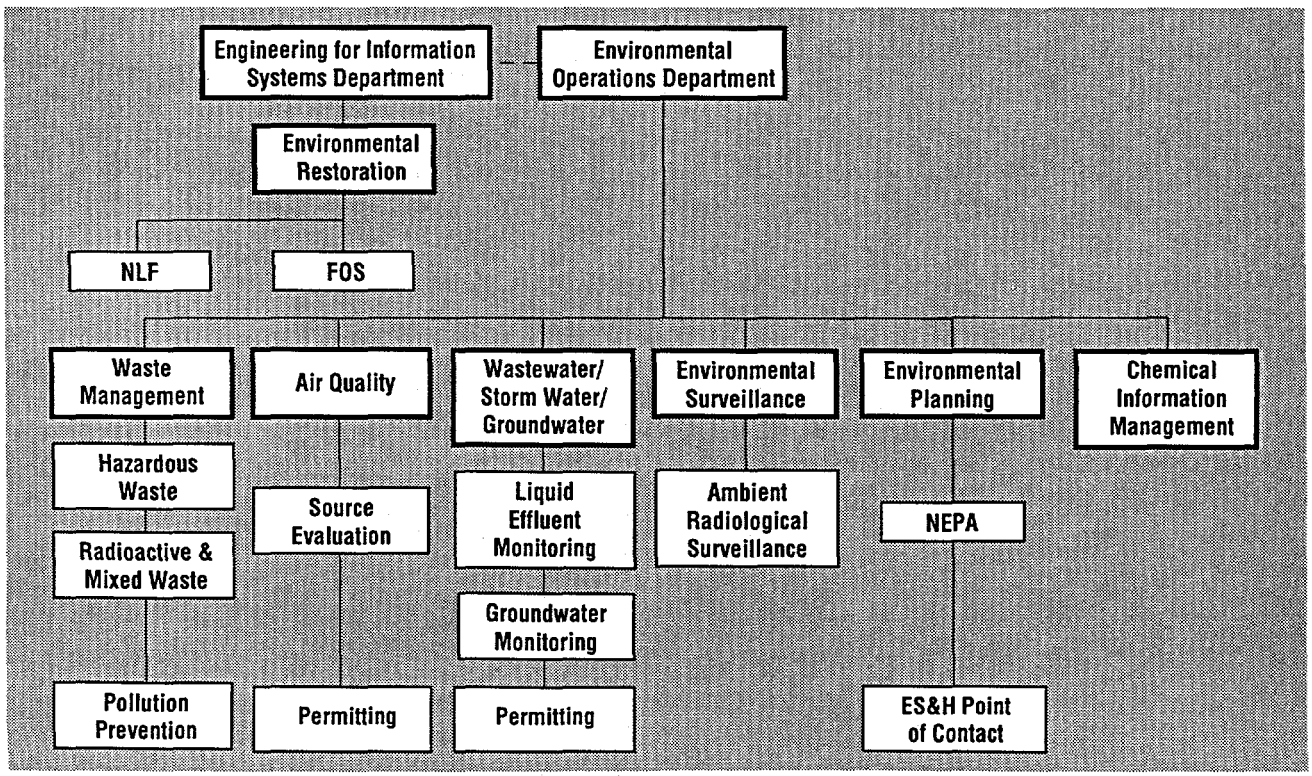


Figure 2. SNL/California Environmental Operations Department.

5.0 RESPONSIBILITIES AND AUTHORITY

5.1 Waste Management

The Waste Management Group is responsible for managing radioactive, mixed, medical, energetic, and hazardous wastes. Waste management activities include the collection, on-site transport, storage, treatment, packaging, and shipment of wastes in accordance with DOE-, EPA-, and State-specified regulations and requirements. The group also manages the following Waste Management Program activities: training, permitting, reporting, interfacing with regulators through the DOE, program planning, recordkeeping, and budgeting.

The Waste Management Group is responsible for operations conducted in the Hazardous Waste Storage Facility, the Tritiated Waste Storage Facility, and the Radioactive and Mixed Waste Storage Facility. In addition, the group manages the permitting of three on-site treatment facilities that are regulated under "permit-by-rule" (two waste compactors and a fluorescent light tube crusher).

5.2 Pollution Prevention

The Pollution Prevention Group is responsible for promoting pollution prevention and source reduction of all wastes in all site activities. Responsibilities include:

- gathering process information,
- evaluating processes and assessing pollution prevention opportunities,
- fostering employee awareness of pollution prevention and source reduction issues and technologies, and
- developing and maintaining site recycling programs.

The Pollution Prevention Group also is responsible for preparing reports to the DOE and to Federal, State, and local regulators. SNL/California has a waste minimization/pollution prevention coordinator to manage these efforts.

5.3 Environmental Surveillance

The Environmental Surveillance Group at SNL/California assesses potential impacts to the public and the environment from site operations. The group is responsible for ensuring that SNL/California compiles with Federal, State, and local regulations and DOE orders governing protection of the environment. Specifically, environmental surveillance personnel maintain a direct radiation monitoring system. The group also prepares reports and other documents to demonstrate compliance.

5.4 Air Quality

The Air Quality Group manages a program to facilitate site compliance with regulations governing air emissions to the environment. The Air Quality Compliance Program maintains the site air emissions inventory and evaluates Sandia operations that are potential sources of air pollutants.

5.5 Environmental Planning

The Environmental Planning Group is responsible for implementing the National Environmental Policy Act (NEPA) at the SNL/California site. This responsibility involves evaluating proposed projects, activities, and programs for potential environmental and human impacts. Key environmental concerns include potential air emissions (through vents or stacks on buildings), water effluents (storm water or sanitary sewer outfall), human exposure to hazardous substances, and waste generation and minimization.

In addition, the Environmental Planning Group acts as the point of contact for the ES&H Interdisciplinary Team, which comprises representatives from each of the primary disciplines within ES&H, and when appropriate, facilities and security programs. The Interdisciplinary Team is responsible for helping SNL/California's project teams consider ES&H, facility, and security issues as they plan and implement new

projects or change ongoing projects. By reviewing proposed projects early in the planning stages, the Interdisciplinary Team helps make sure they begin on time.

5.6 Wastewater/Storm Water/Groundwater Management

The Wastewater/Storm Water Group is responsible for ensuring that SNL/California complies with all Federal, State, and local regulations and DOE orders regarding the quality of wastewater and storm water discharges. The group monitors these discharges both visually and through sampling and analysis. The group ensures that SNL/California site activities do not impact the quality of surface waters in the vicinity or in the San Francisco Bay. The group verifies that wastewater and storm water discharges are in compliance with established standards and requirements. The group performs monitoring of the groundwater underlying the SNL/California site in accordance with orders issued by the Regional Water Quality Control Board. The group prepares numerous reports, permit applications, and other documents to demonstrate compliance with various environmental regulations and DOE orders.

5.7 Chemical Information Management

The Chemical Information Management Group is responsible for providing consultation for chemical analysis and data review, and for maintaining the site-wide Chemical Information System/Material Safety Data Sheet system. This is a database containing comprehensive information for tracking chemicals used at SNL/California. It includes a site-wide inventory of chemical containers and potential personnel exposure data.

6.0 SITE BACKGROUND

6.1 Site Description

6.1.1 Location

SNL/California is approximately 65 km (40 miles) east of San Francisco, on the southeastern boundary of the City of Livermore. Figure 3 shows the location of SNL/California in the San Francisco Bay Area.

The SNL/California site covers 1.7 km^2 (413 acres, not including a 228-acre buffer zone). It lies at the western base of the Altamont hills, which form the eastern boundary of the Livermore Valley. The Livermore Valley is an irregularly shaped lowland in the Diablo Range of the California Coastal Mountain Range. It is approximately 26 km (16 miles) long (east to west) and averages about 11 km (7 miles) wide. The Valley floor slopes to the west from a high elevation in the east of approximately 200 m (660 ft.) to a low of about 90 m (295 ft.) at the western end of the Valley.

The Valley's major drainage is via seasonally intermittent streams (arroyos). These arroyos generally carry water to the southwest end of the Valley and into the Alameda Creek near Sunol. Alameda Creek then continues on to the San Francisco Bay.

6.1.2 Geology

The geology of the Livermore Valley is complex. The northern portion of the site is on gently northwest-sloping land underlain by alluvial deposits (clay, silt, sand, gravel, and similar materials deposited by running water). These deposits are mapped as Pleistocene Epoch (up to 2 to 3 million years old). The hilly southern portion of the site is underlain by older alluvial terrace deposits and deformed beds of Liver-

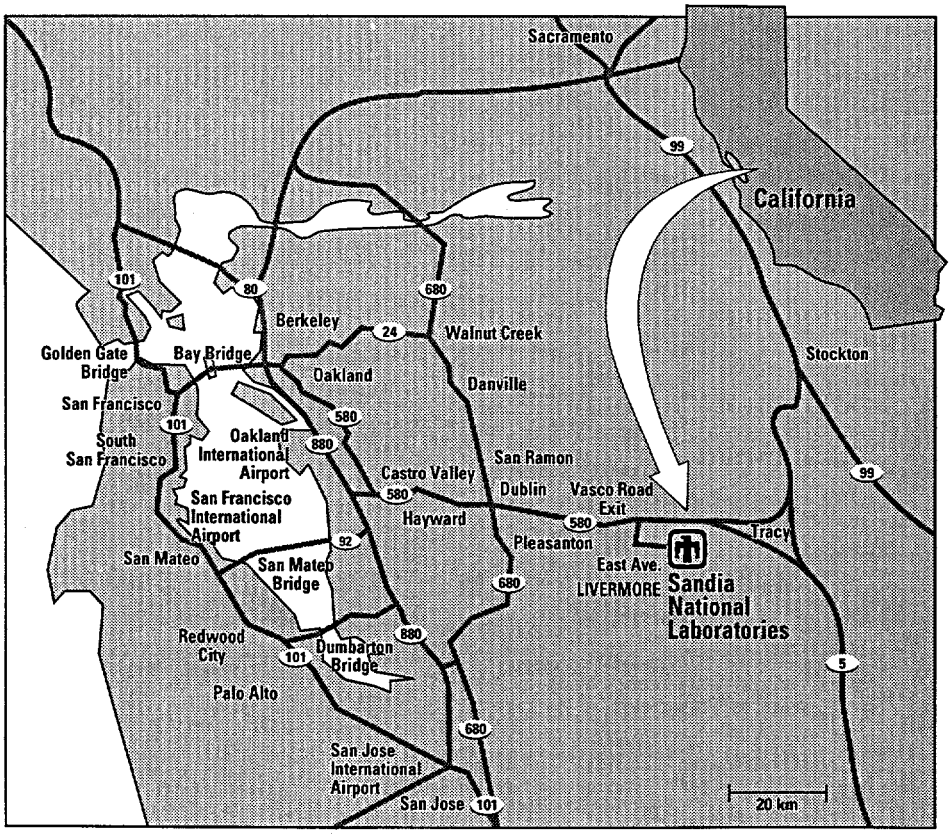


Figure 3. SNL/California in a regional setting.

more gravels. These two areas, with contrasting physiography and stratigraphy, are separated by the Las Positas fault, which extends northeast to southwest. It runs across the site along the change in slope from the hilly southern portion to the gently sloping northern portion.

The alluvial deposits create interbedded layers of higher and lower permeability overlying the older Livermore formation. The groundwater of the Livermore Valley is in the more permeable layers, which lie between 5 and 33 m (17 and 110 ft.) below the surface. Groundwater flows generally in a northwesterly direction. The groundwater flow beneath the SNL/California site is strongly influenced by the north branch of the Las Positas Fault. Groundwater underlying the portion of the site to the north of the fault appears to flow predominantly in a westerly direction. Groundwater flow to the south of the fault is not as well understood. A groundwater "mound" appears to exist under the southern portion of the site, and the influence of the fault may be causing radial flow from this mound.

The Arroyo Seco traverses the SNL/California site from the southeast to the northwest. It receives stormwater runoff from the site and acts as the primary pathway for groundwater recharge near the site.

6.1.3 Climatology

The climate of the Livermore Valley consists of mild, rainy winters, and warm, dry summers. The mean annual temperature is 12.5°C (55°F), with extremes ranging from 0° to 38°C (32° to 100°F). The average annual rainfall is less than 15 in., which classifies the area as semi-arid. Rain falls primarily between October and April. The wind patterns also show a strong seasonal variation. During the summer months, the winds are predominantly from the west or southwest, flowing into the Valley from the San Francisco Bay Area through the Dublin Gap at its western end. The winds typically exit the Valley through the Altamont Pass at the eastern end. Peak winds tend to occur during the afternoon due to the "sea-breeze" effect caused by the high air temperatures in the inland valleys compared to the cooler air over the Pacific Ocean. Periods of calm occur most often during the early morning hours just before dawn. During the winter months, winds tend to blow predominantly from the south, with a secondary component from the north. Relative humidity ranges from daily lows of 40–60% in the afternoons to daily highs of 80% to over 90% in the early morning.[29]

6.1.4 Vegetation

An 1990 on-site environmental field investigation showed three distinct vegetation communities at SNL/California:[30]

1. *Non-native Valley Grassland*—Most of the undeveloped portions of the site are covered by vegetation indicative of this plant community, which is characterized by ripgut brome (*Bromus diandrus*), wild oat (*Avena fatua*), star thistle (*Centaurea solstitalis*), Russian thistle (*Salsola kali*), doveweed (*Eremocarpus setigerus*), alfalfa (*Medicago sativa*), sweet fennel (*Foeniculum vulgare*), coast sagebrush (*Artemesia californica*), and ryegrass (*Lolium multiflorum*).
2. *Great Valley/Valley Oak Riparian Forest*—Remnants of this plant community still exist along the course of the Arroyo Seco on the eastern portion of the site. It is characterized by sycamore (*Platanus racemosa*), valley oaks (*Quercus lobata*), red willows (*Salix lasiandra*), mule fat (*Baccharis viminea*), seaside heliotrope (*Heliotropium curassavicum*), curly dock (*Rumex crispus*), and tree tobacco (*Nicotania glauca*).
3. *Cismontane Alkali Marsh*—A small area on the eastern portion of the site contains species indicative of this plant community, including salt grass (*Distichlis*

spicata) and alkali ryegrass (*Elymus triticoides*). At the time of the field investigation, no water was at this site, but it does lie within the drainage channel of the Arroyo Seco and another smaller drainage channel to the north of the Arroyo Seco.

The central and western portions of the Arroyo Seco contain less diverse vegetation, consisting of a few valley oaks, almond trees, sweet fennel, several eucalyptus (*Eucalyptus* sp.), and a canyon live oak (*Quercus chrysolepsis*).

The channel of the Arroyo Seco meets the criteria for classification as a wetland.

Portions of the developed site areas have been landscaped. These areas include lawns, ground cover, and various trees.

The field investigation shows that suitable areas for the following endangered, threatened or candidate (for endangered or threatened status) species are present at SNL/California:

Amsinckia grandiflora
Eschscholzia rhombipetala
Cordylanthus mollis ssp. hispidus
Cordylanthus palmatus
Helianthella castanea
Lasthenia conjugens
Tropidocarpum capparideum

However, the survey was conducted after the flowering season of these plants, and their existence could not be verified.

6.1.5 Wildlife

The 1990 field investigation assessed the area for evidence of the endangered San Joaquin kit fox (*Vulpes macrotis mutica*), and the red-legged frog (*Rana aurora draytoni*), and the California tiger salamander (*Ambystoma tigrinum californiense*), which is a candidate for listing.[30] There were several burrows on the eastern portion of the site, along the Arroyo Seco, and a carnivore scat (animal dropping) was collected from the entrance of one of the burrows, which could indicate the presence of the kit fox. However, the fox has not been seen, and the burrows were destroyed by the heavy rains of the 1994–95 and 1995–96 rainy seasons.

California tiger salamanders were observed on the SNL/California site in November 1994. They were observed during work to replace the water tanks on the southern portion of the site (these tanks supply water to Sandia and LLNL). They were also observed during the winter of 1995–96 in burrows near the LLNL percolation ponds in SNL/California's western buffer zone. The California tiger salamander is listed as a "species of special concern" under State regulations and is a candidate for listing under the Federal Endangered Species Act. Other candidate species that have been sighted at SNL/California are the Ferruginous hawk (Buteo regalis) and the burrowing owl (Speotyto cunicularia). No action is required by SNL/California at this time.

6.1.6 Archaeological and Cultural Resources

A cultural resources overview and an assessment were done in 1990.[31,32] These studies were completed under the most current Federal cultural resources guidelines and regulations. No properties, structures, or features were found at the SNL/California site that could potentially qualify for inclusion in the National Register of Historic Places.

6.2 Land Use

Figure 4 is an aerial photograph of the SNL/California site and vicinity, showing the predominant land uses.

The SNL/California site is immediately bounded on the east, south, and west by a security buffer zone. No development is allowed in this zone, and public access is not permitted.

LLNL lies directly to the north of SNL/California. Patterson Pass Road is the northern boundary of the LLNL site. Across Patterson Pass Road to the north is a light industrial park. A Union Pacific Railroad line runs east to west along the northern boundary of the industrial

park. Land uses further north include vacant land, industrial, a Southern Pacific Railroad line, and Interstate 580 (I-580). Land northeast of the site is agricultural used primarily for grazing. Wind turbines are on the hills of the Altamont Pass further northeast of the site.

The SNL/California site is bordered on the east by private property and Greenville Road. The property east of Greenville Road is mainly agricultural, used primarily for grazing, with a few scattered rural residences. A Western Area Power Administration electrical substation is on the southeast corner of Greenville Road and Patterson Pass Road. The South Bay Aqueduct, a branch of the California Aqueduct, traverses the land east of the SNL site from north to south and runs parallel to SNL/California's eastern boundary. The Patterson Reservoir and filtration plant for the South Bay Aqueduct are northeast of the SNL/California site along Patterson Pass Road.

Tesla Road borders the southern portion of the SNL/California site. Approximately 50 acres south of the SNL/California site border (between the border and Tesla Road) are vineyards. Agricultural lands south of Tesla Road and west of Greenville Road are also vineyards.

The SNL/California site is bordered on the west by private property and Vasco Road. A low-density, single-family residential subdivi-

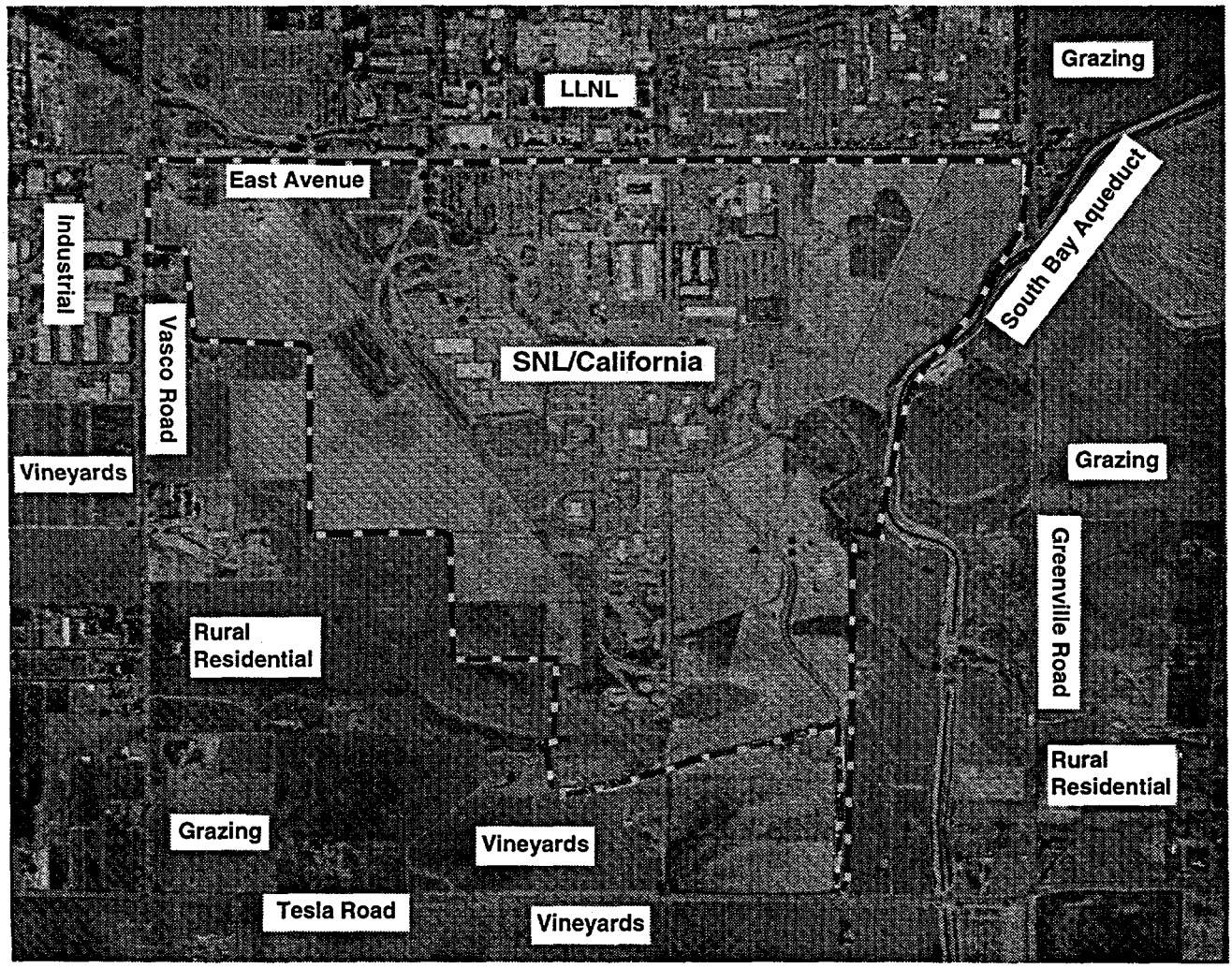


Figure 4. Predominant land uses around the SNL/California site.

sion is on the southwest corner of Patterson Pass Road and Vasco Road. An area of vacant land lies west of the site (north of East Avenue), and low- to medium-density residential areas are on the west side of this vacant land (approximately 2,000 ft. west of Vasco Road). A light industrial park is on the southwest corner of East Avenue and Vasco Road. Other lands to the west are rural residential and agricultural (primarily vineyards).

Several easements for utilities cross the SNL/California site. PG&E has easements for overhead high-voltage electric power transmission lines and an underground high-pressure gas line. Standard Oil Company of California has an easement for an underground oil line.

6.3 Operational Activities

SNL/California's engineering, research and development work requires the use of small quantities of hazardous and radioactive materials. These materials are present only in small, laboratory-scale quantities. Table 1 lists SNL/California's facilities by building number, their description and use, and size (square footage). The following are Sandia's activities that could release pollutants to the environment:

1. *Space Heating*—SNL/California has twelve boilers on-site for providing space heating. All of the boilers are fired by natural gas or diesel fuel. The BAAQMD has issued permits for the

Table 1. SNL/California Facilities

Bldg. No.	Description/Use	Sq. Ft.
904	Auditorium	5,110
905	Combustion Research Facility (CRF) Offices	25,050
906	CRF Labs	16,430
907	Mechanical Building	4,480
910	Weapons Laboratory Building	86,540
911	Personnel, Medical, Purchasing	20,100
912	Offices, Services, Computer Center	122,910
913	Model Shop, Test Assembly, Labs	85,840
914	NDE, Applied Mechanics Labs	24,510
915	Steam Plant	3,090
916	Laboratories, Offices	40,530
917	Pump House	520
918	Office and Laboratory Material Storage	6,120
919	Welding Laboratory	800
920	Offices	12,240
921	Offices and Library	12,240
922	Offices	12,240
923	Offices	3,880
927	Warehouse	22,840
928	Shipping, Receiving, Stores	27,650
940	Integrated Manufacturing Technology Laboratory (IMTL) Offices	17,662
941	IMTL	31,870
942	IMTL	26,000
943	IMTL	7,200
955	Environmental Test Facility	4,170
956	Dynamic Test Facility	2,580
961	Decontamination and Storage Facility	3,660
962	Maintenance Landscape Shop	560
963	Maintenance Shops	11,940
964	Security Building	10,620
966	High Pressure Test Facility	7,750
967	Chemical & Radiation Detection Laboratory (CRDL) Office	4,580
968	CRDL	15,760
969	CRDL Mechanical Assembly	2,760
970	Energy Conversion Laboratory	4,700
971	Laboratory	720
972	Centrifuge and Laboratories	9,000
973	Firing, Support Labs, and Offices	6,190
974	Explosive Assembly	130
976	Gas Applications and Systems Facility	3,530
977	Storage and Laboratory	1,450
978	Explosive Test Facility	3,280
979	Component Development Laboratory	4,700
981	Explosives Shipping and Receiving	180
982	Explosives Packaging Storage	260
983	FTU Assembly	1,670
M03	Facilities Management Offices	5,780
M14	Office and Control Room	520
M15	Support	520
M16	Support	520
M17	Field Office	520
M22	Educational Television Center	2,160
M23	Diversity and Development, Offices	2,160
M24	Offices	3,360
M25	Education Outreach, Offices	3,120
M26	CRF Technical Support	1,440
M27	Uncleared Offices	4,800
M28	Instrument Issue and Repair	1,440
M29	Offices	1,440
M30	Training Classroom	1,440
M45	Microelectronics Outreach	1,440
	Total	**735,282**

operation of these boilers. These permits are updated and reissued annually.

2. *Degreasers*—SNL/California operates seven equipment degreasers and cleaners. The solvents used in these degreasers are 1-1-1-trichloroethane, methylene chloride, and other compounds. The BAAQMD has issued permits for these degreasers. These permits are updated and reissued annually.
3. *Paint Spray Booth*—SNL/California operates one paint spray booth, which has been permitted by the BAAQMD. This permit is updated and reissued annually.
4. *Hazardous Waste Storage Facility*—This facility is housed in Buildings 961 and 9622. Building 961 is used for storing radioactive and mixed wastes. Building 9622 is used as a staging area for solid and liquid containerized wastes. All exits from Building 9622 have troughs coated with chemical-resistant epoxy to contain any leaks or spills. Eight outside storage bays around these facilities are used for storing containerized and drummed wastes. All of these areas are floored with monolithic concrete, which is coated with a chemical-resistant epoxy. Each bay is designed to contain at least 10% of the volume of the stored waste in addition to any rain from 24 hours of rainfall from a thirty-year storm. The BAAQMD has issued permits for equipment used in this facility. These permits are updated and reissued annually.
5. *Printed Wiring Facility*—The Printed Wiring Facility in Building 910 contains dip and rinse tanks containing the following materials: copper, cadmium, gold, lead, ammonia, and volatile organics. Effluents from this laboratory are directed to a process water tank and are analyzed for copper before being released to a Liquid Effluent Control System (LECS). The contents of the LECS are analyzed for compliance with Livermore Water Reclamation Plant (LWRP) discharge limits before they are released to the sanitary sewer. In addition, effluents from this laboratory are analyzed biannually under the requirements of the Federal Categorical Pretreatment Regulations.[17] The LWRP also independently samples and analyzes the effluents from these processes.
6. *Electroplating Laboratory*—The Building 913 electroplating laboratory was moved to Building 943 in 1995. The new equipment has no liquid effluent discharge, and therefore, effluent monitoring for this categorical process is no longer required. The BAAQMD has issued permits and exemptions for processes in this facility. The permits and exemptions are updated and reissued annually.
7. *Explosives Testing*—Small-scale testing of explosive devices is conducted in enclosed test cells. The BAAQMD has issued exemptions for these operations. The exemptions are updated and reissued annually.
8. *Radiography*—Isotopic gamma ray sources (^{60}Co and ^{192}Ir) and x-ray-producing machines are used in the 941 complex. The external dose rates in and around the building were studied and were determined to slightly exceed background levels during operations. These operations do not release radioactive materials to the environment.
9. *Combustion Research Facility*—This facility houses research-scale studies of combustion processes, including research on internal combustion engines. The BAAQMD has issued permits and exemptions for processes in this facility. The permits and exemptions are updated and reissued annually.
10. *Maintenance Shop*—This shop maintains and repairs mechanical equipment for all SNL/California organizations. These

operations entail the use of various solvents and other chemicals that may be subject to environmental regulations.

11. *Model Shop/Test Assembly*—This shop fabricates and assembles components for research and experiments. These operations may involve the use of radioactive or hazardous materials.
12. *Experimental Laboratories*—Various small, research-scale laboratories use a wide range of chemicals or hazardous substances. Airborne and liquid emissions have been evaluated and controlled as necessary. Appropriate permits or written exemptions have been obtained for these laboratories.

Table 2 lists the permits held by SNL/California for discharge of effluents and waste management, the category for each discharge, the regulatory agency and regulations governing each discharge, and the permit status.

6.4 Known Areas of Contamination

Several areas at the SNL/California site have been investigated to determine if environmental contamination was present. One contaminated site has been remediated and formally closed. The following discussion covers those areas where environmental contamination exists.

6.4.1 Fuel Oil Spill Site

In 1975, as the result of an accidental puncture of an underground transfer line, 59,500 gallons of #2 diesel fuel spilled into the vadose zone from an above-ground reserve fuel tank. SNL/California has monitored the groundwater in this area since 1985. It shows occasional low-level contamination with fuel oil components. Neighboring farmers sometimes use this aquifer as a source of drinking or agricultural water.

SNL/California completed a remedial investigation of the spill site in November 1988. In 1990, SNL/California, Argonne National Laboratory, and the University of Notre Dame performed several bench-scale tests to determine the most effective means of cleanup. The resulting treatability report indicated that bioremediation would be the most effective of the technologies tested in reducing fuel oil contamination. In 1991, *in situ* bioremediation tests were done.

Table 2. SNL/California Environmental Permits

Category	Regulation/Authority	Permit Status
Waste Management	Title 40 CFR 264 (RCRA), EPA; Title 22 CCR, Division 4.5, Cal/EPA	Part B permit effective January 4, 2003.
Air Quality	Bay Area Air Quality Management District	BAAQMD permits for 32 air emission sources. Permits renewed annually.
Wastewater Discharge	City Ordinance, City of Livermore	Permit for the site sanitary and industrial wastewater discharge. Permit renewed annually.
Storm Water Discharge	Clean Water Act (Title 40 CFR 122–124), EPA, National Pollutant Discharge Elimination System, State Water Resources Control Board, Regional Water Quality Control Board, City Ordinance, City of Livermore	SNL/California has a Notice of Intent on file with the State Water Resources Control Board. As a result, Sandia is covered by the State's National Pollutant Discharge Elimination System General Permit for Discharge of Storm Water Associated with Industrial Activities. Permit renewed every five years.
Groundwater Discharge	City of Ordinance, City of Livermore	Permit for discharging treated groundwater to the sanitary sewer. Permit renewed annually.

Bioremediation was proven effective, but in the field it proceeds at a slower rate than laboratory tests done in slurry reactors.

In December 1990, Argonne began groundwater flow and contaminant transport modeling to support the pilot bioremediation system design. Using a computer code developed at Los Alamos National Laboratory and monitoring well data, experts at Los Alamos prepared a three-dimensional model characterizing the spill area. Argonne conducted additional bench-scale studies at Notre Dame to establish the required nutrient and oxygen levels and to identify degradation products. SNL/California completed three groundwater wells downgradient of the spill site to control and monitor the spread of the contaminated groundwater.

After heavy rainfall in the spring of 1993, the groundwater at the Fuel Oil Spill site rose about 3.6 m (12 ft.). Diesel and BTEX contamination were noted during the second-quarter groundwater sampling. As a result, the Regional Water Quality Control Board directed SNL/California to implement an Interim Remedial Measure, a groundwater treatment system. Because SNL/California is planning to move the system to a permanent location (to serve as the water treatment system for the Fuel Oil Spill pilot study nutrient injection and withdrawal systems), it has been termed the "Temporary Interim Remedial Measure."

In the fall of 1993, the Regional Water Quality Control Board approved SNL/California's work plans for the Fuel Oil Spill pilot study and the Temporary Interim Remedial Measure. SNL/California completed the Fuel Oil Spill site plan in October 1993 and the Temporary Interim Remedial Measure work plan and system design in December 1993.

SNL/California completed site preparation—including fencing, gates, site grading, gravel, and paving—in December 1993. Using the conceptual design from Argonne National Laboratory, SNL/California installed a free product separator and carbon filtration beds in January 1994. The Temporary Interim Remedial Measure went on-line in early February 1994.

In March and April 1994, SNL/California drilled ten monitoring boreholes and installed downhole instrumentation, five injection/withdrawal wells, four Zone 1 withdrawal wells, and five geophysical logging boreholes. SNL/California set up a small landfarm (*ex situ* bioremediation) to treat the drill cuttings from the wells and boreholds. The landfarm reduced the contamination in the soil to less than 50 ppm, and in 1995, was closed.

During the summer of 1994, utility hookups were completed, and the data acquisition software was finished and installed. Following these activities, SNL/California installed a subsurface infiltration gallery, seven transiometers, and a remote barometer at the pilot study site. Multiplexers and data loggers were installed and connected to the computers. The data collection computer system began baseline monitoring for temperature, pressure, and soil moisture. This system comprised 158 information channels collecting data once every minute, 24 hours per day.

In late November 1994, SNL/California completed the construction of the pilot study system. The components of the Temporary Interim Remedial Measure were moved into the pilot study system and were tested. The Final Interim Remedial Measure now is continuously operating.

SNL/California conducted a small-scale, flow-through test in April 1995.

The bioremediation pilot study began in June 1995, with injection of water into the ground. The water contained the necessary nutrients for *in situ* bacterial growth: nitrogen and phosphorus, with calcium and magnesium salts added to modify the soil properties. Using low to moderate flow rates of 1.5 to 6.0 gallons per minute, nearly 2,000,000 gallons of water were injected into the fuel oil spill soils.

In October 1995, the injection system was shut down, and the withdrawal phase was started. About 60,000 gallons of water were removed and treated; the rest remains in the pores of the soil to facilitate the bioremediation.

In November 1995, the aeration phase was started, with air forced into the soil and pulled from the soil at a low rate (about 5 cubic feet per minute). This phase continued through the end of 1995.

In 1996, the three phases (nutrient injection, withdrawal, and aeration) will be repeated two or three times. Ongoing data collection and chemical analyses will help SNL/California monitor the progress of the bioremediation.

Late in 1996, SNL/California will test the soil to determine the extent of the *in situ* bioremediation.

6.4.2 Solvent Plume from LLNL

The plume of TCE contaminated groundwater underlying LLNL property extends onto SNL/California property. The source of the TCE was from past practices at LLNL. LLNL is treating the groundwater to remove the TCE. SNL/California has no responsibilities in this area.

7.0 EFFLUENT MONITORING

7.1 Background

Effluents are monitored to demonstrate SNL/California's compliance with applicable Federal, State, and local laws, regulations, and orders. Monitoring is done through quantification of pollutant emissions at the points of discharge from facilities.

Data from effluent monitoring equipment are used to assess compliance with standards for pollutant emissions.

Sandia is committed to conduct operations so that emissions of hazardous materials to the environment are in compliance with all applicable regulations. Moreover, Sandia strives to keep emissions to ALARA levels.

SNL/California monitors two types of effluents: process wastewater and the sanitary sewer effluent (where it leaves the site and joins the sanitary sewer effluent from LLNL).

Since the cleanup of the former TRL and its transition to non-nuclear uses, SNL/California no longer models doses to the public from airborne effluents. However, SNL/California personnel do retain the capability to perform such modeling should the need arise in the future.

7.2 Liquid Effluents

SNL/California has established the following policy for wastewater discharges:[33]

Any wastewater discharged either directly to the site sanitary sewer system or to a LECS shall not have pollutant concentrations exceeding the site outfall discharge limits imposed by the City of Livermore. Wastewater effluents from categorical processes (Printed Wiring Laboratory) must comply with Federal Pretreatment Standards.

Routine discharges from the LECS to the site sewer system must also comply with site outfall discharge limits. If LECS wastewaters inadvertently exceed these concentrations, but are below hazardous waste concentrations, the Environmental Operations Department may treat the effluent before discharge. If the effluent exceeds hazardous waste concentrations, it shall be shipped off site as a hazardous waste.

Long-standing Sandia policy prohibits hazardous waste disposal down sink drains or in any other way that releases hazardous wastes into the sanitary sewer system.

7.2.1 Requirements

DOE/EH-0173T and Section 13.32 of the City of Livermore Municipal Code outline the monitoring requirements for process wastewater and sanitary sewer effluents.[25] These requirements are also included in the Wastewater Discharge Permit #1251.[34] Table 3 lists the site sanitary sewer outfall discharge limits for specific pollutants.

7.2.2 Liquid Effluent Control Systems

Liquid effluents from selected SNL/California operations (those that could release pollutants) are routed to the site's liquid effluent con-

Table 3. Specific Pollutant Limitations[a]

Pollutant	Concentration Limit[b]	Pollutant	Concentration Limit[b]
Arsenic	0.06 mg/L	Silver	0.20 mg/L
Cadmium	0.14 mg/L	Zinc	3.00 mg/L
Copper	1.0 mg/L	Cyanide	0.04 mg/L
Chromium (total)	0.62 mg/L	TTO[c]	1.0 mg/L
Lead	0.20 mg/L	pH	5–10 standard units
Mercury	0.01 mg/L	Fat, oil, or grease	100 mg/L
Nickel	0.61 mg/L		

[a]These limits are specified in Section 13.32.100 of the City of Livermore Municipal Code and have been adopted by SNL/California as internal operating limits.

[b]1 mg/L is equivalent to 1 ppm (parts per million).
[c]TTO = total toxic organics

trol systems (LECS). LECS are not required by any regulations, but Sandia has established them to provide better control of liquid effluents and to ensure compliance with regulatory discharge limits and sound management practices.

The LECS comprise large, doubly-contained, leak-monitored, holding tanks. These tanks collect and retain the wastewater, allowing a sample of it to be analyzed for process constituents. (If a tank contains pollutants at levels greater than administrative limits, then the liquid is treated or disposed of as hazardous waste, as described in the policy statement above.)

To assure independence from the line organizations, the Environmental Operations Department issues release authorizations. The Environmental Operations Department is responsible for managing all aspects of the LECS, to include collecting and analyzing LECS samples, disposing of wastewater, and keeping records.

Locations of LECS

Figure 5 shows the locations of the LECS at the SNL/California site.

Bldg. 906—process wastewater is routed to a LECS consisting of two 5,000-gallon tanks.

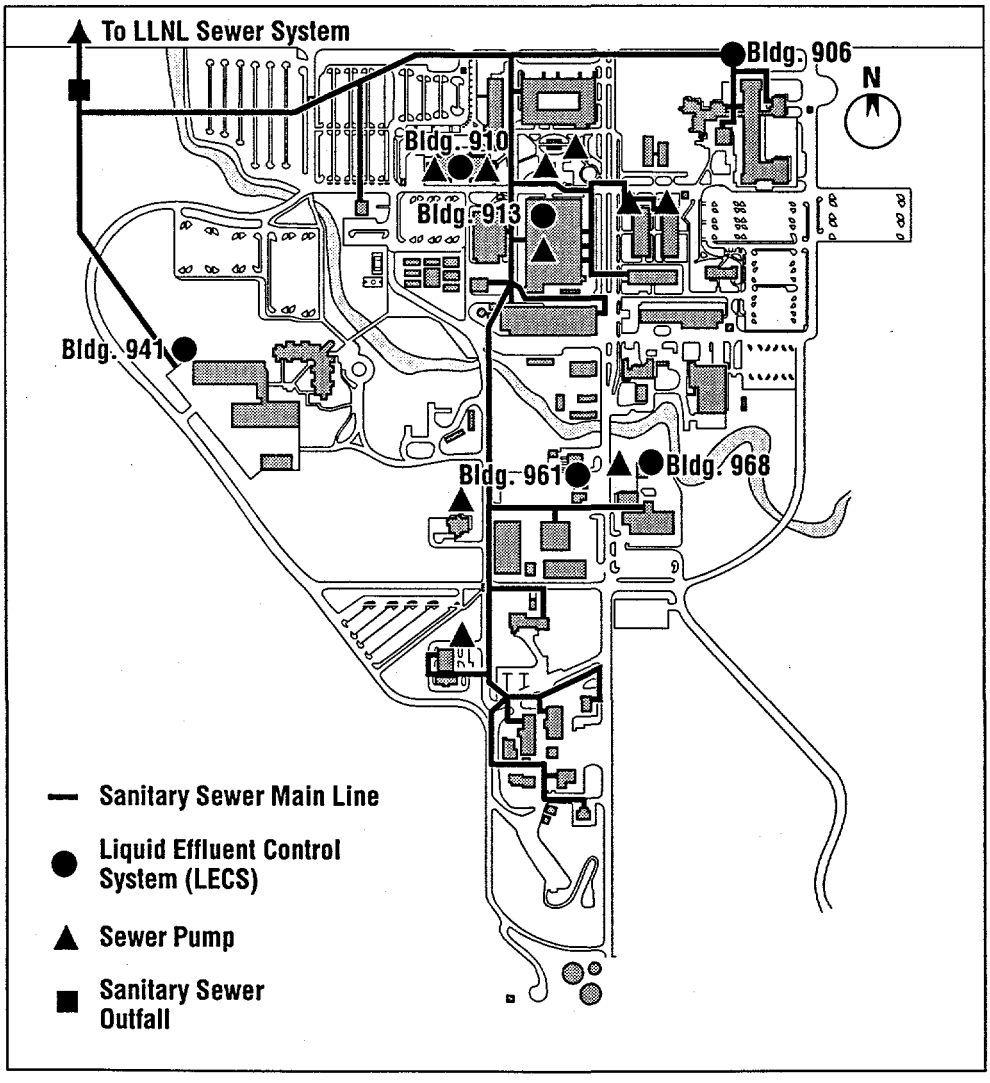


Figure 5. SNL/California sanitary sewer system and locations of the liquid effluent control systems.

Bldg. 910—process wastewater is routed from the Printing Wiring Facility to a LECS consisting of one 5,000-gallon tank.

Bldg. 913—process wastewater from the central and southern portions of Bldg. 913 and from laboratories in Bldg. 916 is routed to a LECS consisting of three 5,000-gallon tanks.

Bldg. 941—process wastewater is routed to a LECS consisting of two 5,000-gallon tanks.

Bldg. 961—water from decontamination operations is routed to a LECS, consisting of one 2,000-gallon tank.

Bldg. 968—all floor drains and laboratory sinks are routed to two 2500-gallon tanks.

Monitoring Methods

When the liquid level in a tank reaches a predetermined level, the tank is isolated and a sample is collected and analyzed. The tank receives no more wastewater before its contents are properly disposed of.

To assure that a representative sample is collected, the contents of the tanks are agitated by recirculation stirring, or by air being bubbled through them before they are sampled.

Analyses

A State-certified contract laboratory analyzes all LECS samples, except tritium samples, which are analyzed on site. All LECS also are continuously monitored for pH and liquid level.

The analyses done on each LECS are based on the process generating the wastewater (see Table 4). The primary constituents of concern are metals.

The Electroplating Laboratory in Building 943 and the Printed Wiring Laboratory in Building 910 are also subject to the Federal Categorical Pretreatment Standards.[17] Grab samples are collected semiannually except for the Electroplating Laboratory, which is a closed-loop system and has no liquid effluent. Samples are analyzed for pH, As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, CN^-, and total toxic organics (TTO), which comprise the EPA organic priority pollutants. The sample from the Printed Wiring Laboratory is collected directly from the LECS. No other processes discharge to this LECS.

Quality Assurance/Quality Control

The Environmental Operations Department is formalizing the *Wastewater Discharge Program Plan*,[33] which includes procedures for collecting and analyzing samples from the LECS. The procedures also address quality assurance and control issues.

7.2.3 Sanitary Sewer

After the SNL/California sanitary sewer effluent leaves the site, it combines with the LLNL sanitary sewer effluent. The combined effluent is discharged to the city's sewer system.

Effluent from the LWRP is transported via pipeline to the San Francisco Bay. A small amount is diverted for municipal irrigation in Livermore. Before the early 1980s, the LWRP effluent was discharged to the Arroyo Seco. This practice is assumed to be responsible for the slightly elevated tritium concentrations in some of the monitoring wells downgradient of the LWRP. To provide a final check on the quality of the effluent flow, SNL/California continuously monitors and samples the effluent before it leaves the site (see Table 5 for the analyses performed on the samples). This way, SNL can verify compliance with discharge limits.

In addition, the combined effluent at the LLNL sewer outfall is monitored extensively, to include continuous monitoring for metals (Ag,

Table 4. LECS Wastewater Analyses

LECS	Analyses
B. 906	As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn
B. 910	As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, CN^-, TTO
B. 913	As, Cr, Cu, Pb, Hg, Ni, Ag, Zn
B. 941	As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn
B. 961	As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, ^3H, ^{238}U
B. 968	As, Cr, Cu, Pb, Hg, Ni, Ag, Zn

Cd, Cr, Cu, Ni, As, Hg, Pb, Zn), pH, flow, and gamma radiation. This monitoring is supplemented by flow proportional grab samples, which are analyzed daily for gross alpha activity, gross beta activity, and tritium. These composite grab samples are also analyzed monthly for metals, organics, TDS, TSS, specific conductivity, BOD, COD, CN^-, and oil and grease. Daily grab samples from the LWRP effluent are analyzed for gross alpha activity, gross beta activity, and tritium.

Locations

Sanitary sewer effluent samples are collected at the site sewer outfall approximately 400 m northwest of the Building 941 complex (see Fig. 5).

Requirements

The City of Livermore Wastewater Discharge Permit contains pollutant limits based on applicable Federal and State regulations.[21,24] Title 17 CCR contains discharge limitations for radionuclides.[35] The Groundwater Discharge Permit regulates the discharge of treated groundwater to the sanitary sewer.[36]

Methods

Continuous monitoring of flow and pH is done at the outfall. Flow is measured by a Poly-Level model ER586-F flowmeter. The pH probe is a Foxboro Model 1871A.

Weekly grab samples are collected manually at the outfall, upstream of the flow-measuring instrument. Monthly grab samples are also collected manually. Continuous flow-proportional samples are collected with an ISCO 3700R refrigerated sampler. All compliance samples are analyzed off-site by a State-certified laboratory. Table 5 shows the collection frequency of the various types of samples. A second flow proportional sampler collects a backup sample, which is archived until results from the original sample have been received.

Analyses

Continuous monitoring is done for pH and flow. Weekly grab samples are collected for oil and grease, and cyanide. Monthly grab samples are collected for semi-volatile organics, volatile organics, and pesticides (the organics results are compared to the TTO effluent limitation). Flow-proportional weekly composites are collected for metals, TDS, TSS, BOD, chemical oxygen demand (COD), and conductivity. These analyses are done by a State-certified contract laboratory.

7.2.4 Reporting

Semiannual categorical process reports and groundwater reports are prepared and submitted to the City of Livermore (see section 7.2.1 and 7.2.2). Sewer effluent monitoring data are reported to the City of Livermore monthly. If any substances exceeding the permit limits are detected through monitoring, the City is notified within 24 hours. These data are also summarized in the annual *Site Environmental Report*.[37]

Table 5. Sanitary Sewer Sampling Type and Frequency

Frequency	Type	Parameter	EPA Method
weekly	grab	oil & grease	413.1
weekly	grab	cyanide	335.2
monthly	grab	semivolatile organics	625
monthly	grab	volatile organics	624
monthly	grab	pesticides	608
weekly	composite	metals	200.7, 206.2, 239.2, 245.1
monthly	composite	TDS, TSS, BOD	150.1, 160.1, 160.2
monthly	composite	COD	410.4

8.0 ENVIRONMENTAL SURVEILLANCE

The goal of the Environmental Monitoring Program is to monitor the major potential pollutant release pathways from the SNL/California site. Environmental surveillance samples also provide a means of verifying the effectiveness of environmental controls (at the source). They provide valuable data for determining SNL/California's compliance with applicable environmental regulations.

The Environmental Monitoring Program also provides surveillance for detecting and quantifying unplanned releases (e.g., in case of an accident).

SNL/California monitors external radiation and liquid effluents. Table 6 shows the DOE's minimum criteria for determining a need for environmental surveillance. Table 7 summarizes SNL/California's environmental surveillance activities.

State and local authorities also require SNL/California to perform environmental surveillance, as reflected in Table 7.

In this chapter, the following are discussed for each environmental medium: the monitoring system, sample collection methods, analyses performed, reporting requirements, and quality assurance activities.

8.1 External Radiation

The public may be exposed to external radiation from nuclear facility operations. Pathways include cloud passage of airborne effluents; previously released and deposited radionuclides on soil, vegetation, or sediments; radiation-generating facilities, especially high-energy accelerators or industrial x-ray equipment and large isotopic radiation sources; and the storage or movement of large amounts of radioactive waste.

Table 6. Minimum Criteria for Determining Need for Environmental Surveillance

Topic	Criteria
Routine surveillance of all pathways (ingestion, inhalation, immersion, and submersion doses)	When feasible, all environmental media that, as determined by site-specific radiation exposure pathway analysis, might lead to a measurable annual dose of site origin at the site boundary should be routinely sampled and analyzed (for the critical radionuclides to dose) and routine measurements of penetrating radiation should be performed at those sites that, as determined by site-specific exposure pathway analysis, might result in an annual dose of site origin at the site boundary, if the total exceeds a) 5 mrem effective dose equivalent; or b) 100 person-rem collective effective dose equivalent within a radius of 80 km of a central point in the site.
Periodic confirmation	Environmental surveillance measurements may be performed periodically, but should be performed at least every five years, to confirm the low dose levels, if the projected annual effective dose equivalent of site origin is less than 0.1 mrem. The frequency and magnitude of environmental surveillance should be proportional to the potential annual dose. Where potential annual dose represents a significant fraction of the reference dose for routine surveillance, environmental sampling should be more frequent. At 20% of the reference dose (e.g., 1 mrem effective dose equivalent from emissions during a year), annual surveillance for confirmation should be considered.
Pathway measurements	Actual measurements on two media for each critical radionuclide/pathway combination, one of which might be the effluent stream, should be performed as part of the site routine effluent monitoring and environmental surveillance program.
Use of control data	Use of data should be based on statistically significant differences between the point of measurement and background (or control) data.
Unplanned releases	Provisions should be made, as appropriate, for the detection and quantification of unplanned releases of radionuclides to the environment.

Table 7. Environmental Monitoring Sampling Program

Medium	No. of Locations	Parameters	Frequency	Requiring Authority	Authority Reported to
Groundwater	28	tritium, metals, solvents, pesticides, minerals, diesel	quarterly	DOE Order 5400.1	DOE, RWQCB
Sewer	1	tritium, metals, pH, TSS, priority pollutants, cyanide, BOD, COD, TDS, oil and grease	continuously, weekly, monthly semiannually	DOE Order 5400.1, City of Livermore	DOE, City of Livermore
Storm water	9	tritium, pH, TSS, oil and grease	two storms per year	DOE Order 5400.1 State of California	DOE State of California
External radiation	40	dose	monitored continuously, analyzed quarterly	DOE Order 5400.1	DOE

The only sources of external radiation at the SNL/California site are large isotopic radiation sources used for industrial radiography operations. Thermoluminescent dosimeters (TLDs) are used to measure the dose rates near SNL/California. Dosimeters are located at the site perimeter and more distant locations near the California site. Presumably, if the Laboratory were contributing significantly to the external radiation dose, the dosimeters at the site perimeter would show a higher dose than those at more distant locations.

8.1.1 Requirements

DOE/EH-0173T contains guidance on external radiation monitoring methods.[3] Additional guidance on external radiation monitoring may be found in the U.S. Nuclear Regulatory Commission's (NRC's) Regulatory Guide 4.13[38] and ANSI-N545-1975.[39]

8.1.2 Locations

SNL/California maintains four on-site TLDs (Fig. 6). Figure 6 also shows the near-field TLD locations (maintained by LLNL), and Fig. 7 shows the distant TLD locations (also maintained by LLNL).

8.1.3 Methods

The TLDs used on-site at SNL/California are Harshaw Li-F TLD-700, high-sensitivity ribbons. Environmental Operations Department personnel collect them quarterly and send them to SNL/New Mexico, for analysis by the Health Instrumentation Division. In the field, sets of five ribbons are put in plastic vials, which are placed in waterproof, light-sealed containers at the sampling location.

The off-site TLDs are collected quarterly by LLNL's EMG and are processed by LLNL's Hazards Control Division. They are kept in mylar bags while in the field. The sampling locations have been chosen to avoid interference from large or massive objects nearby (according to U.S. NRC Regulatory Guide 4.13[38]).

The TLDs used by LLNL are Panasonic UD814 dosimeters. Each one contains three elements of thallium-activated calcium sulfate and one element of lithium borate.

8.1.4 Reporting

External radiation monitoring data are reported in the annual *Site Environmental Report*.[37]

8.0 ENVIRONMENTAL SURVEILLANCE

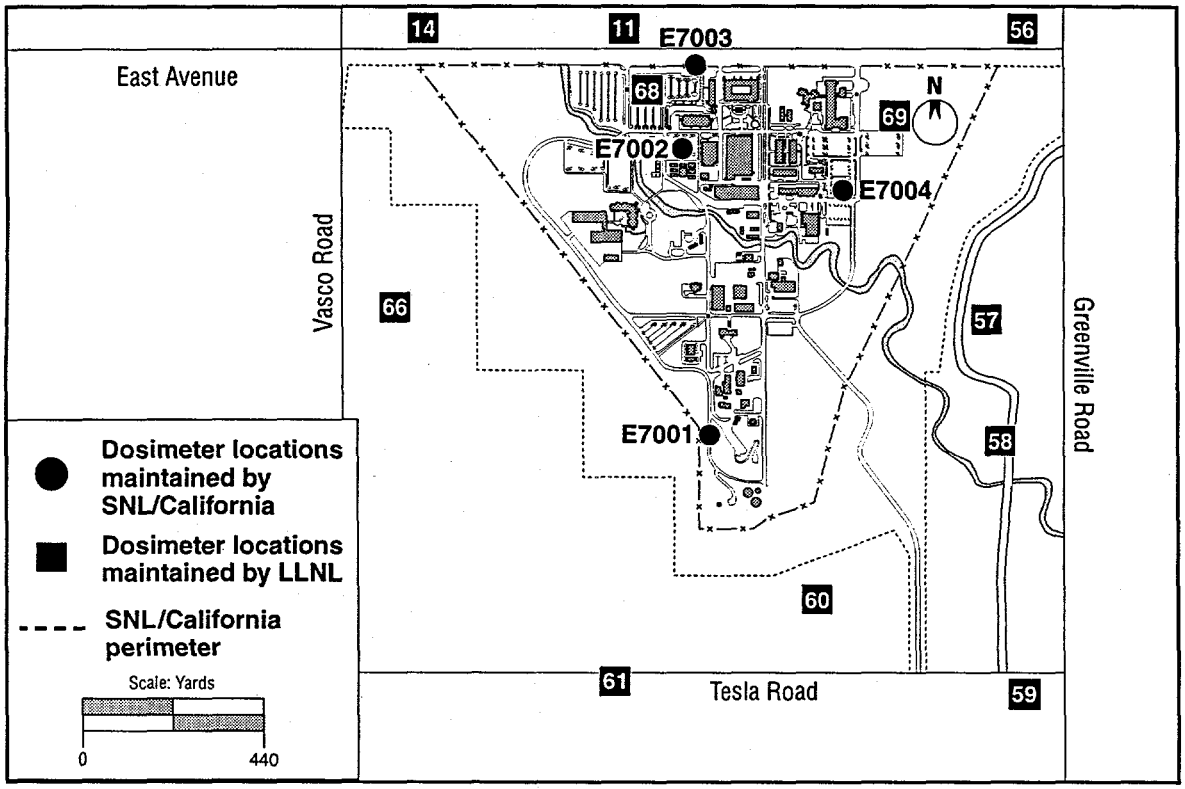


Figure 6. Near-field thermoluminescent dosimeters (external radiation monitoring).

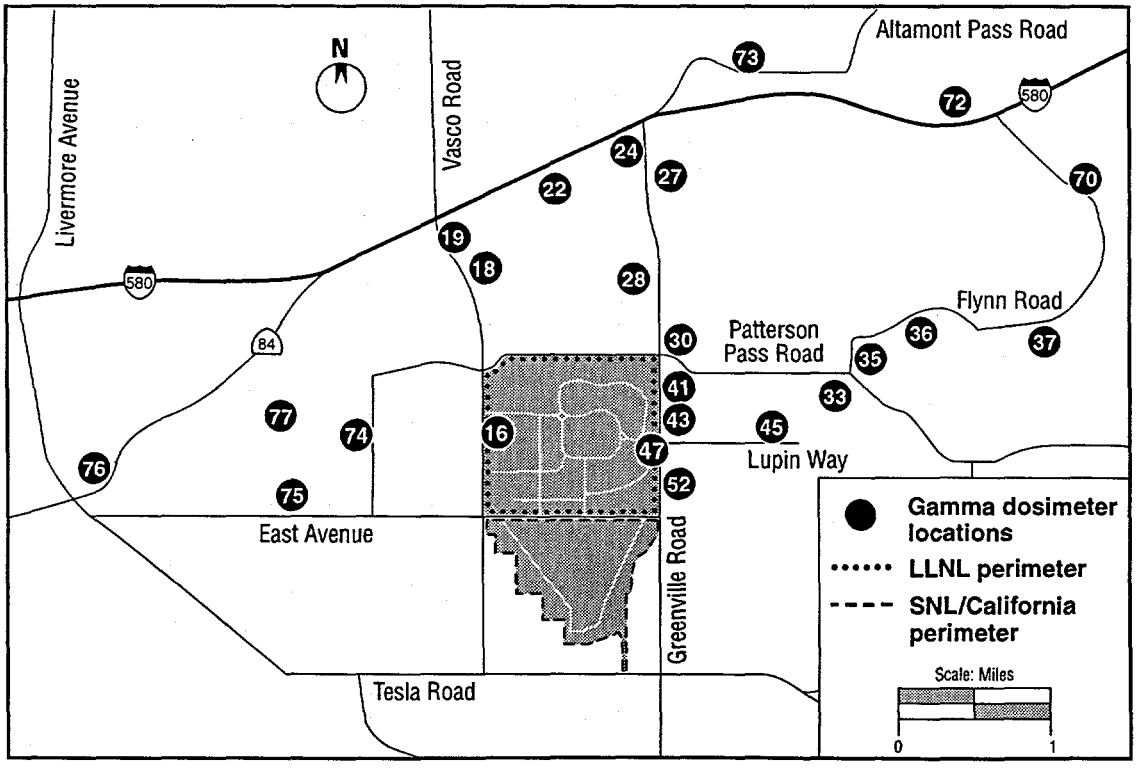


Figure 7. Locations of distant thermoluminescent dosimeters (external radiation monitoring).

8.1.5 Quality Assurance/Quality Control

Each phosphor of LLNL's TLD must read within ±5% of the other three phosphors upon calibration to be acceptable for placement in the field. Dosimeters with a known exposure are introduced as blind samples during processing of the field dosimeters. These are equivalent to spiked pseudosamples for the purpose of establishing the accuracy of the system.

Duplicate dosimeter packets are placed at random locations and are analyzed with the routine dosimeters. The dosimeters are calibrated using NIST-traceable standards.

The State of California also has TLDs at some of the LLNL and SNL/California TLD locations for use as an independent cross check. They are read by an independent contract laboratory.

Potential doses to the TLDs during collection and transit are assessed by the use of transit or trip controls.

8.1.6 Accuracy and Precision

Table 8 contains the results of the analyses of the duplicate dosimeters for 1994, which show that the precision criteria are not being met. The regression analysis shows that the duplicate dosimeters do not correlate well with the routine dosimeters. However, this discrepancy may be due to the statistical techniques used, rather than a true lack of correlation.

8.2 Storm Water Runoff

Storm water may pick up various pollutants, such as oil and grease, soil, litter, pesticides and fertilizer, as it runs off rooftops, material handling areas, parking lots, and other impervious areas on-site. The SNL/California site has a storm drain system that transports surface runoff to the Arroyo Seco directly or via a ditch along East Avenue. Generally, any flow in the Arroyo Seco during wet months discharges into Alameda Creek, which eventually flows into San Francisco Bay. During dry months, any non-storm water discharge would eventually evaporate; however, pollutants may still be transported to San Francisco Bay when the Arroyo Seco flows again.

8.2.1 Requirements

SNL/California is governed by California's General Industrial Activities Storm Water NPDES permit (general industrial storm water permit). This permit regulates storm water discharges from "industrial activities" (as defined by the EPA's November 1990 regulations). It generally requires that SNL/California does the following:

- effectively eliminates non-storm water discharges,
- prepares and implements a *Storm Water Pollution Prevention Plan* (SWPPP),[40] and
- develops and conducts a Storm Water Monitoring Program.

A City of Livermore ordinance regulates SNL/California's discharges to the municipal storm drain system. However, the City has agreed that the RWQCB is the appropriate lead agency for Federal facilities.

Two main objectives of the SWPPP are to help identify sources of pollutants discharged to the storm drain system and to describe implementation of best management practices (BMPs) to reduce the discharge of these pollutants.

Table 8. Precision and Accuracy of Thermoluminescent Dosimeter Analyses

		Regression		
Parameter	Type	correlation coefficient	slope	y-intercept
Precision:				
Penetrating radiation	field duplicates	0.67	1.01	-0.165

8.0 ENVIRONMENTAL SURVEILLANCE

The Storm Water Monitoring Program demonstrates compliance with the general industrial storm water permit conditions and allows Environmental Operations Department staff to monitor if and where pollutants are being discharged to the storm drain system. Discharge locations are generally the outfall of a pipe or open concrete channel that collects surface runoff.

If pollutants are detected at an outfall, potential sources can be identified by looking at activities done in the watershed for that outfall. BMPs must then be implemented to control the potential sources. Storm Water Monitoring Program data also may be used to evaluate and verify the effectiveness of BMPs.

Specific requirements of the Storm Water Monitoring Program are:

- wet weather (October through April) storm water sampling and analysis,
- wet weather visual observations of storm water at discharge locations,
- dry weather (May through September) visual observations of discharge locations, and
- a comprehensive annual site inspection.

8.2.2 Locations

Storm water sampling and analysis are conducted at two of the nine storm drain outfalls along East Avenue and four of the eight storm water outfalls into the Arroyo Seco (Fig. 8). Sampling locations were selected based on upstream activities that might discharge pollutants into storm water. Storm water samples are not collected from outfalls whose upstream areas comprise administrative buildings. An additional sample is collected upstream of storm water outfalls that discharge large areas. The additional samples help identify potential sources if pollutants are detected.

Storm water samples are also collected in the Arroyo Seco as it flows onto the site and immediately before it leaves the site.

All storm drain outfalls are visually inspected once during the wet season, when surface runoff results in a continuous discharge of storm water for approximately one hour or more. Visual observations help identify if pollutants, such as oil and grease or floating and/or suspended materials, are discharged with storm water.

All storm drain outfalls are inspected at least twice during the dry season to identify if non-storm water is being discharged. Visual observations are also done to detect any evidence, such as stains or odors, that may indicate a past or intermittent non-storm water discharge.

The site is inspected at least once a year to identify outdoor areas or activities that may potentially contribute pollutants to the storm drain system. The site inspection also helps determine if BMPs identified in the SWPPP are being implemented properly and are achieving the objectives of the general industrial storm water permit.

8.2.3 Methods

Storm water sampling and sample preservation is done in accordance with EPA standard methods described in Title 40 CFR, Part 136.[41] Samples are analyzed to identify the following parameters, as required by the general industrial storm water permit:

- pH
- total suspended solids
- oil and grease
- tritium (at the site outfall only)

Storm water normally is sampled twice during wet seasons, as specified in the general industrial storm water permit. Table 9 lists the allowable ranges of chemical concentrations from the locations sampled.

8.2.4 Reporting

Storm water monitoring data are reported in the SNL/California *Annual Storm Water Monitoring Report*,[42] which is submitted to the Executive Officer of the San Francisco Bay Regional

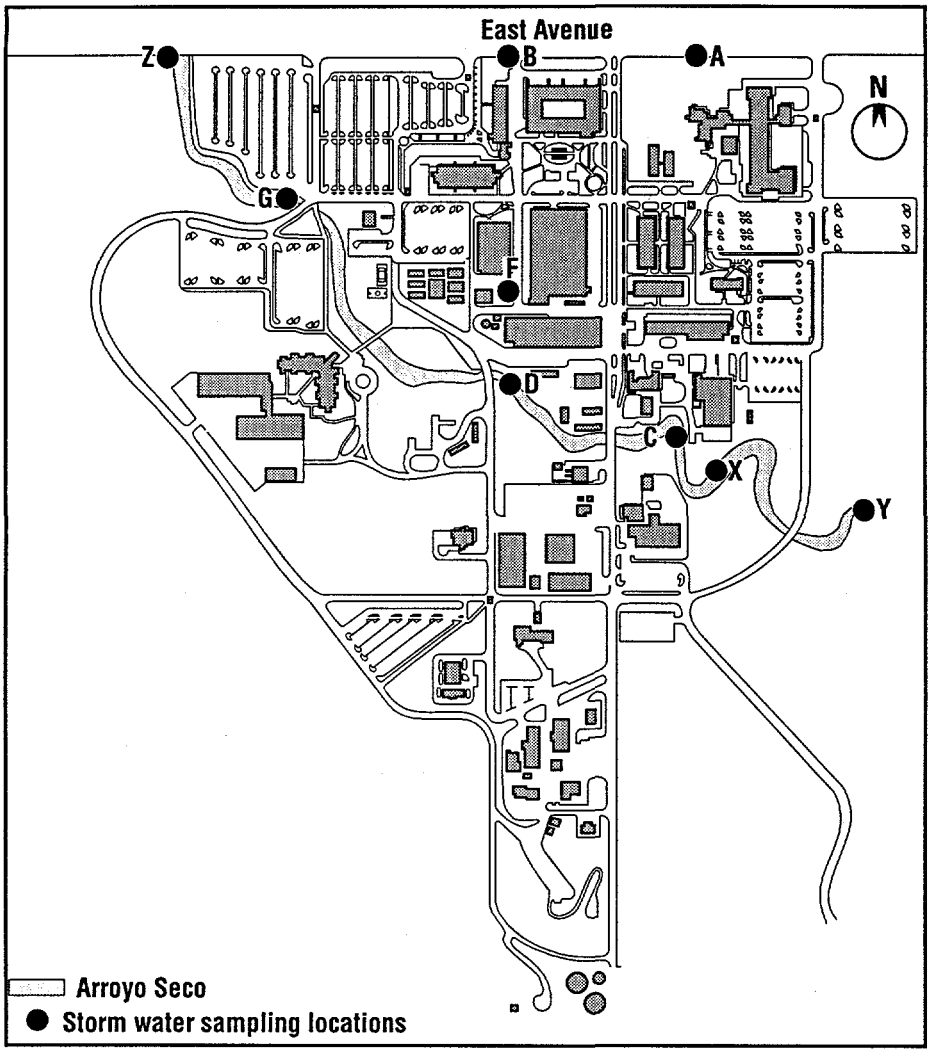


Figure 8. SNL/California site storm water sampling locations.

Water Quality Control Board (RWQCB) (by July 1 of each year) and in the annual *Site Environmental Report*.[37]

8.2.5 Quality Assurance/ Quality Control

Duplicate samples are collected at random outfalls during each storm in which a sample is collected. Blank samples also are collected to assess the potential for sample contamination.

EPA interlaboratory intercomparison samples for tritium are analyzed to verify the on-site tritium analyses.

8.2.6 Accuracy and Precision

Table 10 shows the results of the duplicate sampling program for storm water runoff. Accuracy and precision analyses cannot yet be performed because the Storm Water Sampling Program is relatively new, and insufficient data have been collected.

8.3 Groundwater

The migration of pollutants to groundwater could expose the public if the contaminated groundwater is used for drinking water or irrigation. The primary area of groundwater

Table 9. Summary of Storm Water Sampling Results

Parameter	Detected Level (Range)
pH (standard units)	6.9–8.9
specific conductance (µmhos/cm)	19–1100
total suspended solids (mg/L)	<10–4300
oil and grease (mg/L)	<5–14
semivolatile organics (µg/L)	<5–39
pesticides (µg/L)	0.04
volatile organics (µg/L)	18
total arsenic (mg/L)	<0.005
total cadmium (mg/L)	<0.005
total chromium (mg/L)	0.01–0.02
total copper (mg/L)	0.01–0.23
total lead (mg/L)	<0.05
total mercury (mg/L)	<0.0005–0.005
total nickel (mg/L)	<0.02–0.94
total silver (mg/L)	<0.01
total zinc (mg/L)	<0.01–0.71
tritium (pCi/L)	12.1–12.9

recharge on the Sandia site is the Arroyo Seco. Pollutants that could be released to the Arroyo are tritium, metals, pesticides, and priority pollutants (organics). In September 1990, SNL/California established a *Groundwater Protection Program Plan*, which details groundwater monitoring near the Sandia site.[43]

8.3.1 Requirements

DOE/EH-0173T provides guidance on the type of groundwater monitoring DOE facilities should be doing.[3] Groundwater monitoring requirements also are specified by RWQCB Orders 88-142 and 89-184 and Groundwater Permit #1513 G (1996–97, City of Livermore).[44,45,36]

8.3.2 Locations

SNL/California has established four monitoring wells along the Arroyo Seco. One of these wells is upgradient of the site (for background sampling), and the other three are downgradient (for indicator sampling).

Table 10. Storm Water Runoff Duplicate Results

Parameter	Ratio
pH	1.01
Specific conductivity	0.976
Total suspended solids	0.909

One area of known groundwater contamination exists on the SNL/California site. It is the result of a diesel fuel spill in 1975. The site is undergoing remedial investigations. SNL/California has also identified an inactive landfill onsite, but no soil or groundwater contamination has been detected in this area. Monitoring wells are located at each of these sites (Fig. 9).

Drinking water from various companies serving the Livermore Valley is also sampled. Monitoring wells near the LWRP are sampled annually to track any contamination resulting from the LWRP's past practice of discharging the sewer plant effluent to the Arroyo.

8.3.3 Methods

Each quarter, a Sandia sampling team collects groundwater samples from as many as 28 monitoring wells across the site (some wells may not be sampled if the well does not contain enough water). The wells are sufficiently purged to ensure that samples are representative of the aquifer. Sample containers, with the appropriate preservatives already added, are provided by the contract laboratory used to perform the analyses. Groundwater samples are stored on ice while in transit to the analytical laboratory.

8.3.4 Reporting

Groundwater monitoring data are reported in the annual *Site Environmental Report*,[37] quarterly groundwater monitoring reports sent to the RWQCB,[46] and semiannual groundwater discharge reports sent to the City of Livermore.

8.3.5 Quality Assurance/Quality Control

Duplicate samples are collected at a rate of approximately 10% of the sample load. Field blanks are collected by adding deionized water to the appropriate sample containers in the field, using as much of the normal sampling equipment as practical. Spiked pseudosamples are used in the laboratory as dictated by the operating requirements of the various instruments used for the sample analyses.

8.3.6 Accuracy and Precision

Table 11 shows the typical precision and accuracy estimates for the analyses done. Some of these estimates do not meet the performance goals stated earlier, but are considered the best achievable with current technology.

8.4 Meteorological Monitoring

Sandia maintains a meteorological tower on the western portion of the site (Fig. 10). This location was selected after consultation with a qualified meteorologist. The site was chosen as representative of the terrain at the release points and is clear of obstruction by any nearby structure.

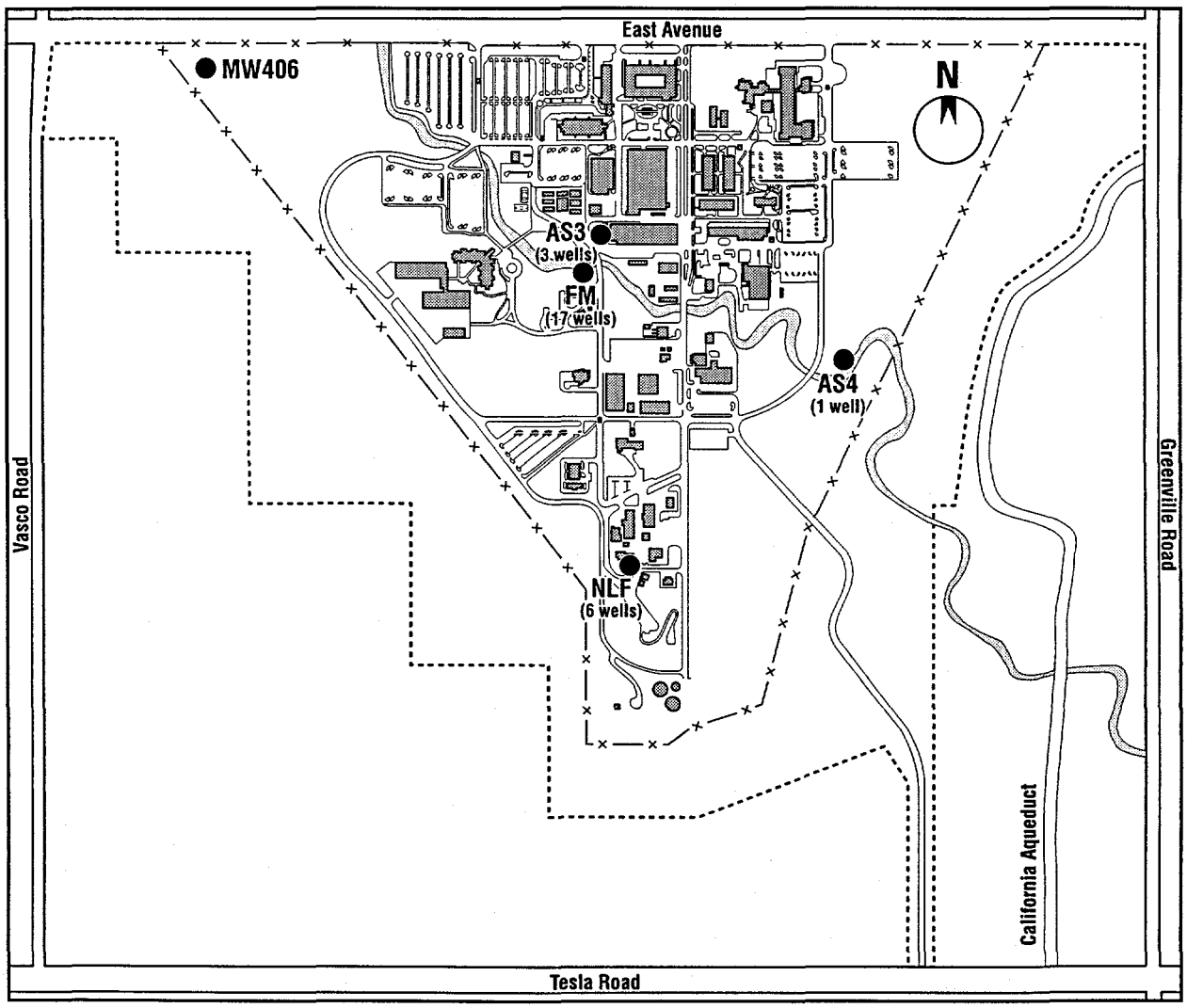


Figure 9. Groundwater monitoring wells on the SNL/California site.

8.0 ENVIRONMENTAL SURVEILLANCE

Table 11. Precision and Accuracy of Groundwater Analyses

Sample Type	Analysis Type	Percent Recovery, Typical Range
Laboratory Standards	Halocarbons (EPA 601)	70–125
	Volatile Aromatics (EPA 602)	100–115
	Total Petroleum Hydrocarbons	100–132
Matrix Spikes	Halocarbons (EPA 601)	95–133
	Volatile Aromatics (EPA 602)	100–117
	Total Petroleum Hydrocarbons	106–133
		Relative Percent Difference, Typical Range
Duplicates	Halocarbons (EPA 601)	0–9
	Volatile Aromatics (EPA 602)	0–8
	Total Petroleum Hydrocarbons	0–4

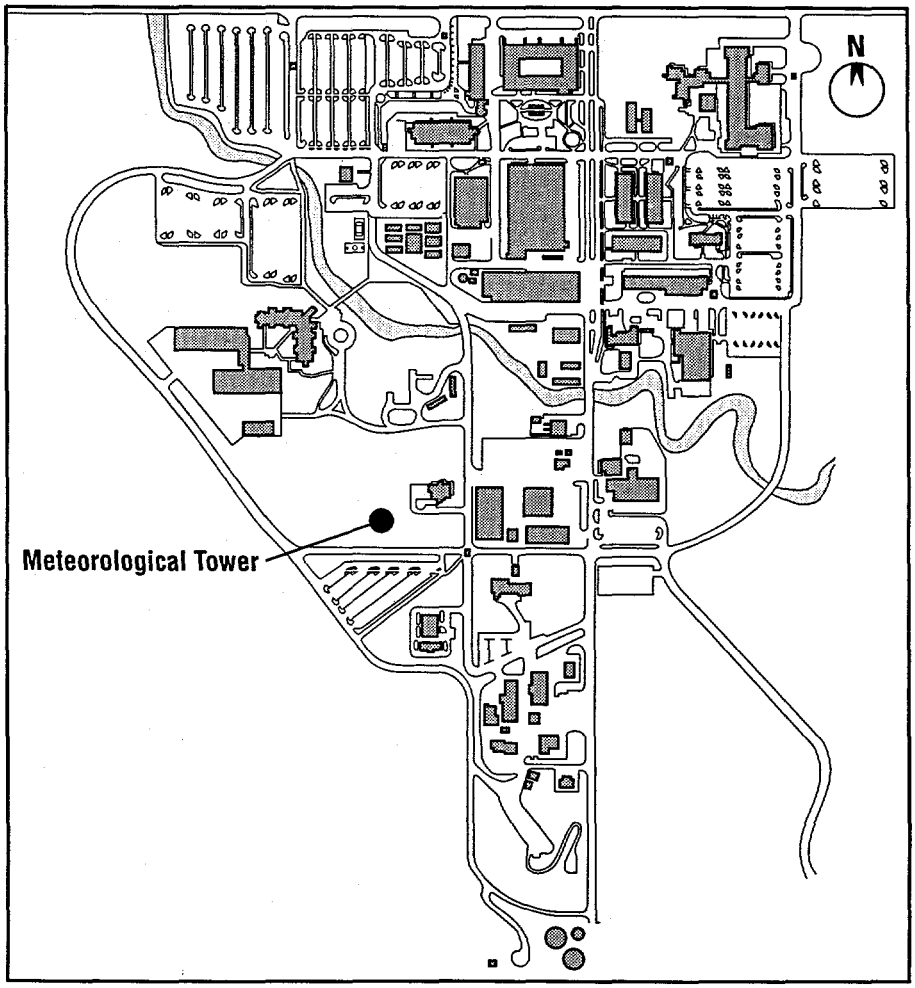


Figure 10. Location of the meteorological tower on the SNL/California site.

8.0 ENVIRONMENTAL SURVEILLANCE

The Health & Safety Department is responsible for the emergency response aspects of the program.

The meteorological system is part of the Atmospheric Release Advisory Capability (ARAC), a DOE-run network of meteorological stations designed to provide information to emergency response personnel in case of a release of radioactive or toxic materials.

ARAC provides 24-hour access to trained assessors and computer models to evaluate atmospheric dispersion and calculate doses in case of an accidental release of radioactive or hazardous materials. The system can calculate the spread of the released material from data supplied to the ARAC center by emergency response personnel. It can also use real-time meteorological data and terrain features to project surface deposition, ground-level air concentrations, and maximum radiological dose.

LLNL maintains a virtually identical ARAC tower approximately one mile north of the SNL/California tower. The existence of two towers provides both sites backup capability in case of malfunction or maintenance down-time.

9.0 LABORATORY PROCEDURES

Accurate laboratory analyses are critical to any environmental monitoring program. SNL/California's laboratory analyses include an appropriate number of blanks, duplicates, and spiked pseudosamples in order to assess accuracy and precision.

Contract laboratories used by SNL/California also must be accredited by the State of California. The State of California periodically inspects these laboratories under the State Laboratory Certification Program. The laboratories are not audited by Sandia personnel.

SNL/California performs the tritium analyses of storm water and sewer effluent.

The following sections summarize the analyses done on samples from each of the environmental media. More detailed information is available in the referenced procedures.

9.1 External Radiation

TLDs collected by SNL/California personnel are processed by the Health Instrumentation Department at SNL/New Mexico. These TLDs are stored in a lead shield until they are processed. The TLD reader used is a Harshaw model 2000 manual reader. The readout data are analyzed with software that allows the systematic and uniform processing of data for each location. The net field results are compared to the calibration values. This comparison yields the field exposure in microroentgen (μR) per hour.

The TLDs collected by LLNL personnel are processed by LLNL's Hazards Control Department using automated equipment. The TLDs are stored in a lead shield until they are processed.

9.2 Storm Water Runoff

9.2.1 Tritium

The SNL/California Health Protection Department analyzes tritium samples by liquid scintillation counting.

9.2.2 Other Analyses

The oil and grease, pH, and TSS samples are sent to a contract laboratory, where they are processed according to EPA standards.

9.3 Groundwater

Groundwater samples from the four monitoring well sites are sent to a State-certified commercial laboratory for analysis. They are processed according to EPA methods. The analyses done are EPA method 624 (volatile organics), EPA method 625 (semivolatile organics), Title 22 CCR organics, diesel, minerals, metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag), ^{226}Ra, ^{228}Ra, and tritium.

9.4 Liquid Effluent Control Systems

Samples from the LECS are sent to a State-certified laboratory for analysis. The samples are analyzed using appropriate EPA methods. Analyses are performed for regulated constituents used in the process generating the effluent.

The contents of the Bldg. 961 LECS are analyzed for radionuclides, as indicated by process knowledge.

9.5 Sanitary Sewer

All metals, organics, and physical analyses are done by a contract laboratory using standard EPA methods. Health & Safety Department personnel conduct the tritium analyses by filtering a sample of the effluent and counting for tritium by liquid scintillation.

10.0 DATA MANAGEMENT

SNL/California has developed the *Quality Assurance Management Plan* for the Center for ES&H, Facilities, and Security.[47] This plan addresses quality control, but does not specifically address data review and management practices for the portions of the environmental monitoring system under SNL/California's direct control. For this purpose, Environmental Monitoring Program personnel have written the *Quality Assurance Project Plan,*[48] the *Operating Procedure for Data Validation and Verification for the Environmental Monitoring Program,*[4] and the *Operating Procedure for Data Analysis for the Environmental Monitoring Program.*[49] These documents describe data management activities.

The Environmental Monitoring Program maintains data from the LECS analyses, storm water analyses, direct radiation, and sewer outfall analyses in an electronic database. The ES&H Records Center also keeps a hard-copy file.

11.0 RECORDS AND REPORTS

Several reports are prepared each year by the Environmental Operations Department in order to meet regulatory requirements:

- a site environmental report, prepared annually and a draft submitted to the DOE in June of the following year; this report summarizes all environmental monitoring data and all environmental activities at the SNL/California site;[37]
- quarterly groundwater monitoring reports, submitted to the RWQCB.[46] These reports are due 30 days after the end of each calendar quarter; they contain data collected from the monitoring wells at the environmental remediation sites and the wells upgradient and downgradient of the SNL/California site. Groundwater discharge reports are also prepared for the LWRP semiannually.
- semiannual categorical process reports, prepared and sent to the LWRP; these reports contain data collected from the analyses done on the liquid effluents from the metal finishing processes governed under the Federal categorical pretreatment regulations;[50]
- a monthly report on the results of the sewer monitoring program, sent to the LWRP; and
- an annual storm water monitoring report sent to the RWQCB.

Table 12 summarizes the Environmental Monitoring Program's reporting requirements.

Table 12. Summary of Routine Compliance Reports, Environmental Monitoring Program

Report Title	Frequency	Due Date	Regulator	Comments
Site Environmental Report	Annually	June 1	DOE	Required by DOE Order 5400.1
DOE Quarterly Environmental Compliance Report, SEN-7A-90	Quarterly	Dec. 14, Mar. 12, June 11, Sept. 10	DOE	Required by SEN-7A-90
Groundwater Monitoring Reports	Quarterly	Jan. 15, April 15, July 15, Oct. 15	RWQCB	Required by RWQCB
Groundwater Discharge to Sanitary Sewer	Semiannually	Jan. 20 July 20	LWRP	Required by Groundwater Discharge Permit
Semiannual Categorical Process Report	Semiannually	Jan. 20, July 20	LWRP	Required by Federal Pretreatment Standards; Title 40 CFR, Part 403.12; and LWRP Wastewater Discharge Permit
Sewer Monitoring Report	Monthly	20th of the month	LWRP	Transmittal of sewer outfall self-monitoring data
Storm Water Discharge Report	Annually	July 1	SWRCB/ RWQCB	Required by General Industrial Discharge Permit

12.0 DOCUMENT CONTROL

DOE Environmental Regulatory Guide EH-0173T requires that auditable records of the environmental surveillance and effluent monitoring programs be maintained.[3] These records are to include calculations, computer programs, procedures, and raw data.

SNL/California's *Quality Assurance Management Plan* prepared for the Center for ES&H, Facilities, and Security includes details of a document control system.[47] The system includes guidance on safeguarding, handling, and archiving documents. Each department in the National Security and Environmental Technologies Center is responsible for determining which of its records are to be classified as Quality Assurance Records.

The National Security and Environmental Technologies Center has a Document Control Center. Procedures have been written for document submittal, storage, and use. Options for dual storage are being evaluated. Environmental monitoring data were added to the system at the end of 1992.

All environmental monitoring plans, procedures, and data were designated quality assurance records during the data archiving process.

13.0 QUALITY ASSURANCE

SNL/California issued a *Quality Assurance Management Plan* in 1995.[47] It is designed to address the DOE quality assurance requirements contained in Order 5700.6C.[51] It also incorporates lessons learned in the first years of the quality assurance program. ANSI/ASQC E-4 was used to apply EPA quality requirements, where appropriate.[52]

The Quality Assurance Program will continue to be upgraded to meet new requirements and to improve existing processes.

The Environmental Monitoring Program has written a *Quality Assurance Project Plan* to describe specifically how to apply quality assurance requirements to environmental monitoring activities.[48] Several operating procedures for the Environmental Monitoring Program have been issued. They incorporate chain-of-custody procedures, quality control samples to be collected, details required for controlling "special processes" and data analysis.

Contract laboratories doing analyses for SNL/California's environmental monitoring program must be accredited by the State of California. To receive accreditation, the laboratory must have an implemented quality assurance plan. Periodically, Cal-EPA inspects accredited laboratories to make sure they are operating within quality assurance requirements.

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ARAC	Atmospheric Release Advisory Capability
ASME	American Society of Mechanical Engineers
BAAQMD	Bay Area Air Quality Management District
BOD	biological oxygen demand
CCR	California Code of Regulations
CFR	Code of Federal Regulations
COD	chemical oxygen demand
DHS	Department of Health Services
DOE	Department of Energy
EML	Environmental Measurements Laboratory (DOE)
EMSL	Environmental Measurement Systems Laboratory (EPA)
EPA	Environmental Protection Agency
ES&H	Environment, Safety and Health
HPR	Health Physics Representative
LECS	Liquid Effluent Control System
LLNL	Lawrence Livermore National Laboratory
LWRP	Livermore Water Reclamation Plant
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board
SNL	Sandia National Laboratories
TCE	trichloroethylene
TDS	total dissolved solids
TLD	thermoluminescent dosimeter
TOC	total organic carbon
TSS	total suspended solids
TTO	total toxic organics

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