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Environmental Monitoring Plan

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Prepared by
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ENVIRONMENTAL MONITORING PLAN

SAND93-8011 • UC-402
Supersedes SAND91-8013 • UC-606

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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. This revision to the Environmental Monitoring Plan was written to document the changes made to the Monitoring Program during 1992. Some of the data (most notably the statistical analyses of past monitoring data) has not been changed.

*Science Applications International Corporation (SAIC)

MASTER
Environmental Monitoring Plan

**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 under a no-profit, no-fee contract. 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; tritium 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, the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* establish environmental protec-

tion program requirements, authorities, and responsibilities.¹⁻³ These Orders stipulate that all DOE facilities will comply with Federal, State, and local environmental protection laws and regulations, and best management practices. They require an Environmental Monitoring Plan to document how Sandia will comply with these laws and regulations. This plan also documents Sandia's efforts 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 uses 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 are preparing a formal agreement defining their roles in the joint monitoring program to ensure a sound, comprehensive monitoring system.

This Environmental Monitoring Plan documents SNL/California's current monitoring system, describing its design basis and rationale. Data generated by the system are used as a basis for determining its adequacy and areas of needed improvement, which are also discussed in this Plan.

2.0 SCOPE

This Environmental Monitoring Plan has been prepared in accordance with DOE Order 5400.1 and DOE/EH-0173T, the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*.^{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. The purposes of this Plan are to:

- assess the use of hazardous and radioactive materials, their potential for release (either planned or accidental), the potential pathways for transport of the materials to the environment or the public, and the potential impact from such releases;
- identify regulatory requirements for environmental monitoring and document Sandia's compliance or plan to achieve compliance;
- specify the types of samples collected, methods of collection, methods of analysis, data interpretation and reporting; and
- provide guidance for Plan implementation.

3.0 PERFORMANCE OBJECTIVES

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

1. airborne and liquid effluent monitoring,
2. meteorological monitoring, and
3. 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. Title 40, Code of Federal Regulations (CFR), Part 61, contains regulations concerning airborne emissions of radioactive material; subpart H contains Environmental

Protection Agency (EPA) approved principles and methods for measuring airborne emissions to demonstrate compliance with the standard.⁴

Meteorological information is needed to assess the transport, diffusion, and deposition of materials released to the atmosphere. It also provides the information necessary to determine the best locations for collecting environmental samples. DOE/EH-0173T includes the types of meteorological information to be gathered by DOE facilities.³ The EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems* contains additional guidance.⁵

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 samples also help identify trends in the pollutant levels. Surveillance data provide a means of evaluating the effectiveness of pollu-

3.0 PERFORMANCE OBJECTIVES

tion 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 Additional guidance for monitoring specific environmental media may be found in other sources, such as Title 40 CFR, Part 58 (location of air samplers).⁶

SNL/California has established criteria for the acceptability of environmental monitoring data in OP-EM-9, *Data Validation and Verification*.⁷ 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 detec-

tion 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 (such as that for the siting of meteorological instruments), 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 DOE/EH-0173T, the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, specifies the necessary elements 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*—establishes requirements and standards to protect the public and the environment against radiation.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 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.⁸
5. Order 5000.3A, *Unusual Occurrence Reporting System*—establishes DOE policy and

provides instructions for reporting, analyzing, and disseminating information on programmatically significant events.⁹

6. Order 5700.6C, *Quality Assurance*—sets forth requirements and assigns responsibilities for establishing, implementing, and maintaining plans and actions to assure quality achievement.¹⁰

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.¹¹
2. Title 40 CFR, Part 58, *Ambient Air Quality Surveillance*—provides standards for State and local air monitoring stations.⁶
3. Title 40 CFR, Part 60, *Performance Standards for New Stationary Sources*—prescribes emission standards for new stationary sources of air pollution.¹²
4. Title 40 CFR, Part 61, *National Emission Standards for Hazardous Air Pollutants (NESHAPs)*—restricts substances that may cause or contribute to incapacitating or irreversible illness. Asbestos, benzene, beryllium, mercury, vinyl chloride, arsenic, radionuclides, coke oven emissions, and Radon 222 are regulated as hazardous air pollutants.⁴

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

4.0 REQUIREMENTS

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

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.¹⁷
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 board; adopts EPA standards (Title 40 CFR, Part 122–125¹³) for NPDES permitting and reportable quantities of hazardous materials.¹⁸
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.¹⁹
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.²⁰
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.²¹
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.²²

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*.²³
2. City of Livermore, Municipal Code Section 13.32, *General Discharge Prohibitions*²⁴—contains regulations concerning wastewater discharges to the sanitary sewer, including processes covered by the Federal Categorical Pretreatment Standards.²⁵ This section also contains limitations of discharge of specific pollutants.

4.5 State Oversight Agreement

In September 1990, the DOE entered into a formal Agreement in Principle (AIP) with the State of California to give California citizens independent assurance that DOE sites are fulfill-

4.0 REQUIREMENTS

ing their commitments to health, safety, and protection of the environment. DOE's policy is to comply with the State's environmental statutes and regulations. The AIP grants the State of California the authority to oversee DOE sites to make sure they are complying with regulations and using sound management practices.

To achieve the goals of the AIP, SNL/California has agreed to make all effluent and environmental monitoring data available to the State of

California. SNL/California is working with the State to develop plans for a State-run environmental monitoring program at the Livermore site. This program would serve as an independent cross-check of the SNL/California monitoring system. The monitoring requirements of the AIP are now being developed. The State monitoring plan for SNL/California will be included in updates of this Environmental Monitoring Plan, when it becomes available.

5.0 RESPONSIBILITIES AND AUTHORITY

Sandia corporate policy concerning 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 ES&H Programs and the requirements of Federal, State, and local government agencies. The Vice President, California Laboratory, has overall responsibility for ES&H at SNL/California. Responsibility for implementing the ES&H Program lies with the ES&H and Facilities Center (Organization 8600). Figure 1 shows the

organizational structure of ES&H at SNL/California.

The primary mission of the ES&H and Facilities Center 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 ES&H and Facilities 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,²⁶ is as follows:

5.0 RESPONSIBILITIES AND AUTHORITY

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

These responsibilities and authorities are detailed in the SNL/California *Environmental Protection Implementation Plan*.²⁷ This Plan documents management directives to ensure that all Sandia operations are conducted so that human health and the environment are protected.

The ES&H and Facilities Center has three ES&H departments: Health Protection, Environmental Protection, and Safety. The Health Pro-

tection Department is responsible for industrial hygiene and health physics. The Environmental Protection Department is responsible for waste management, waste minimization, environmental technology, environmental monitoring, environmental remediation, air quality, and regulatory affairs. The Safety Department is responsible for explosives control/storage, fire protection, pressure safety, occurrence reporting

5.0 RESPONSIBILITIES AND AUTHORITY

and tracking, and records management. An ES&H Quality Assurance Group reports to the Center Director and is functionally independent of the three departments.

The Environmental Protection Department is responsible for implementing this Plan. The Department Manager has the authority to provide the manpower and resources to do so effectively. Department staff ensure that emissions from SNL/California are within acceptable regulatory levels, that hazardous waste is disposed of safely and properly, and that environmentally damaging problems are solved. Each group's responsibilities are described briefly below.

5.1 Waste Management

The Waste Management Group manages hazardous, radioactive, energetic, infectious, and mixed wastes. Responsibilities include picking up, transporting, storing, and disposing of (off-site) wastes in accordance with EPA and State regulations. The Group is also responsible for employee training in hazardous waste generation, disposal, and spill control and remediation. The only waste treatment processes done on-site are compaction (to reduce waste volume), consolidation and commingling, and crushing of fluorescent light bulbs. No transuranic or high-level waste is generated at this site. No hazardous waste has ever been disposed of on-site by SNL/California. This group also does process waste assessments for major hazardous waste generators, with the goal of reducing hazardous waste generation.

5.2 Waste Minimization

The Waste Minimization Program promotes the reduction of waste generated by site operations as much as possible. It coordinates source reduction and recycling. SNL/California has appointed a waste minimization coordinator to manage this program.

The Waste Minimization Group is responsible for SNL/California's Waste Minimization Program and employee training in waste minimiza-

tion and reduction techniques. The Waste Minimization and Pollution Prevention Awareness Program represents an ongoing effort to make pollution prevention part of Sandia's operating philosophy.

Sandia follows DOE's policy of waste reduction—adopting a hierarchical approach. Waste must first be eliminated or minimized through source reduction. If possible, waste materials that cannot be eliminated or minimized are recycled (reused or reclaimed). All waste is treated to reduce volume, toxicity, or mobility before storage or disposal.

5.3 Environmental Technology

The Environmental Technology Group is responsible for a wide range of environmental support activities, including environmental chemical analyses, on-site laboratory quality assurance (ES&H laboratory), and development of a site-wide chemical information management system. This system is designed to help SNL/California more effectively comply with Federal and State regulations and DOE Orders. The system is a database that tracks chemical containers in facilities by bar-code labels. It provides detailed information to several programs: Employee Right-to-Know, Emergency Planning and Community Right-to-Know, Waste Minimization, Spill Information and Emergency Preparedness, Fire Protection, and California Proposition 65 Compliance.

5.4 Environmental Monitoring

The Environmental Monitoring Group verifies that SNL/California complies with all Federal, State, and local regulations and DOE Orders governing emissions to the environment. The group monitors airborne effluents, wastewater discharges, and the general environment of the Laboratory and vicinity to verify compliance with established safety standards. The group prepares numerous reports (including this Environmental Monitoring Plan), permit applications, and other documents to demon-

5.0 RESPONSIBILITIES AND AUTHORITY

strate compliance with various environmental regulations and DOE Orders. The group also provides training to the line organizations on issues concerning discharges to the air and sanitary sewer.

5.5 Environmental Remediation

The Environmental Remediation Group identifies, assesses, and treats past hazardous material releases on-site. The group's primary focus is to fulfill SNL/California's responsibilities under the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*;²⁸ however, it also addresses other environmental problems. This group is responsible for the underground storage tank program. SNL/California has two active environmental remediation sites: the Fuel Oil Spill site and the Navy Landfill. The Fuel Oil Spill site is undergoing preliminary tests in preparation for cleanup via bioremediation. A report on the Navy Landfill

has been submitted to the State. The Environmental Remediation Group also samples wells throughout the site to monitor the condition of the groundwater.

5.6 Air Quality

The Air Quality Group is responsible for the regulatory compliance of all air emission sources at the SNL/California site. The group obtains permits or exemptions for all emission sources, as applicable. It also works with managers to formulate strategies to achieve regulatory compliance.

5.7 Regulatory Affairs

The Regulatory Affairs Group examines new projects/activities for compliance with the National Environmental Policy Act (NEPA). Proposed changes to existing conditions are evaluated to minimize their impact on the environment, workers, and the public.

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 2 shows the location of SNL/California in the San Francisco Bay Area.

The SNL/California site covers 1.7 km² (413 acres). 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 Dia-

blo 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 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.

Figure 2. SNL/California in a regional setting.

6.0 SITE BACKGROUND

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 Livermore 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. Continuing investigations in the area have been impeded because the extended drought has lowered the water table.

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/California³⁰:

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 solstitialis*), Russian thistle (*Salsola kali*), doveweed (*Eremocarpus setigerus*), alfalfa (*Medicago sativa*), sweet fennel (*Foeniculum vulgare*), coast sagebrush (*Artemisia 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*

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racemosa), valley oaks (Quercus lobata), red willows (Salix lasiandra), mule fat (Baccharis viminea), seaside heliotrope (Heliotropium curassavicum), curly dock (Rumex crispus), and tree tobacco (Nicotiana 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 chrysolepis).

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 California

tiger salamander (Ambystoma tigrinum californiense) and the red-legged frog (Rana aurora draytoni), which are candidates for listing.³⁰

There are 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. The California tiger salamander and the red-legged frog probably do not exist on-site because ponded water does not last long enough. However, this hypothesis has not been verified by investigations during the rainy season.

6.1.6 Archaeological and Cultural Resources

A cultural resources overview³¹ and assessment³² were done in 1990. 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 3 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.

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The SNL/California site is bordered on the east by 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 Vasco Road. A low-density, single-family residential subdivision 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 2000 ft. west of

Figure 3. Predominant land uses around the SNL/California site.

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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 operation of these boilers. These permits are revised and reissued annually.
2. *Degreasers*—SNL/California operates seven equipment degreasers and cleaners. The solvents used in these degreasers are 1-1-1 trichloroethane and methylene chloride. The BAAQMD has

Table 1. SNL/California Facilities

Bldg. #	Description/Use	Sq. Ft.	Bldg. #	Description/Use	Sq. Ft.
904	Auditorium	5,110	966	High Pressure Test Facility	7,750
905	Combustion Research Facility (CRF)		967	Tritium Research Laboratory (TRL) Office	4,580
	Offices	25,050	968	TRL	15,760
906	CRF Labs	16,430	969	TRL Mechanical Assembly	2,760
907	Mechanical Building	4,480	970	Energy Conversion Laboratory	4,700
910	Weapons Laboratory Building	86,540	971	Laboratory	720
911	Personnel, Medical, Purchasing	20,100	972	Centrifuge and Laboratories	9,000
912	Offices, Services, Computer Center	122,910	973	Firing, Support Labs, and Offices	6,190
913	Model Shop, Test Assembly, Labs	85,840	974	Explosive Assembly	130
914	NDE, Applied Mechanics Labs	24,510	976	Gas Applications and Systems Facility	3,530
915	Steam Plant	3,090	977	Storage and Laboratory	1,450
916	Laboratories, Offices	40,530	978	Explosive Test Facility	3,280
917	Pump House	520	979	Component Development Laboratory	4,700
918	Reclamation	6,120	981	Explosives Shipping and Receiving	180
919	Welding Laboratory	800	982	Explosives Packaging Storage	260
920	Offices	12,240	983	FTU Assembly	1,670
921	Offices and Library	12,240	M03	Facilities Management Offices	5,780
922	Offices	12,240	M14	Office and Control Room	520
923	Radiography Facility	3,880	M15	Support	520
924	Heat Treatment Laboratory	800	M16	Support	520
927	Warehouse	22,840	M17	Field Office	520
928	Shipping, Receiving, Stores	27,650	M22	ETV	2,160
940	Integrated Manufacturing Technology Laboratory (IMTL) Offices	17,662	M23	Offices	2,160
941	IMTL	31,870	M24	Health Protection Department, Offices	3,360
942	IMTL	26,000	M25	Electronics Laboratories	3,120
943	IMTL	7,200	M26	CRF Technical Support	1,440
955	Environmental Test Facility	4,170	M27	Uncleared Offices	4,800
956	Dynamic Test Facility	2,580	M28	Instrument Issue and Repair	1,440
961	Decontamination and Storage Facility	3,660	M29	Environmental Prot. Department, Offices	1,440
962	Maintenance Landscape Shop	560	M30	Center for Computational Engineering	1,440
963	Maintenance Shops	11,940	M40	Environmental Prot. Department, Offices	1,440
964	Security Building	10,620	M41	ES&H Department, Offices	1,440
					Total 748,942

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issued permits for these degreasers.

These permits are revised and reissued annually.

3. *Paint Spray Booth*—SNL/California operates one paint spray booth, which has been permitted by the BAAQMD. This permit is revised and reissued annually.
4. *Tritium Research Laboratory (TRL)*—Stack emissions of tritium from experimental operations and the low-level tritium evaporator averaged 1061 Ci/year during 1986–90. The evaporator (only) is permitted by BAAQMD for tritium emissions of up to 100 Ci/year. Limits for the total amount of tritium released from the TRL are based on DOE and EPA (NESHAPs) regulatory limits on dose delivered to the public.⁴ Due to pollution abatement systems and administrative controls, actual emissions are a small fraction of the regulatory limits.
5. *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.
6. *Printed Wiring Facility*—This laboratory 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.²⁵ The LWRP also independently samples and analyzes the effluents from these processes.
7. *Electroplating Laboratory*—This laboratory contains dip and rinse tanks containing the following materials: hexavalent chromium, gold, and cyanide. All liquid effluents from this laboratory are directed to a doubly-contained and leak-monitored sump beneath the floor in the laboratory. The contents of the sump are treated by ion-exchange to remove metals and then are analyzed before being transferred to a LECS. The contents of the LECS are also analyzed before being released to the sanitary sewer. In addition, effluents are analyzed biannually under the requirements of the Federal Categorical Pretreatment Regulations.²⁵ The LWRP also independently samples and analyzes the effluents from these processes.
8. *Incinerator*—The incinerator has been used to burn classified documents, film, and biomedical wastes. It is fueled by diesel oil. It is permitted by the BAAQMD. It is now non-operational, pending issuance of a RCRA Part B permit.
9. *Printing*—SNL/California has two printing presses on-site. An exemption request for one press and a permit application for the other have been submitted to the BAAQMD.
10. *Explosives Testing*—Small-scale testing of explosive devices is conducted in

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enclosed test cells. The BAAQMD has exempted these operations from permitting requirements.

11. *Radiography*—Isotopic gamma ray sources (^{60}Co and ^{192}Ir) and x-ray-producing machines are used in Building 923. 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.
12. *Combustion Research Facility*—This facility houses research-scale studies of combustion processes, including research on internal combustion engines.
13. *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.
14. *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.
15. *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.

Appendix A lists the permits held by SNL/California for discharge of effluents, the regulated substance for each discharge, and the regulatory agency and regulations governing each discharge.

Table 2 lists unsealed radioactive sources at SNL/California. Sealed sources are not included on this list because they do not pose a risk of releasing radioactive materials. These sealed sources are checked for leakage biannually.

6.4 Pathway Analyses

To assess the impact of pollutant discharges to the environment, we must estimate the concentration of the pollutant(s) in different environmental media and human exposure to those media. We can use several assessment methods: dispersion theories, empirically derived transfer factors, direct measurement of pollutant concentrations in environmental media, and human habits and activities (e.g., land use, recreation). Complete understanding of pollutant movements in the environment is limited by the inherent variability of natural systems and by the difficulties of measuring all the potential variables at all locations. Potential sources of error and uncertainty in the assessment are due to theoretical omissions or oversimplifications, natural variability in the process modeled, and errors of measurement or extrapolation.

A source term (amount of pollutant(s) released) must be developed for input into dispersion calculations. We can then assess the dispersion, transfer, measured concentrations, and habits to determine the critical pathways of exposure to the public. The input into and output from our pathway analysis methods are shown in Fig. 4.

Table 2. Unsealed Radioactive Sources

Isotope	Approximate Activity (Ci)	Half-life (years)
^{210}Po	—	0.38
^{133}Ba	1×10^{-5}	10.7
^{207}Bi	5×10^{-5}	38
^{14}C	5.3×10^{-4}	5730
^3H	1.8×10^5	12.3
^{85}Kr	1.38	10.7
^{147}Pm	10.2	2.6
^{106}Ru	1×10^{-5}	1
^{204}Tl	2.75×10^{-4}	3.8
^{57}Co	8×10^{-3}	0.74
^{55}Fe	0.11	2.7
^{238}U	<30 kg (total)	5×10^9

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Figure 4. Pathway analysis input and output, the Environmental Surveillance Program.

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6.4.1 Source Term

Hazardous Chemicals

Several small, research-scale laboratories at SNL/California use small quantities of hazardous chemicals. The airborne and liquid emissions from these have been evaluated. As necessary, emissions are controlled under the provisions of permits granted by regulatory authorities (see Section 6.3). If no permit is required, the appropriate regulatory agency has issued a written exemption. These sources are not monitored further.

The emissions from air-pollution-producing operations (e.g., boilers, printing presses, painting) have also been evaluated. Permits or exemptions have been obtained as necessary (see Section 6.3). These sources are not monitored further.

The only area of known environmental contamination at the SNL/California site is the diesel fuel oil spill site. In 1975, as a result of an accidental puncture of an underground transfer line, 59,500 gallons of diesel fuel were released from an above-ground storage tank. The fuel oil has migrated to the first water-bearing zone (aquifer), which is located about 105 feet below the ground's surface. Cleanup and restoration of this site are under way.

Another site that may be contaminated is an inactive landfill that was used by the Navy during World War II and later by LLNL in the 1950s and early 1960s. Investigations to date have revealed no hazardous material contamination.

Uranium

Depleted uranium in various forms is used at SNL/California. The only form in which it is considered hazardous is a fine powder, which can become airborne. It can then be inhaled or settle on food or water that may be ingested. Less than 30 kg depleted uranium powder is used on-site. In areas where it is used, emissions to the atmosphere are controlled by high-efficiency particulate air (HEPA) filters.

Tritium

Tritium is used primarily at the TRL. Its use and air emissions are controlled by both administrative and physical controls (see Section 7.1). TRL releases of tritium during 1986–91 averaged 1061 Ci/year to the air and 0.246 Ci/year to the sanitary sewer.

When released to the atmosphere, tritium may be found in two chemical forms: tritiated hydrogen gas (HT or T₂) and tritiated water vapor (HTC or T₂O). HT has very little dose significance because it is not absorbed by biological systems. However, HTO is chemically the same as water and can easily be absorbed into biological systems. The radiation dose for a given amount of tritium is approximately 25,000 times greater for HTO than for HT. The HTO may be inhaled, absorbed through the skin, or ingested (through plants and animals that have absorbed or ingested it). HTO may also be carried out of the atmosphere by rain, thus exposing plants and animals through root uptake or ingestion. After release, HT is converted to HTO at a rate of approximately 1% per hour.

6.4.2 Pathways

Air Exposure Pathway

A primary exposure pathway is airborne tritium that is inhaled or absorbed through the skin.

Ambient air is sampled at the SNL/California site boundary and locations in the Livermore Valley for measuring the concentration of tritium in air. The highest ambient air tritium concentration (for a two-week period) measured during 1986–91 was 448×10^{-11} $\mu\text{Ci}/\text{ml}$. The average concentration was 2.1×10^{-11} $\mu\text{Ci}/\text{ml}$.

Ambient air is also sampled for particulate uranium at the boundary of the LLNL site and the northern site boundary of the SNL/California site. The highest ²³⁸U concentration measured during 1986–91 was 14.37×10^{-5} $\mu\text{g}/\text{m}^3$. Gross alpha and gross beta activity measurements taken at all air particulate sampling locations are also useful for detecting particulate uranium.

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Air-Vegetation-Man Pathway

People may be exposed to tritium by tritium uptake into vegetation, which they subsequently consume. Therefore, vegetation in the Livermore Valley is measured for tritium concentration. Measurements made during 1986–91 indicate a maximum concentration of 80.5×10^{-7} $\mu\text{Ci}/\text{ml}$ of recovered water and an average concentration of 12.3×10^{-7} $\mu\text{Ci}/\text{ml}$.

The Livermore Valley is not a major agricultural production area. The most economically important crop in the area is wine grapes (see Section 6.2). Therefore, the pathway of greatest concern is uptake of tritium into the grapes, which is then incorporated into the wine. The highest concentration of tritium in Livermore Valley wine measured during 1986–91 was 7.4×10^{-7} $\mu\text{Ci}/\text{ml}$. The average concentration was 3.0×10^{-7} $\mu\text{Ci}/\text{ml}$.

Air-Vegetation-Goat-Milk Pathway

Although no milk cows are near the SNL/California site, human exposure may occur through the ingestion of goat milk produced on small farms in the area. Locally produced goat milk is analyzed for tritium content. The highest measured tritium concentration in goat milk during 1986–91 was 6.8×10^{-7} $\mu\text{Ci}/\text{ml}$. The average concentration was 2.0×10^{-7} $\mu\text{Ci}/\text{ml}$.

Air-Vegetation-Beef-Man Pathway

The Livermore Valley is not a major producer of meat for commercial consumption, although some beef cattle is raised in the area. This pathway is not monitored.

Air-Water-Ingestion/Immersion

There are no direct pathways for the release of tritium into water bodies from the SNL/California site. However, airborne tritium may diffuse into bodies of water or be transported into them by rainfall. Therefore, tritium is monitored in all local bodies of water.

Stormwater runoff entering the arroyos is also analyzed for metals and organics. The highest measured concentration of tritium in water near SNL/California during 1986–91 was 574×10^{-7} $\mu\text{Ci}/\text{ml}$ in stormwater runoff at LLNL. The average concentration was 2.8×10^{-7} $\mu\text{Ci}/\text{ml}$ for all water sources.

6.5 Implementation Plan

SNL/California is committed to implementing the provisions of this Monitoring Plan as expeditiously as possible. This implementation includes evaluating the recommendations for improvement and implementing those considered appropriate. Implementation depends on the following items:

- review of the adequacy of environmental sampling locations and necessary adjustments;
- addition of new sampling locations to improve monitoring of SNL/California operations—this will require coordination with LLNL because LLNL maintains the off-site sampling locations;
- upgrade of the low-level tritium analytical laboratory at LLNL—the increased number of sampling locations and analyses recommended in this Plan will require increased analytical capacity; LLNL's Nuclear Chemistry Division has already analyzed the capacity expansion needed and has completed a design of the new facilities; and
- formalization of the agreement between SNL/California and LLNL concerning off-site environmental monitoring; it will need to cover issues such as SNL/California involvement in decisions concerning the monitoring system and data transfer methods.

7.0 EFFLUENT MONITORING

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.

Effluent monitoring also alerts process operators to upsets in processes or emission control equipment. Data from effluent monitoring equipment are used to assess compliance with standards for pollutant emissions and as input into dose calculations (for radionuclides).

Sandia is committed to conducting 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 three types of effluents: airborne tritium at the TRL, process wastewater (through the LECS), and the sanitary sewer effluent (where it leaves the site and joins the sanitary sewer effluent from LLNL).

7.1 Airborne Effluents

SNL/California monitors airborne effluents that could contain significant amounts of radioactive or hazardous materials. The monitoring data are used, in conjunction with meteorological data, to calculate the maximum potential doses to members of the public from airborne tritium releases.

The only facility at the SNL/California site that could release a significant amount of airborne contaminants is the TRL. TRL emissions are monitored continuously for tritium content.

SNL/California is planning to phase out tritium operations at the site within the next five years, and following formal approval by DOE, the TRL will be transitioned to other uses. SNL/California is developing a comprehensive plan for the safe cleanup and transition of the facility. This plan will follow the guidance of DOE Order 5820.2A, Chapter V, *Decommissioning of Radioactively Contaminated Facilities*.³³ The first phase of the project includes transferring

experiments to other DOE sites, reducing the tritium inventory at the TRL to zero, and removing hazardous and radioactive wastes from the facility. This phase will include facility characterization and environmental review. The goal to eliminate tritium from the site has been set for fiscal year 1993.

7.1.1 Administrative Controls

The TRL contains a maximum of 15 g of tritium. The amount of tritium on-site is not expected to increase over the next few years. Administrative controls limit the amount of tritium in use at any given time to 15 g. Administrative controls also limit the amount of tritium that may be used in any single operation to 15 g. Operations involving more than 0.1 g tritium must be performed in a secondary containment system. The volume of low-level liquid wastes at the TRL is reduced by a low-level tritium evaporator, which has been permitted by the BAAQMD. The permit allows a maximum emission of 100 Ci of tritium per year. Effluents from the TRL are controlled by the two pollution abatement systems described below.

7.1.2 Emission Control Systems

Gas Purification System

The Gas Purification System (GPS) is designed to remove tritium-contaminated air from glove boxes used as secondary containment during operations at the TRL. The system passes the contaminated air through a precious metal catalyst system to oxidize tritium gas and organic tritium compounds to HTO, which is then collected in molecular sieve traps. The GPS achieves decontamination factors from a high of 10^5 for tritium gas (HT or T_2) to a low of 10^3 for tritiated methane (CT_4) in a single pass. The gas stream may then be routed back through the system for further decontamination, or it may be exhausted to the stack (at this point, very little tritium is left).

Vacuum Effluent Recovery System

The Vacuum Effluent Recovery System (VERS) is designed to collect tritium-contami-

7.0 EFFLUENT MONITORING

nated gases from the vacuum pumps used to collect waste gases or transfer tritium in the TRL. The collected effluents are temporarily stored in a tank, then routed through a precious metal catalyst to convert tritium gas to HTO, which is then collected in molecular sieve traps. The decontaminated gas is then routed to the facility stack.

7.1.3 Requirements

DOE regulates the discharge of radionuclides to the air through DOE Order 5400.5 and DOE/EH-0173T.^{2,3} DOE Order 5400.5 establishes the maximum allowable concentration of radionuclides in ambient air. DOE/EH 0173T requires continuous monitoring of all emission sources that could result in an effective dose equivalent to any member of the public of 0.1 mrem per year or greater.

The EPA regulates the discharge of radionuclides to the air through NESHAPs.⁴ NESHAPs limit the total dose to any member of the public to 10 mrem per year. This regulation also

requires continuous monitoring of all emission sources that could result in an effective dose equivalent to any member of the public of 0.1 mrem per year or greater.

The BAAQMD has the authority to regulate all sources of air emissions. Permits or written exemptions have been obtained for all air emission sources at the SNL/California site (see Section 6.3).

7.1.4 Stack Monitoring System

The stack monitors are designed to collect and analyze a sample of the TRL effluent before it is released to the atmosphere (Fig. 5). The extraction port is located approximately 50 ft. up the height of the TRL stack. The extraction manifold comprises six ports spaced across the diameter of the stack. These ports are downstream of the last major flow obstruction (the fans) in order to provide a representative sample. No other obstructions exist between the sampling ports and the release point.

Figure 5. Tritium Research Laboratory stack monitoring system.

7.0 EFFLUENT MONITORING

The sample line is routed along the stack, then back into the TRL. It is not heated, but condensation is not a problem because the exhaust gases are always at ambient temperature. The sample is passed through two ion chambers for real-time monitoring of tritium. It is then passed through an ethylene glycol bubbler for integrative monitoring (to determine the total amount released).

7.1.5 Methods

The two ion chambers (one low-level and one high-level) provide real-time monitoring for tritium. These monitors have three alarm settings:

Low: 40 $\mu\text{Ci}/\text{m}^3$. At this level, the Health Physics Representative (HPR) and TRL personnel respond to determine the source of the problem.

Intermediate: 4 mCi/m^3 . An alarm at this level warns operations personnel that stack and room air concentrations are increasing.

High: 40 mCi/m^3 . An alarm at this level indicates a serious, but not necessarily hazardous, condition. The HPR and TRL operations personnel must determine whether room air or some other source is causing the problem.

The ion chambers cannot discriminate between HT and HTO. The ethylene glycol bubbler is used to provide this capability and integrative totals of low-level releases. The gas is first passed through three ethylene glycol bubblers, which collect HTO. It is then passed through a precious metal catalyst which converts the remaining HT to HTO, which is then collected on the next three bubblers.

7.1.6 Analyses

The only additional analysis required is the determination of the tritium content of the ethylene glycol. The HPR (a member of the Health Protection Department) does this by preparing a sample of the ethylene glycol for liquid scintillation counting. The TRL HPR maintains monitoring data in a computerized database. The data are reported to the Environmental Protection Department.

7.1.7 Reporting

The Health Department prepares an internal SNL report, the *Tritium Research Laboratory Quarterly Health Physics Compliance Report*, which is sent to DOE.³⁴

The Environmental Protection Department prepares an annual *DOE Effluent Information System Report*, in accordance with DOE Order 5400.1.^{35,1} This report is sent to the DOE Waste Information Systems Branch.

The Environmental Protection Department also prepares an annual report detailing SNL/California's compliance with NESHAPs.⁴ This report is sent to the EPA.

Stack monitoring data are summarized and reported in the SNL/California annual *Site Environmental Report*,³⁶ which is prepared and sent to DOE by the Environmental Protection Department. This report is also available to the public.

7.1.8 Quality Assurance/Quality Control

The ion chambers are calibrated annually. Semiannual performance checks are also made. The liquid scintillation counter is calibrated according to the manufacturer's specifications. The calibration schedule and procedure meet the requirements of DOE-EH0173T.³

7.1.9 Recommendations

The stack flow gauge and the sampler velometer have been calibrated only once (in 1992) since they were installed. TRL personnel have stated that the stack flow sensor will be placed on a yearly calibration cycle.

7.2 Liquid Effluents

SNL/California has established the following policy for wastewater discharges:³⁷

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 (Electroplating and Printed Wiring Laboratories) must comply with Federal Pretreatment Standards.

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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, the Environmental Protection Department may grant a special allowance to discharge the liquid as long as liquid concentrations are below the EPA's criteria for Best Available Control Technology (BAT). If LECS wastewater exceeds the BAT concentrations, and treatment is not possible, the liquid must be disposed of as 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 Liquid Effluent Control Systems (LECS)

Liquid effluents from selected SNL/California operations (those that could release pollutants) are routed to the LECS. The LECS provides a source control mechanism to ensure that liquids discharged to the sanitary sewer comply with applicable regulations and sound management practices. The LECS comprises 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 greater than administrative limits, then the liquid is disposed of as hazardous waste.)

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

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.^{3,24} LECS are not required by any regulations, but Sandia has established them to provide better control of liq-

uid effluents and to ensure compliance with regulatory discharge limits. Table 3 lists the site sanitary sewer outfall discharge limits for specific pollutants.

Locations of LECS

Figure 6 shows the locations of the LECSs at the SNL/California site.

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

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 tanks.

Bldg. 910—process wastewater is routed from the Printed Wiring Facility to a LECS consisting of one tank.

Bldg. 961—water from decontamination operations is routed to a LECS.

Table 3. Specific Pollutant Limitations^a

Pollutant	Concentration Limit ^b
Arsenic	0.06 mg/l
Cadmium	0.14 mg/l
Copper	1.0 mg/l
Chromium (total)	0.62 mg/l
Lead	0.20 mg/l
Mercury	0.01 mg/l
Nickel	0.01 mg/l
Silver	0.61 mg/l
Zinc	3.00 mg/l
Cyanide	0.04 mg/l
TTO ^c	1.0 mg/l
pH	6–9
Fat, oil, or grease	100 mg/l
TDS ^d	325 mg/l
BOD ^{e,g}	300 mg/l
TSS ^{f,g}	300 mg/l

^aThese 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.

^b1 mg/l is equivalent to 1 ppm (parts per millions).

^cTTO = total toxic organics

^dTDS = total dissolved solids

^eBOD = biological oxygen demand

^fTSS = total suspended solids

^gAdvisory limit only

7.0 EFFLUENT MONITORING

Figure 6. Locations of the Liquid Effluent Control Systems on the SNL/California site.

Bldg. 906—process wastewater is routed to a LECS.

Bldg. 941—this facility and its LECS were officially opened in October 1992. The LECS comprises two tanks. Analyses will be done for process constituents.

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 waste before its contents are properly disposed of.

To assure that a representative sample is collected, the contents of the tanks are agitated by

recirculation or by air being bubbled through them before they are sampled.

Analyses

Environmental Protection Department personnel analyze the contents of the LECS (by ACP/IES) using equipment owned and maintained by the Inorganic and Physical Chemistry and Environmental Protection Departments. All LECS 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).

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The Electroplating Laboratory in Bldg. 913 and the Printed Wiring Laboratory in Bldg. 910 are also subject to the Federal Categorical Pretreatment Standards.¹⁶ Grab samples are collected semiannually. They are analyzed for the following parameters: pH, oil and grease, total dissolved solids (TDS), total suspended solids (TSS), biological oxygen demand (BOD), As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, CN⁻, and total toxic organics (TTO), (which consists of the EPA organic priority pollutants). The sample from the Electroplating Laboratory is collected from the doubly-contained, leak-monitored, polyethylene floor sump after treatment by ion exchange to avoid dilution effects from other processes discharging to the LECS. The sample from the Printed Wiring Laboratory is collected directly from the LECS because no other processes discharge to this LECS.

Quality Assurance/Quality Control

The Environmental Protection Department is formalizing the Wastewater Program Plan,³⁷ which includes procedures for collecting and analyzing samples from the LECS. The draft procedures address quality assurance and control issues.

7.2.2 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. 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, 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 IMTL (Fig. 7).

Requirements

The City of Livermore Wastewater Discharge Permit contains pollutant limits based on applicable Federal and State regulations.^{37,20} DOE Order 5400.5 contains discharge limitations for radionuclides.²

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 Lakewood Instruments model 1020.

Weekly grab samples are manually collected at the outfall upstream of the flow-measuring instrument. Monthly grab samples are also collected manually. Continuous flow-proportional (composite) samples are collected with an ISCO

Table 4. LECS Wastewater Analyses

LECS	Analyses
B. 913	pH, As, Cr, Cu, Ni, Zn, CN ⁻
B. 910	pH, As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn
B. 968	pH, ³ H
B. 961	pH, As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, ³ H, ²³⁸ U
B. 906	pH, As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn
B. 941	The wastewater from this facility will be analyzed for process constituents

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Figure 7. SNL/California sanitary sewer system.

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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. If large enough samples are collected, a portion is retained for archive purposes until the analytical results 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, pH, chemical oxygen demand (COD), specific conductivity, and tritium. These analyses are done by a State-certified

contract laboratory, except for the tritium analysis, which has been approved for in-house analysis.

Reporting

Semiannual categorical process reports are prepared and submitted to the City of Livermore. They contain data generated from monitoring. Sewer effluent monitoring data are reported to the City of Livermore monthly. If, through monitoring, any substances exceeding the permit limits are detected, the City is notified within 24 hours. These data are also included in the annual *Site Environmental Report*.³⁶

7.2.3 Quality Assurance/Quality Control

The Environmental Protection Department is formalizing its sampling and analysis procedures, which will address quality assurance and control.

7.2.4 Recommendations

Flow-proportional composite sampling is required daily; however, the amount of flow in the sewer line is sometimes insufficient (especially on weekends) for the automatic sampler to collect a sample. The permit requirements should be renegotiated or the sampler should be modified to collect samples during low flow conditions (if possible).

For the archive samples, a set volume is removed from each aliquot of the sample—not a flow-proportional amount; therefore, the remaining sample (which is used for the regular analyses) is no longer flow proportional. The entire sample should be composited before the archive sample is taken or a second sampler should be installed at the same sampling point for the sole purpose of collecting the archive sample.

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	semi-volatile organics	625
monthly	grab	volatile organics	624
monthly	grab	pesticides	608
weekly	composite	tritium	—
weekly	composite	metals	200.7, 206.2, 239.2, 245.1
weekly	composite	TDS, TSS, BOD, pH, COD, specific conductivity	150.1, 160.1, 160.2, 405.1 410.4

8.0 METEOROLOGICAL MONITORING

8.1 Introduction

Environmental protection activities* require meteorological information representative of conditions at SNL/California. This information is needed for assessing the transport, diffusion, and deposition of materials released to the atmosphere by SNL/California operations.

The meteorological information requirements also are related to the magnitude of potential source terms, the nature of potential releases, possible pathways to the atmosphere, and distance from the release points to the critical receptors (the public).

DOE recommends that the data be collected at a location that represents the atmospheric conditions at the release point. Topography, prevailing wind direction and obstructions should be considered in siting and installation of meteorological instruments. Data should be recorded by two separate systems, at least one of which should be digitally controlled. The instrument output should be continuously displayed in an area where instrument performance can be monitored regularly.

8.2 Requirements

DOE/EH 0173T states that every DOE site should establish a meteorological monitoring program appropriate to the site.³ The following factors should be considered: magnitude of potential source terms, possible pathways to the atmosphere, and distance to critical receptors. The DOE Guide also specifies operating sensitivities and accuracies for meteorological sensors.

The EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems* contains guidance on the siting, operational, and QA requirements for meteorological monitoring systems.⁵

Meteorological data are also required as input to computer models for determining compliance with NESHAPs.⁴

8.3 Description

Sandia maintains a meteorological tower on the western portion of the site (Fig. 8). 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.

The Environmental Protection Department is responsible for maintenance, calibration, and data archiving. The Health Protection 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. Figure 9 is a schematic diagram of the ARAC system for SNL/California.

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 an 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.

8.4 Methods

SNL/California's tower is instrumented with HANDAR model 540 instruments (the instruments specified by the ARAC system). Measurements for wind speed, wind direction, and tem-

*These activities include the assessment of impacts of planned and unplanned airborne releases on public health and safety, and the demonstration of compliance with applicable Federal, State, and local laws, regulations, and orders.

8.0 METEOROLOGICAL MONITORING

Figure 8. Meteorological tower on the SNL/California site.

perature are made at the 10-m and 40-m levels to provide the necessary vertical temperature profile required by the ARAC models. The instruments are mounted on booms extending from the sides of the tower. These booms are oriented so as to minimize the influence of the tower on measurements under the most prevalent wind conditions (the wind hits the sensor before it hits the tower). The instruments are polled every second, and 15-minute averages are calculated by the HANDAR 540A data logger. Table 6 describes the instrumentation.

The Environmental Protection Department is responsible for managing the meteorological data. Data are transferred from the data logger over telephone lines to the site ARAC system, which is in the basement of Building 964. The data are stored on the system hard disk, which

makes them available for modeling purposes. Because the storage capacity of the hard disk is limited, the data must be archived onto diskettes monthly for permanent recordkeeping. One month's accumulation of data is stored on each diskette. A duplicate copy of the diskette is sent to a separate location for retention as a backup. A minimum of three weeks' worth of data is maintained on the hard disk at all times.

Data from the tower are electronically sent to the ARAC system for emergency modeling purposes. Sandia is obtaining software that will improve the usefulness of the meteorological data for environmental surveillance purposes.

These data and the stack monitoring data are used in the AIRDOS-EPA code for calculating off-site doses. Meteorological data are also used for emergency response, studies in the climatol-

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Figure 9. Configuration of the site ARAC system.

Table 6. HANDAR Instrumentation of the Meteorological Tower

Parameter	Instrument	Threshold	Mfr.'s Stated Accuracy	DOE Accuracy Requirements	Other Requirements
Wind Speed	HANDAR540-430A	≤ 0.77 m/s	± 0.5 m/s or $\pm 5\%$	± 0.22 m/s (< 2.2 m/s), $\pm 10\%$ (> 2.2 m/s), threshold < 0.5 m/s)	n/a
Wind Direction	HANDAR540-431A	0.77 m/s	$\pm 5^\circ$	$\pm 5^\circ$, delay distance < 2 m	Distance constant 2.4 m
Temperature	HANDAR540-432A	n/a	$\pm 0.2^\circ\text{C}$ ($> 0^\circ\text{C}$) $\pm 0.6^\circ\text{C}$ ($< 0^\circ\text{C}$)	$\pm 0.5^\circ\text{C}$, $\pm 0.15^\circ\text{C}$ per 50 m for temperature difference measurements	n/a
Data Logger	HANDAR540-S1-ARAC	n/a	n/a	n/a	n/a
Site Computer	DEC PC380	n/a	n/a	n/a	n/a

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ogy of the Livermore Valley, and plant engineering and research needs. The collection of meteorological data is required to demonstrate compliance with DOE and EPA regulations. For this report, the meteorological data were also used as an aid in designing an environmental monitoring network.

8.5 Reporting

Meteorological data are not reported directly to a regulatory agency. They are used to calculate the estimated dose to the public from SNL/California site operations, which are reported in the annual *Site Environmental Report* (to include a summary of the meteorological data).³⁶

8.6 Quality Assurance / Quality Control

The meteorological instruments are calibrated semiannually by the U.S. Bureau of Land Management.³⁹

The Environmental Protection Department is responsible for timely review of the data for general reasonableness and acceptability.

The Environmental Monitoring Program personnel have prepared a draft Meteorological Monitoring Plan and draft Operating Procedure. These documents describe how SNL/California's meteorological monitoring system complies with regulations and give detailed procedures for operating and calibrating the system.

Because LLNL has an identical meteorological monitoring tower, SNL/California does not need redundant data storage. If the SNL/California tower is non-operational for any length of time, LLNL data can be used.

9.0 ENVIRONMENTAL SURVEILLANCE

The goal of the Environmental Surveillance Program is the ability to detect the impact of pollutant releases on and around the SNL/California site and to detect the buildup of pollutants in the vicinity. 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 Surveillance Program monitors the critical exposure pathways (as identified in Section 6.4), based on past releases and expected future releases. The program also provides surveillance for detecting and quantifying unplanned releases (e.g., in case of an accident). Samples are collected near the site perimeter (near-field) for assessing the maximum potential impact to an off-site area. Samples are also collected from distant areas for comparing to the perimeter samples and for detecting the extent of pollution dispersal, if it occurs.

SNL/California monitors on-site and perimeter air, external radiation, and liquid and gaseous effluents. Most of the off-site environmental surveillance is done by the Environmental Monitoring Group (EMG) at LLNL. Table 7 shows DOE's minimum criteria for determining a need for environmental surveillance. Table 8 summarizes SNL/California's and LLNL's environmental surveillance activities. A comparison of these two tables shows that the environmental surveillance program exceeds the requirements based on Sandia's effective dose equivalent (0.15–1.4 mrem over the last four years).

In this chapter, the monitoring system for each environmental media and suggested improvements or changes are discussed. The sample collection methods are mentioned.

9.1 Ambient Air

Because air is a primary exposure pathway to humans from radionuclides released to the atmosphere, it is continuously sampled to eval-

Table 7. Minimum Criteria for Determining Need for Environmental Surveillance

Topic	Criteria
Routine surveillance of all pathways (ingestion, inhalation, and immersion 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.

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uate potential doses from inhaled or ingested radionuclides.

Ambient air is monitored to assess the exposure of the public to effluents from SNL/California site operations. The potential emissions of concern are ^{238}U (a uranium isotope), and ^3H (tritium). The ^{238}U is collected as a particulate, and ^3H is collected as HTO or HT. The air filters are more extensively analyzed to monitor the impacts of LLNL operations, which include a greater range of radionuclides (see Table 9). Gross alpha and gross beta activity are measured for screening purposes. The shorter time required for these analyses (compared to the radionuclide-specific analyses) provides more immediate indications of an increase in uranium activity. The ratio of the uranium isotopes $^{235}\text{U}/^{238}\text{U}$ is measured to assess the impact of

immediate indications of an increase in uranium activity. The ratio of the uranium isotopes $^{235}\text{U}/^{238}\text{U}$ is measured to assess the impact of SNL/California and LLNL operations on the environment. Uranium emissions from the facilities are in the form of depleted uranium (uranium that has had most of the isotope ^{235}U removed); therefore, if the air filters show less ^{235}U than expected to occur naturally in soils (approximately 0.7%), the source of the uranium is probably site operations.

9.1.1 Requirements

DOE/EH-0173T contains guidance on the sampling and analyses of ambient air for radionuclides.³ General guidance on the location and operation of ambient air samplers may also be found in Title 40 CFR, Part 58,⁶ and in

Table 8. Environmental Monitoring Sampling Program

Media	No. of Samplers	Parameters	Frequency	Requiring Authority	Authority Reported to
Air particulates	17	gross alpha, gross beta, uranium	weekly, monthly	DOE Order 5400.1	DOE
Air tritium	12	tritium	bi-weekly	DOE Order 5400.1, EPA NESHAPs	DOE EPA
Soil	15	uranium, tritium, metals, solvents, pesticides	annually	DOE Order 5400.1	DOE
Groundwater	20	gross alpha, gross beta, tritium, metals, solvents, pesticides	quarterly	DOE Order 5400.1	DOE
Surface water	12	gross alpha, gross beta, tritium	quarterly	DOE Order 5400.1	DOE
Sewer	2	tritium, metals, pH, TSS, priority pollutants, cyanide, BOD, COD, TDS, oil and grease	continuously, weekly, semiannually	DOE Order 5400.1, City of Livermore	DOE, City of Livermore
Stacks	1	tritium	monitored continuously, analyzed weekly	DOE Order 5400.1, EPA NESHAPs	DOE
Vegetation and foodstuff	43	tritium	quarterly, monthly	DOE Order 5400.1	DOE
Stormwater	1	tritium, metals, solvents, pesticides	two storms per year	DOE Order 5400.1	DOE
External radiation	58	dose	monitored continuously, analyzed quarterly	DOE Order 5400.1	DOE

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the EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems*.⁵

9.1.2 Locations

The ambient air monitoring system consists of sampling stations at the site perimeter and other locations throughout the Livermore Valley. SNL/California is implementing a new tritium-in-air sampling network, using the same type of samplers as used by LLNL. The locations of these samplers will be as shown in Fig. 10. The near-field sampling locations maintained by LLNL are shown in Fig. 11, and the distant locations maintained by LLNL are shown in Fig. 12. All these locations were chosen under the assumption that if the detected radionuclides were due to site operations, the concentrations at the perimeter locations would be higher than at the Valley locations. The Valley locations also serve to monitor concentrations of radionuclides in the closest population centers. Table 9 shows the analyses done on the samples from each site.

Locations VET, CAFE, SALV, XRDS, ZON7, ALTA, LCCY, FIRE, HOSP, and SANDIA ATS-01-07 are most pertinent to the SNL/California site. The other air monitoring locations serve primarily to monitor LLNL operations.

9.1.3 Methods

LLNL personnel collect air tritium samples at locations CAFE, SALV, VET, XRDS, MESQ, MET, VIS, COW, ZON7, ALTA, FIRE, and LCCY. General Metal Works high-volume air samplers are used to collect air particulates at all locations. The filters used are Whatman #41 filters, which have an area of 0.052 m². These filters are used as a balance between particulate collection efficiency and the need for an easily dissolved, low-metal-content filter. The flow rate is maintained at 400 liters per minute by a mass flow controller. At the end of the one-week collection period, the total run-time is noted and used to calculate the volume of air sampled.

Air tritium samples are collected by pumping ambient air through a glass flask containing sili-

Table 9. Analyses Done on Samples from Air Sampling Locations

Location	Analyses
SALV	²³⁹ Pu, ²³⁵ U, ²³⁸ U, ³ H, Be, gross alpha, gross beta
MESQ	²³⁹ Pu, ²³⁵ U, ²³⁸ U, ³ H, Be, gross alpha, gross beta
CAFE	²³⁹ Pu, ²³⁵ U, ²³⁸ U, ³ H, Be, gross alpha, gross beta
MET	²³⁹ Pu, ²³⁵ U, ²³⁸ U, ³ H, Be, gross alpha, gross beta
VIS	²³⁹ Pu, ²³⁵ U, ²³⁸ U, ³ H, Be, gross alpha, gross beta
COW	²³⁹ Pu, ²³⁵ U, ²³⁸ U, ³ H, Be, gross alpha, gross beta
TANK	²³⁹ Pu, gross alpha, gross beta
ZON7	²³⁹ Pu, ³ H, gross alpha, gross beta
FCC	²³⁹ Pu, gross alpha, gross beta
HOSP	²³⁹ Pu, gross alpha, gross beta
LWRP	²³⁹ Pu, gross alpha, gross beta
FIRE	²³⁹ Pu, ³ H, gross alpha, gross beta
XRDS	³ H, gross alpha, gross beta
VET	³ H, gross alpha, gross beta
ALTA	²³⁹ Pu, ³ H, gross alpha, gross beta
LCCY	²³⁹ Pu, ³ H, gross alpha, gross beta
PATT	²³⁹ Pu, gross alpha, gross beta
RRCH	²³⁹ Pu, gross alpha, gross beta
ESCRCH	gross alpha, gross beta
SANDIA ATS-01-07	³ H

ca gel at a flow rate of 0.7 liters per minute. This rate is set when collection begins. The flow at the end of the two-week collection period is noted, and the average of the two flow rates is used to calculate the total volume of sample collected.

9.1.4 Analyses

Monthly composites of the weekly samples from locations CAFE and SALV are analyzed for ²³⁵U, ²³⁸U, gross alpha, and gross beta. Samples from locations VET, XRDS, ZON7, ALTA, LCCY, FIRE, and HOSP are analyzed for gross alpha and gross beta emitters (see Table 9).

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Figure 10. Air monitoring locations (SNL-maintained ethylene glycol air tritium samplers) at the Sandia site perimeter.

9.1.5 Reporting

Ambient air monitoring data are reported in the annual *Site Environmental Report*.³⁶

9.1.6 Quality Assurance/ Quality Control

To assess the precision of samples collected, LLNL uses one high-volume air particulate sampler as a duplicate. It is moved to a different LLNL perimeter location every month and run in parallel with the normal sampler. The filter from this sampler is analyzed for the same substances as the permanent sampler. An air tritium sampler is also run as a duplicate sampler at an LLNL site perimeter location. This sampler also is moved monthly.

These duplicate samplers provide a basis for determining the precision of the sampling and analytical system. LLNL personnel process blank air filters to check for possible cross contamination. Blank silica gel samples are created by bubbling tap water onto a silica gel sampler. The samples are then analyzed according to the same methods.

9.1.7 Accuracy and Precision

Precision estimates are generated from the analysis of duplicate samples, which are collected at the same time and location as the routine samples. Accuracy estimates are generated from

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Figure 11. Near-field ambient air monitoring locations.

the analysis of reference samples or spiked pseudosamples. LLNL's Radiological Analytical Services Laboratory (RASL) of the Nuclear Chemistry Division analyzes for ^{238}U and ^3H . The RASL participates in two intercomparison studies for air filters: the DOE Environmental Measurements Laboratory (EML) and the EPA Environmental Radioactivity Laboratory Intercomparison Studies Program, which is run by the Environmental Measurement Systems Laboratory (EMSL). Only the DOE program includes analysis for ^{238}U .

For assessing the accuracy of the tritium-in-air measurements, the Nuclear Chemistry Division personnel prepare a spiked pseudosample for analysis by bubbling an NIST-traceable standard solution onto clean silica gel. They then process it as a normal sample. (See Section 10.0 for more details on laboratory procedures.) For the uranium determinations, they analyze unused filters as blanks and blank filters spiked with known amounts of uranium isotopes. Table 10 contains the results of the precision and accuracy determinations for calendar-year 1991 (1992 data are not yet available), including the results of the

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EML intercomparison. This table shows that the accuracy goals for the EML intercomparison of ^{238}U and the laboratory precision goals for ^{238}U are being met, but the field precision goals are not. The precision goals for tritium are not being met; although a regression analysis of the routine and duplicate samplers shows good correlation statistics, there appears to be a positive bias. The regression for the laboratory spikes shows a negative bias in the analysis, which could affect the routine samples.

Figure 12. Ambient air monitoring locations in the Livermore Valley (distant).

Table 10. Precision and Accuracy of Ambient Air Analyses for 1991

Parameter	Type	Regression			Confidence Interval
		correlation coefficient	slope	y-intercept	
Precision:					
Tritium	field duplicate	0.84	0.75	$2.3 \times 10^{-12} \mu\text{Ci/ml}$	+39/-27%
Tritium	laboratory split	0.997	1.033	-0.073	+13.6/-13.3%
Uranium	field duplicate	0.96			
Accuracy:					
Uranium	laboratory spikes	n/a	n/a	n/a	+32.2/-30.5%
Tritium	laboratory spikes	0.880	0.472	1.933	-16.6/-37.2%

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9.1.8 Recommendations

Locations

Several sampling locations do not meet the EPA siting criteria for air monitoring locations, as specified in Title 40 CFR, Part 58 (i.e., unobstructed air flow for 270° around the sampler, linear distance from the nearest obstruction at least twice the height of the obstruction, 20–50 m from roadways).⁶ These locations do not meet the criteria for the following reasons:

- CAFE and SALV (perimeter locations) are too close to trees, brush, buildings, and East Avenue;
- TANK is too close to water storage tanks;
- HOSP is too close to buildings and trees;
- SNL/California Sampler 1 is too close to a building.

These samplers should be relocated to areas that meet the EPA siting criteria. There are no locations suitable for ambient air monitors along East Avenue between SNL/California and LLNL. However, the area could be adequately covered by samplers located in the undeveloped areas of the SNL/California site that lie south of East Avenue.

The Environmental Monitoring Program, in conjunction with LLNL's Surveillance Monitoring Group, is expanding the tritium-in-air monitoring network at the SNL/California site. The existing four samplers will be removed, and eight on-site and perimeter samplers of the same type used by LLNL will be deployed. LLNL will provide the samplers and analyze the silica gel. SNL/California personnel will be responsible for operating the samplers and collecting samples. This expansion is expected to be completed by May 1993.

Analyses

The current analytical scheme does not allow full determination of site impacts. For example, the $^{235}\text{U}/^{238}\text{U}$ ratio typically deviates from the expected natural ratio of 0.7% for one or two months out of the year. Because this ratio is measured only at the LLNL perimeter locations,

the source cannot be determined as LLNL, SNL/California or elsewhere. This problem could be solved by analyzing all air filters for $^{235}\text{U}/^{238}\text{U}$.

Quality Assurance/Quality Control

Duplicate air samplers should be rotated among all the locations, not just the perimeter locations. Efforts should be made to improve the reproducibility of the silica gel tritium monitors. The source of the variability needs to be determined.

SNL/California personnel need to initiate discussions with LLNL personnel regarding data acceptance criteria and the failure to meet them.

9.2 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.

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.

9.2.1 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 4.13⁴⁰ and ANSI-N545-1975.⁴¹

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9.2.2 Locations

SNL/California maintains five TLDs at the site perimeter (Fig. 13). Figure 13 also shows the 17 near-field TLD locations, and Fig. 14 shows the 41 distant TLD locations.

9.2.3 Methods

The TLDs used on-site at SNL/California are Harshaw Li-F TLD-700, high-sensitivity ribbons. Environmental Protection Department personnel collect them quarterly and send them to SNL, Albuquerque, 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 Haz-

ards 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 4.13⁴⁰).

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.

9.2.4 Reporting

External radiation monitoring data are reported in the annual *Site Environmental Report*.³⁶

9.2.5 Quality Assurance/Quality Control

Each phosphor of the TLD must read within $\pm 5\%$ of the other three phosphors upon calibration to be acceptable for placement in the field. Dosimeters with a known exposure are intro-

Figure 13. Near-field thermoluminescent dosimeters (external radiation monitoring).

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Figure 14. Locations of distant thermoluminescent dosimeters (external radiation monitoring).

duced 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 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.

9.2.6 Accuracy and Precision

Table 11 contains the results of the analyses of the exposed and duplicate dosimeters for 1991

(1992 data are not yet available), which show that the accuracy criteria are being met, but the precision criteria are not. The value of the y-intercept of the regression line (accuracy) is outside the acceptance criteria because of the magnitude of the units measured, as explained in Section 3.0. Although the confidence interval meets the acceptance criteria of $\pm 30\%$, the regression analysis (precision) 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 lack of correlation.

9.2.7 Recommendations

The sources of the error in the analyses of the duplicate dosimeters should be investigated.

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Table 11. Precision and Accuracy of Thermoluminescent Dosimeter Analyses for 1991

Parameter	Type	Regression			Confidence Interval
		correlation coefficient	slope	y-intercept	
Precision:					
Penetrating radiation	field duplicates	0.683	0.291	11.7	+6.2/−8.0%
Accuracy:					
Penetrating radiation	spiked TLDs	0.998	0.916	1.603	+9.7/−3.6%

9.3 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.

9.3.1 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 EPA's November 1990 regulations). The general industrial storm water permit generally requires that SNL/California does the following:

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

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. The Storm Water Monitoring Program demonstrates compliance with the general industrial storm water permit conditions and allows Environmental Monitoring Program 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 may also 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.

9.3.2 Locations

Storm water sampling and analysis are conducted at two of the nine storm drain outfalls

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along East Avenue and five of the eight storm water outfalls into the Arroyo Seco (Fig. 15). 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. Two additional samples are 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 after it leaves the site. An additional storm water sampling location will be collected at the northwest corner of the IMTL facilities during the first wet season they are occupied.

All storm drain outfalls are visually inspected once during wet season months, 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 areas that may contribute, or 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.

Figure 15. Stormwater and arroyo sediment sampling locations, SNL/California site.

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9.3.3 Methods

Storm water sampling and sample preservation is done in accordance with EPA standard methods described in Title 40 CFR, Part 136.⁴² Samples are analyzed to identify the following parameters, as required by the general industrial storm water permit:

- pH
- total suspended solids
- specific conductivity
- total organic carbon
- oil and grease

Although no evidence suggests significant quantities of the following parameters in storm water discharges, additional analyses are done to identify them:

- semi-volatile organics
- pesticides
- volatile organics
- total concentrations of arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc
- tritium

Note: "Significant quantities" is defined by the general industrial storm water permit as the volume, concentration, or mass of a pollutant in storm water discharge that can cause or threaten to cause pollution, contamination, or nuisance; adversely impact human health or the environment; and cause or contribute to a violation of any applicable water quality standards for the receiving water.

Storm water was sampled once during the 1992/93 wet season. Storm water will be sampled twice during wet seasons thereafter, as specified in the general industrial storm water permit. Samples were collected at both sampling points along East Avenue, four of the sampling points along the Arroyo Seco, and the two sampling points upstream of outfalls. Table 12

lists average chemical concentrations from the locations sampled. Access to the fifth sampling location on the Arroyo Seco (which involves entering a manhole) is limited, and potential safety hazards are being evaluated.

9.3.4 Reporting

Stormwater monitoring data are reported in the SNL/California *Annual Storm Water Monitoring Report*, which is submitted to the Executive Officer of the San Francisco Bay RWQCB (by July 1 of each year) and in the annual *Site Environmental Report*.³⁶

9.3.5 Quality Assurance/ Quality Control

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

Table 12. Summary of Storm Water Sampling Results

Parameter	Detected Level
pH (S.U.)	7
specific conductance (umhos/cm)	55
total organic carbon (mg/L)	8
total suspended solids (mg/L)	35
total oil and grease (mg/L)	3
semi-volatile organics (ug/L)	not detected
pesticides (ug/L)	not detected
volatile organics (ug/L)	not detected
total arsenic (mg/L)	<0.02
total cadmium (mg/L)	<0.005
total chromium (mg/L)	<0.01
total copper (mg/L)	0.015
total lead (mg/L)	<0.05
total mercury (mg/L)	<0.0005
total nickel (mg/L)	<0.02
total silver (mg/L)	<0.01
total zinc (mg/L)	0.17

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9.3.6 Accuracy and Precision

Because the program is new, there is not sufficient data to perform an accuracy or precision analysis. Such an analysis will be outlined in the next revision of this EMP.

9.3.7 Recommendations

If a parameter for which analysis is not required is not detected in significant quantities during two consecutive sampling events, analysis for that parameter should be eliminated.

9.4 Soil/Sediment

Soils may accumulate pollutants deposited from the air, rain, or surface runoff, and then release them to the atmosphere, either directly as gaseous effluents or indirectly by resuspension in air. Arroyo sediments may accumulate pollutants contained in stormwater runoff. Due to the ion exchange properties (and other chemical trapping mechanisms) of sediments, pollutant concentrations in the sediment can reach much higher levels than those in the runoff itself. The pollutants then may be released to the underlying groundwater, which may subsequently be used for drinking or irrigation.

9.4.1 Requirements

DOE/EH-0173T provides guidance on soil and sediment monitoring around DOE sites.³ Additional guidance on sampling and analysis of soils and sediments may be found in the EPA's *Test Methods for Evaluating Solid Waste*.⁴²

9.4.2 Locations

Figure 16 shows the soil sampling locations near the SNL/California site perimeter and at distant locations. The locations VIS and TANK are near-field, and the rest are distant. Presumably, any impacts due to site operations would show up as higher concentrations of pollutants in the near-field samples.

Figure 15 (Section 9.3) shows the Arroyo Seco sediment sampling locations. Samples are collected both upstream and downstream of the site in order to assess any addition of pollutants from site operations. Both locations are near-field.

The surface soil samples are taken as close as possible to the air samplers, if present. Soil samples are taken from open areas (not shaded by trees or brush) that show no evidence of recent

Figure 16. Soil sampling locations in the Livermore Valley.

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disturbance due to human activity (such as construction or agriculture).

9.4.3 Methods

Annual soil samples are collected from cores of approximately 9.6 cm in diameter and 5 cm deep. Five cores are collected from a 1 m² area and composited to make a total sample of approximately 1 kg. The soil is then delivered to the Nuclear Chemistry Division at LLNL, where it is ground and blended. Portions are then taken for radionuclide analysis.

Arroyo sediments are collected with a split spoon sampler used for taking cores to a depth of 2 ft. A portion of this core is then delivered to LLNL's Nuclear Chemistry Division for radionuclide analysis. (Plutonium is not used on the SNL/California site.) The rest of the core is sent to an off-site laboratory for analysis for metals, pesticides, polychlorinated biphenyls (PCBs), and priority pollutants.

Sediments collected for tritium analysis are transferred immediately after collection to glass jars. They are kept in an ice chest until they are delivered to LLNL's Nuclear Chemistry Division, where they are frozen until analyzed. The samples collected for volatile organics analysis are sealed into stainless steel sampling tubes with teflon sheets and tape. They are kept in an ice chest until they are delivered to a contract laboratory for analysis. This method meets the requirements of the EPA's *Test Methods for Evaluating Solid Waste*.⁴²

9.4.4 Reporting

Soil and sediment monitoring data are reported in the annual *Site Environmental Report*.³⁶

9.4.5 Quality Assurance/ Quality Control

Duplicate soil and sediment samples are taken at 10% of the soil sampling sites, chosen at

random. These locations are chosen from among all the locations sampled by LLNL, and therefore may not include duplicates taken from a location near SNL/California. Reagent-grade sand is analyzed as blanks. The duplicates and blanks are analyzed at the same facility as the normal samples in order to assess precision and any potential sample contamination.

9.4.6 Accuracy and Precision

Table 13 shows the results of the duplicate soil and sediment sampling for 1991 (1992 data are not yet available). It includes only the parameters measured at a level above the analytical detection limit. No data are available from intercomparison samples.

9.4.7 Recommendations

For the same reasons as suggested for air monitoring locations (proximity to trees, brush, roadways, or restricted air flow), the soil sampling locations CAFE, SALV, and TANK are not appropriate for collecting soil samples (see Section 9.1). More sampling locations at the SNL/California site perimeter should be added. Two locations on the east perimeter, two on the west, and two on the south should be added to supplement the air samplers. If new air sampling locations are established, soil sampling locations should also be established as close to them as possible.

A background location needs to be established. The air sampling location HOSP would be a good choice due to its distance and its position in a predominantly upwind direction.

To help assess the source of the anomalous ²³⁵U/²³⁸U ratios (discussed in Section 9.1), the soils should be analyzed for uranium by mass spectroscopy (current analyses for uranium are done by gamma spectroscopy).

Table 13. Precision of Soil Analyses for 1991

Parameter	Type	Regression			Confidence Interval
		correlation coefficient	slope	y-intercept	
Uranium	field duplicates	0.521	0.492	0.288	+47.1/-75.4%

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The source of the variability in the duplicate samples needs to be determined and methods revised to eliminate it. More complete duplicate data need to be made available (tritium, metals, organics). Standard or spiked samples should be analyzed so we can develop an estimate of the accuracy of the monitoring system.

Changes to this portion of the environmental surveillance program cannot be made until a formal agreement is reached between SNL/California and LLNL.

9.5 Vegetation and Foodstuff

Agricultural products can accumulate radionuclides from airborne or liquid effluents and become a significant pathway for human ingestion of radionuclides.

The only agricultural products produced in appreciable quantities near the SNL/California site are wine, goat milk, beef, and honey. Vegetation or wine grapes may take up pollutants by direct deposition from the air onto the plants, or by uptake through the roots. Pollutants may also find their way into meat or into goat milk from animals that graze or are fed on contaminated vegetation. Honey produced by bees feeding on contaminated vegetation may also be a pathway for human exposure to pollutants.

Wine, rather than grapes, is sampled to assess the dose to the public at the time of consumption. Wines from nearby vineyards and those in other parts of California and Europe are sampled in order to assess the impact of site operations. Grasses and weeds are sampled due to the lack of production in the area of significant quantities of grains or vegetables. Goat milk from distant areas is collected and compared to goat milk produced locally. Honey from local hives is analyzed and compared to honey from distant hives.

9.5.1 Requirements

DOE/EH-0173T provides guidance for the types of agricultural samples to be monitored and the types of analyses likely to be required.³

9.5.2 Locations

Figure 17 shows the sampling locations for vegetation, milk, wine, and honey. Vegetation sampling locations AQUE, ZON7, and TESW are near-field, and locations FCC, VASW, and PATT are distant. Milk locations WRD, MZF, LUP, and COOL are near-field locations, and location MOD is distant. Purchased goat milk is used as a background sample. All the Livermore Valley honey and wine locations are considered near-field. Milk, wine, and honey samples are also collected from areas too far away to be shown in the figure. These are discussed below under the heading Quality Assurance/Quality Control.

9.5.3 Methods

Vegetation samples consist of grasses or weeds that are green at the time of sampling. These represent forage for animals in the region. Vegetation samples are collected quarterly.

Wine, milk, and honey samples are collected from local producers. Milk is collected monthly, except during the winter months (when goats do not produce milk). Honey and wine samples are collected annually. The wine samples are the most recent vintage available for any particular variety. Therefore, each year's collection represents a number of vintage years. These samples are all analyzed for tritium content.

Vegetation samples are collected in plastic bags and are kept in an ice chest until they are delivered to LLNL's Nuclear Chemistry Division, where they are kept frozen until analyzed. Milk samples are collected in plastic milk cartons and are refrigerated until analyzed. Wine and honey samples are stored in an argon atmosphere after the original sample containers have been opened.

9.5.4 Reporting

Vegetation and foodstuff monitoring data are reported in the annual *Site Environmental Report*.³⁶

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9.5.5 Quality Assurance/Quality Control

Duplicate samples are collected for approximately 10% of the sampling locations, chosen at random. Because blanks for these samples would be virtually impossible to create in the laboratory, commercial milk and honey are collected from production areas outside the Livermore Valley. Wine samples are collected from a number of other California wine producers and several European producers for comparison. The only reference standard for these media is the EPA-EMSL radionuclide in milk interlaboratory intercomparison. This sample is not yet being analyzed by LLNL's Nuclear Chemistry Division, but EPA-EMSL has been requested to put the division on the distribution list for this

sample. Creation of spiked pseudosamples for these media is planned, but has not been implemented yet. The Nuclear Chemistry Division is evaluating methods for producing spiked pseudosamples and blank samples for these media.

9.5.6 Accuracy and Precision

Table 14 contains data from the 1990 duplicate sampling effort. These data show that none of the sample types meet the performance objectives for precision. Until analyses of reference materials or spiked pseudosamples have been instituted, assessing the accuracy of the system is impossible.

Figure 17. Vegetation and foodstuff sampling locations (near-field and distant).

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Table 14. Precision of Vegetation and Foodstuff Analyses for 1990

Parameter	Type	Regression			Confidence Interval
		correlation coefficient	slope	y-intercept	
Tritium	vegetation field duplicate	0.983	1.067	-2.511	+93.8/-60.2%
Tritium	vegetation laboratory split	1.000	1.094	0.503	+22.0/-31.3%
Tritium	milk field duplicate	0.493	0.545	0.924	+62.4/-56.6%
Tritium	milk laboratory split	0.055	-0.038	1.808	+198/-135%
Tritium	honey laboratory split	0.985	0.933	0.684	+45.2/-37.3%
Tritium	wine field duplicate	0.901	0.851	0.322	+60.6/-69.2%
Tritium	wine laboratory split	0.979	0.945	0.024	+89.8/-66.8%

9.5.7 Recommendations

In addition to sampling wine when it is available to the public, grapes from the local vineyards to the west and south of the site should be sampled to obtain a more timely evaluation of the impact of site operations on this medium.

The grasses baled yearly on the SNL/California site and sold to a local farmer for feed should be analyzed for tritium before sale.

A land use survey should be done near the SNL/California site every two years, and any garden larger than 50 m² within 2 miles of the site boundary should be sampled. This land use survey should also be used to determine if anyone consumes locally produced meat (beef, pork, or fowl) in significant quantities. If so, the meat should be analyzed for tritium. Sampling of European wines should be discontinued because it is not a valid comparison to sampling of Livermore wines.

The source of the errors in the precision analyses needs to be investigated. Methods should be revised to eliminate the errors (if possible). To evaluate the accuracy of the monitoring system, the feasibility of obtaining standard samples or creating spiked pseudosamples should be assessed.

Changes to this portion of the environmental surveillance program cannot be made until a formal agreement is reached between SNL/California and LLNL.

9.6 Surface Water

Although there are no direct hydrologic connections between the SNL/California site and local surface bodies of water (except the Arroyo Seco), local surface water bodies could still become contaminated from contaminated rain or by absorbing airborne pollutants from site operations. Tritium is the pollutant of primary concern from SNL/California operations because of its gaseous nature and correspondingly high potential for dispersion.

All major water bodies near SNL/California are sampled and analyzed for tritium. Rainwater is also collected and analyzed for tritium.

9.6.1 Requirements

DOE/EH-0173T provides guidance for water monitoring and the types of analyses likely to be required.³ Additional guidance on sampling and analysis of water may be found in the EPA's *Test Methods for Evaluating Solid Waste*.⁴²

9.6.2 Locations

Figure 18 shows the surface water sampling locations near SNL/California. Location ZON7 is the Patterson Pass water treatment facility reservoir (1.2 km east of LLNL). Location DUCK is the Springtown pond (an artificial decorative pond 2.6 km northwest of LLNL). Location DEL is Lake Del Valle (a water storage reservoir 8 km south of LLNL). Location SHAD is the Shadow

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Cliffs Regional Park Recreation Area (a reservoir produced by gravel excavation operations, 11 km west of LLNL). Location CAL is the Calaveras Reservoir (25 km southeast of LLNL). The locations BELL, GAS, and PALM are tap-water sources that receive water from different water services.

Figure 19 shows the rainwater sampling locations in the Livermore Valley.

9.6.3 Methods

Surface water samples are collected quarterly by grab sampling. Samples are collected in argon-flushed glass bottles for tritium analysis.

Rainwater samples are collected in rain gages or open stainless steel buckets during every rainstorm. They are transferred to argon-flushed glass bottles before they are delivered to LLNL's Nuclear Chemistry Division.

9.6.4 Reporting

Surface water monitoring data are reported in the annual *Site Environmental Report*.³⁶

9.6.5 Quality Assurance/Quality Control

Duplicate samples are collected at a rate of approximately 10% of the sample load. Random duplicate rainwater samples are also collected if there is enough water for two samples. Laboratory blanks consisting of dead water are created and processed by LLNL's Nuclear Chemistry Division. DOE-EML and EPA-EMSL both provide interlaboratory intercomparison samples for tritium in water. The Nuclear Chemistry Division's RASL analyzes these samples twice a year (total of four samples). Analysis of spiked pseudosamples for these media is planned, but has not yet been implemented.

Figure 18. Surface water sampling locations in the Livermore Valley.

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Figure 19. Rainwater sampling locations in the Livermore Valley (near-field and distant).

Table 15. Precision of Surface Water Analyses for 1991

Parameter	Type	Regression			Confidence Interval
		correlation coefficient	slope	y-Intercept	
Tritium	field duplicate	0.999	0.987	-6.15 pCi/L	+12/-30%

9.6.6 Accuracy and Precision

Table 12 (Section 9.3) contains the results of the DOE-EML and EPA-EMSL intercomparison studies, which indicate that the accuracy of the measurement system is within the stated goals. Table 15 contains the data for the 1991 duplicate sampling effort (1992 data are not yet available), which indicate that the sampling and analysis system is close to the stated precision goals.

9.6.7 Recommendations

No changes to the surface water or rainwater sampling systems are recommended.

9.7 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 recharge on the Sandia site is the Arroyo Seco.

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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

9.7.1 Requirements

DOE/EH-0173T provides guidance on the type of groundwater monitoring DOE facilities should be doing.³ CERCLA, as amended, contains additional requirements for groundwater monitoring.²⁸

9.7.2 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).

One area of known groundwater contamination exists on the SNL/California site. It is the result of a fuel oil spill. The site is undergoing remedial investigations. SNL/California has also identified an inactive landfill on-site, but no groundwater contamination has been detected in this area. Monitoring wells are located at each of these sites (Fig. 20).

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 sewage plant effluent to the Arroyo.

9.7.3 Methods

A sampling team from a state-certified contract laboratory collects and analyzes groundwater samples quarterly. The laboratory personnel use EPA guidelines. They purge the wells long enough to assure a representative sample. Preservatives are added in the field, and the samples are stored on ice while in transit to the laboratory.

9.7.4 Reporting

Groundwater monitoring data are reported in the annual *Site Environmental Report*³⁶ and in the quarterly groundwater monitoring reports sent

Figure 20. Groundwater monitoring wells on the SNL/California site.

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to the Regional Water Quality Control Board (RWQCB).⁴⁴

9.7.5 Quality Assurance/Quality Control

Duplicate samples are collected at a rate of approximately 10% of the sample load. Field blanks are collected by adding 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.

9.7.6 Accuracy and Precision

Table 16 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.

9.7.7 Recommendations

LLNL has installed several monitoring wells to the west of the SNL/California site during investigations of groundwater contamination from the LLNL site. Some of these wells should be sampled to further monitor the groundwater downgradient of the SNL/California site.

The groundwater contours to the south of the Las Positas fault (underlying the southern portion of the site) are not well known. This area should be further investigated to better characterize the groundwater flow.

No progress has been made due to fiscal constraints and the general lowering of the water table due to the extended drought.

Table 16. 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

10.0 LABORATORY PROCEDURES

Accurate laboratory analyses are critical to any environmental monitoring program. Both the LLNL Nuclear Chemistry Division's RASL and SNL/California laboratory analyses include an appropriate number of blanks, duplicates, and spiked pseudosamples in order to assess accuracy and precision. SNL/California uses RASL for analyzing radionuclides in environmental media (except gross alpha, gross beta, and tritium in groundwater, and gross alpha and gross beta in air particulates, which are analyzed by a commercial laboratory). RASL is obtaining State of California laboratory accreditation. The accreditation process includes extensive documentation and implementation of personnel qualifications, analytical procedures, and quality assurance/quality control programs. RASL issued a quality assurance plan in April 1991 and submitted a State of California accreditation application in September 1991.

SNL/California Environmental Protection Department personnel analyze the LECS liquid contents using equipment owned and maintained by SNL's Environmental Protection and Inorganic and Physical Chemistry Departments. These analyses are done primarily to detect metals (and tritium at the TRL), although the ability to analyze for total organic carbon (TOC) and cyanide will be added. Appendix C contains SNL's Quality Assurance Management Plan for the ES&H and Facilities Center.

Contract laboratories that analyze gross alpha, gross beta, and tritium in groundwater, and gross alpha and gross beta in air particulates must be accredited by State of California. The contract laboratory must meet stringent requirements for personnel qualifications, quality assurance, and analytical performance. These laboratories are not audited by Sandia personnel. Sandia does have a formal operating procedure (ET-2) for contract laboratory data verification. The State of California performs periodic inspections under the State Laboratory Certification Program.

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

10.1 Ambient Air

10.1.1 Air Particulates

Half of an air filter is submitted to the commercial laboratory for gross alpha and gross beta analyses. After four days (to allow decay of radon daughter products), a 2-in. circle is cut from the filter and placed in a gas proportional counter for determining gross alpha and beta activity. The other half of the filter is retained and included in a monthly composite sent to RASL for uranium analyses. The filters are ashed and then dissolved by treatment with hydrofluoric, perchloric, and nitric acids. The uranium is then purified by ion exchange, and the activity of each of the uranium isotopes is determined by mass spectrometry. This analysis is done according to the procedure, *Analysis of Uranium and Gamma in Air Particulates*.⁴⁵

10.1.2 Tritium

Lawrence Livermore National Laboratory

The silica gel is sent to RASL, where it is transferred from the collection flask to a plastic bag. It is thoroughly mixed, and a portion is taken for processing. The sample is placed in a freeze-dry apparatus. The water removed this way is then counted by liquid scintillation to determine its tritium concentration.

Sandia National Laboratories/California

SNL/California's air tritium monitors collect tritium by adsorption of water vapor onto ethylene glycol. The first stage collects the tritiated water vapor. The sample then is passed over a precious metal catalyst to convert the gaseous form (HT) into water vapor, which is then collected in the second stage. A portion of this ethylene glycol is counted by liquid scintillation to determine its tritium concentration. This process will be discontinued when the new air tritium monitoring network is in place (see 9.1.8).

10.0 LABORATORY PROCEDURES

10.2 External Radiation

The TLDs collected by SNL/California personnel are processed by the Health Instrumentation Department at SNL, Albuquerque. These TLDs are also stored in a lead shield until they are processed. The TLD reader used is a Harshaw model 2000 manual TLD reader. The read-out data is 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 microrentgen (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.

10.3 Stormwater Runoff

10.3.1 Tritium

The tritium samples are sent to RASL, where they are prepared for counting by distillation in an argon atmosphere. After distillation, a portion is taken for liquid scintillation counting. This analysis is done according to the procedure, *Tritium Analysis of Water Samples*.⁴⁶

10.3.2 Other Analyses

The metals and organics samples are sent to a contract laboratory, where they are processed according to EPA standards. The analyses for stormwater runoff samples are EPA method 624 (volatile organics), EPA method 625 (non-volatile organics), Title 22 CCR organics, metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag), oil and grease, COD, TOC, NO_3^- , F_3^- , gross alpha, and gross beta.

10.4 Soil/Sediment

10.4.1 Tritium In Arroyo Sediment

A portion of the sediment is sent to RASL, where it is freeze-dried. The removed water is then counted for tritium activity by liquid scintillation. This analysis is done according to the

procedure, *Arroyo Sediment Tritium Determination*.⁴⁷

10.4.2 Other Analyses In Arroyo Sediments

The metals and organics samples are sent to a commercial laboratory, where they are processed according to EPA standards. The analyses of sediment samples are EPA method 8020, EPA method 8080, and metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag).

10.4.3 Surface Soils

The surface soil samples are sent to RASL, where they are analyzed for various radioactive constituents. The only parameter of concern to SNL/California is the uranium, analyzed using gamma spectrometry. This analysis is done according to the procedure, *Plutonium and Gamma Analyses of Soil and Sediment Samples*.⁴⁸

10.5 Vegetation and Foodstuffs

All vegetation and foodstuff samples are processed by RASL.

10.5.1 Tritium In Vegetation

A portion of the vegetation is freeze-dried, and the removed water is counted for tritium activity by liquid scintillation. This analysis is done according to the procedure, *Tritium Analysis of Vegetation Samples*.⁴⁹

10.5.2 Tritium In Milk

A portion of the milk is freeze-dried, and the removed water is counted for tritium activity by liquid scintillation. This analysis is done according to the procedure, *Tritium and Gamma Analysis of Milk Samples*.⁵⁰

10.5.3 Tritium In Wine

A portion of the wine is passed through a Peterson furnace to oxidize all the organic matter in the wine to water and carbon dioxide. This water is then passed through a gas conversion furnace, which converts it to hydrogen gas. The gas is then counted for tritium activity by an internal gas proportional counter. This analysis is done according to the procedure, *Tritium Analysis of Wine Samples*.⁵¹

10.0 LABORATORY PROCEDURES

Alternatively, the tritium content of the wine may be determined by measuring the accumulation of the daughter of tritium (^3He) using mass spectroscopy.

10.5.4 Tritium in Honey

A portion of the honey is placed in a Parr bomb, where it is burned, converting the organic matter into water. This water is then passed through a gas conversion furnace, which converts it to hydrogen gas. The gas is then counted for tritium activity by an internal gas proportional counter. This analysis is done according to the procedure, *Tritium Analysis of Honey Samples*.⁵²

10.6 Surface Water

Surface water samples are processed by RASL.

10.6.1 Low Tritium Water

Water expected to have a very low tritium content (such as certain surface waters and well water) are processed by electrolytically concentrating the tritium content of the water (enriching it) and then analyzing the water for tritium activity by liquid scintillation counting. These analyses are done according to the procedure, *Tritium Analysis of Water Samples*.⁴⁶

10.6.2 High Tritium Water

Because this water contains higher levels of tritium, electrolytic enrichment is not necessary. High-tritium water is distilled in an argon atmosphere and analyzed for tritium content by liquid scintillation. These analyses are done according to the procedure, *Tritium Analysis of Water Samples*.⁴⁶

10.7 Groundwater

Groundwater samples from the four monitoring wells are collected by the commercial labo-

ratory that analyzes them. They are processed according to EPA methods. The analyses done are EPA method 624 (volatile organics), EPA method 625 (non-volatile organics), Title 22 CCR organics, metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag), gross alpha, gross beta, and tritium.

10.8 Liquid Effluent Control System

Liquid samples for metals are digested in acid and then analyzed by inductively coupled plasma mass spectrometry, according to Environmental Protection Department procedures that are compatible with applicable EPA procedures. These analyses are done according to the draft Operating Instruction, *Metals Analysis*.⁵³

Analyses for pH are done according to Environmental Protection Department procedures, which are compatible with EPA procedures.

Tritium content of the Bldg. 968 (TRL) LECS is analyzed in the TRL by liquid scintillation counting.

10.9 Sanitary Sewer

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

10.10 Tritium Research Laboratory Stack Effluent

As mentioned in Section 7.0, a portion of the effluent gases from the TRL are collected on ethylene glycol for integrative monitoring of the stack effluent. An aliquot of this ethylene glycol then is added to liquid scintillation cocktail, and the tritium content is determined by liquid scintillation counting.

11.0 RADIOLOGICAL DOSE ASSESSMENT

This section presents the methods, assumptions, data input, and calculations used to assess routine radiological exposures from each environmental pathway, as discussed in Section 6.4. It covers routine operations involving uniform releases to the environment and is not intended for assessing consequences of unusual occurrences.

SNL/California annually assesses radiologic impacts of site operations on the public. This assessment is done in accordance with DOE- and EPA-approved methods. The results are published and made available to the general public each year in the *SNL/California Site Environmental Report*.³⁶

The radiological impacts from SNL/California operations are assessed by determining the radiologic dose to members of the public who would receive maximum credible exposures. This assessment involves the following:

- measuring radioactive emissions from SNL/California (discussed in earlier sections),
- identifying all relevant exposure pathways,
- evaluating environmental transport and fate of contaminants (see Section 6.4), and
- estimating human intake and resulting dose.

In most cases, the amount of radioactive material emitted by SNL/California is too small for dose to be determined from direct measurements of radionuclide concentrations in environmental media, using current monitoring methods. That is, it is not always possible to discriminate between Sandia's contribution to radiation in the environment and natural background sources of radiation. Also, because Sandia is so close to LLNL, the monitoring system cannot always differentiate the emissions from the two sites. Therefore, off-site doses are calculated based on radioactive effluent measurements at the point of discharge from the facility. Environmental transport and exposure pathway

computer models are used to estimate radionuclide concentrations in various environmental media at locations accessible to the public. Dosimetric models then are applied to determine human intake and to convert intake to dose.

Radiological doses are expressed in terms of "effective dose equivalent." "Dose equivalent" is a term used in radiation protection that expresses all types of radiation (alpha, beta, and so on) on a common scale for calculating the effective absorbed dose. It is the product of the absorbed dose in rads and certain modifying factors. (The unit of dose equivalent is the rem.) The "effective dose" is the hypothetical whole-body dose that would give the same risk of cancer mortality and/or serious genetic disorder as a given exposure and that may be limited to just a few organs. The effective dose equivalent is equal to the sum of individual organ doses, each weighted by degree of risk that the organ dose carries. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent due to penetrating radiation from sources external to the body; it is expressed in units of rem (or sievert).

The method used to calculate effective dose equivalents applies the dosimetric parameters recommended by the International Commission on Radiological Protection (ICRP) in Publications 26 (1977) and 30 (1980).^{54,55}

Doses from the air pathway also are calculated and reported pursuant to NESHAPs.⁴ These doses are calculated using the Clean Air Act Code (CAAC), which contains models (AIR-DOS-EPA and RADRISK) approved by the EPA for calculating atmospheric transport and exposure. Population exposure is converted to radiation dose using dose conversion factors and weighting factors specified by the EPA.

11.1 Exposure Pathways

Figure 21 simplistically represents the important pathways of radioactivity released to the environment. Based on the environmental path-

11.0 RADIOLOGICAL DOSE ASSESSMENT

way analysis for SNL/California (Section 6.4), and the land use characteristics on and around the site (Section 6.2), the following doses are calculated:

- external (direct) dose at the site boundary;
- inhalation from the air pathway and submersion from plume passage; and
- ingestion from consumption of locally produced foodstuffs and drinking water.

These doses are determined at the point of maximum exposure in uncontrolled areas, i.e., publicly accessible locations. The doses may be compared to DOE and EPA radiation protection standards. Each of the doses used to evaluate the radiological impact from SNL/California operations is described briefly below.

11.1.1 External "Fence-Line" Dose

The fence-line dose rate is a measure of the maximum external radiation dose at locations of nearest uncontrolled public access.

The TLDs measure dose rates from all external radiation sources, including cosmic radiation, radioactivity that occurs naturally in the environment, fallout from nuclear weapons testing, and any contribution from SNL operations. In most cases, the dose rates are a measure of regional background, as shown by comparing the perimeter measurements to those made at off-site

locations (in the Livermore Valley). Moreover, these measurements are made at points of maximum exposure and assume an occupancy of 24 hours a day, 365 days a year. No member of the public actually resides at these locations for extended periods of time; therefore, these estimates are conservative.

11.1.2 Inhalation/Submersion Dose

Air pathway doses are calculated for each airborne radioactive discharge to the atmosphere. Inhalation/submersion doses are calculated at the site perimeter, at the location of the nearest resident, and at the point of maximum off-site exposure. The amount of radioactivity released by SNL/California is usually too low for radionuclide concentrations in ambient air to be measured accurately and for dose to be deter-

Figure 21. Major exposure pathways.

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mined. Therefore, environmental transport and exposure pathway models are used to calculate potential dose resulting from effluent emissions (measured at the TRL stack). The two methods used comply with both DOE standards and NESHAPs (see Section 11.2.1).⁴

The atmospheric transport of radioactive materials from SNL/California is calculated based on source term and meteorological conditions. Meteorological factors (wind speed, direction, and atmospheric stability) are measured continuously at a monitoring station on the SNL/California site. Atmospheric observations are collected at two tower levels (10 m and 40 m). Because the 30-m TRL stack is being modelled, the corresponding 40-m tower data are used.

11.1.3 Ingestion Dose

Potential doses from ingestion of locally produced foodstuff and surface water are based on actual measurements of radionuclide concentrations in the various media (determined by sample analysis). Conservative exposure data and current ICRP dosimetric factors are used to estimate doses to the individual. Field measurements are used to assess tritium in water, milk, and vegetation (which includes the forage-cow milk pathway).

11.2 Methods

11.2.1 External Methods

Dose rates from external penetrating radiations (primarily gamma rays) are measured using TLDs. These dosimeters provide a direct measure of external radiation exposure rates (expressed in milliroentgens per unit time). The exposure rates are then converted to dose equivalent units (mrem) to compare

to appropriate standards. (See Sections 9.0 and 10.0 for further discussion of external radiation monitoring.)

11.2.2 Annual Inhalation and Submersion Dose Methods

Radioactive materials released to the atmosphere are subject to complex processes, which govern their movement in the environment. Figure 22 simplistically represents the method used to assess the inhalation/submersion pathway.

Figure 22. Dose assessment of air pathway.

11.0 RADIOLOGICAL DOSE ASSESSMENT

Sandia Method

The method used to calculate doses complies with the DOE primary radiation protection standards for the public.² Expressed as effective dose equivalents, they also comply with the ICRP risk-based system.

Doses are calculated using a computer code based on the Gaussian plume model. This code provides ratios of concentration to release rate (χ/Q) through sixteen, 22.5° compass sectors and at various distances from potential release points. The average annual χ/Q values are calculated using local meteorological data (obtained from sensors on the SNL/California meteorological tower from a height of 40 m). Measurements of wind speed, wind direction, and atmospheric stability are tabulated at 1/4-hour intervals over the calendar year.

Variance in the horizontal wind direction is used to estimate Pasquill-Gifford stability categories, based on the method described by D. H. Slade (1968). Lateral and vertical standard deviations σ_y and σ_z are entered in the computer code as functions of these stability categories and the respective distances. Based on the annual effluent data and the appropriate χ/Q values, the radionuclide concentrations at the site perimeter and at the location of the nearest resident are calculated.

The atmospheric dispersion parameter (χ/Q) is calculated based on the distance from the facility to the receptor location (i.e., site perimeter, nearest resident, and point of maximum ground-level concentration). This process is repeated for each facility that discharges radioactive matter to the atmosphere. Once the code has calculated the dispersion parameter, it multiplies the parameter by the release rate and the standard human inhalation rate, to obtain intake. Dose conversion factors provided by DOE are used to relate the intake of radioactive material to dose commitment. These dose factors provide estimates of 50-year doses from a chronic one-year intake of radioactivity.

Following are the calculations of air pathway dose at the perimeter, the location of the nearest resident, and the point of maximum exposure.

Inhalation and Submersion Dose (D) Calculations (³H):

$$D_{\max} = C \times U \times D,$$

where

C = radionuclide concentration at the receptor,

U = intake rate (the inhalation rate for a maximally exposed adult is 8400 m³/yr.), and

D = tritium dose conversion factor (9.45×10^{-8} mrem/pCi).

(The tritium dose conversion factor was obtained by multiplying the inhalation dose factor, 6.3×10^{-8} mrem/pCi, by 1.5, to include absorption through the skin).

The radionuclide concentration at the receptor, C, is calculated as follows:

$$C = 3.17 \times 10^4 \text{ Ci/m}^3 (\chi/Q)(Q),$$

where

χ/Q = diffusion parameter (s/m³),

Q = release rate, Ci/yr,

$$3.17 \times 10^4 = \frac{1 \times 10^{12} \text{ pCi/Ci}}{3.15 \times 10^7 \text{ s/yr}}$$

Assessment Assumptions:

Tritium emissions account for all the off-site dose from SNL/California operations. Tritium exits the site in two major forms: tritium oxide or vapor (HTO) and elemental tritium (HT or T₂). Any HTO that enters the body is distributed throughout and is eliminated at the same rate as body water. Only a small fraction of HT is retained. The effective dose equivalent from exposure to elemental tritium in air is 25,000 times lower than an equal exposure to tritium oxide. For this reason, elemental tritium is excluded from the dose calculations.

11.0 RADIOLOGICAL DOSE ASSESSMENT

NESHAPs Method

SNL/California is required to calculate and report radiological doses pursuant to NESHAPs.⁴ The EPA dose limits apply only to exposure to members of the public from airborne emissions of radionuclides. This assessment includes exposures from inhalation, air submersion, ingestion, and ground surface irradiation resulting from airborne emissions.

The EPA regulations require that the dose assessment be performed using the Clean Air Act Code (CAAC), which contains the AIRDOS-EPA and RADRISK models. A personal computer version of the CAAC, called AIRDOS-PC, also has been approved by EPA to demonstrate compliance with the NESHAPs rule for radionuclides. Human intake is converted to dose using dose conversion and weighting factors specified by the EPA. The atmospheric transport and dosimetric models used in the CAAC have been documented in the *RSIC Computer Code Collection*.⁵⁶ For this method, the models and parameters used to predict the transport of radionuclides in the environment and to estimate dose meet EPA requirements.

The assessment methodology was developed for the U. S. EPA Office of Radiation Programs by Oak Ridge National Laboratory. Human exposure data are derived from the atmospheric and environmental transport code AIRDOS-EPA (Moore, 1979). The dosimetric and health effects database used was developed by the RADRISK computer code (Dunning, 1980). The DARTAB computer code (Begovich, 1981) is used to predict dose (and radiation-induced health effects, if desired) from the human exposure and health effects data.

The AIRDOS computer model is used to estimate radiological doses associated with routine emission of radionuclides. The AIRDOS computer model estimates: radionuclide concentrations in air; deposition rates on ground surfaces; ground surface concentrations; intake rates via inhalation of air and ingestion of meat, milk, and fresh vegetables; and radiation doses to

humans from airborne releases of radionuclides. An internal library of dose conversion factors combines radionuclide environmental exposure data with dosimetric and health effects data to generate tabulations of the predicted impact (in terms of effective dose equivalent) of radioactive airborne effluents.

The AIRDOS model calculates atmospheric dispersion for radionuclides released from stacks or area sources. Radionuclide concentrations in meat, milk, and fresh produce are estimated by coupling the deposition rate output of the atmospheric dispersion models with the NRC Regulatory Guide 1.109 terrestrial food chain models.⁵⁷ Radionuclide concentrations for specified distances and directions are calculated for the following exposure pathways:

- immersion in air containing radionuclides;
- exposure to ground surfaces contaminated by deposited radionuclides;
- inhalation of radionuclides in air; and
- ingestion of food in the area.

AIRDOS uses a modified Gaussian plume dispersion model to calculate annual average radionuclide concentrations for each grid sector. Building wake effects and downwash are not included in the AIRDOS-EPA models. The same type of plume rise calculation (buoyant, momentum, or fixed) is used for all sources.

Input into AIRDOS includes a source term that describes facility-specific parameters and options that control the dispersion model and exposure calculations. AIRDOS assigns default values for all other parameters. Meteorological data are also required as input. The source term includes annual radionuclide release rates and stack height, diameter, heat release rate, and stack gas exit velocity. Table 17 lists the stack parameters used for the modeling effort.

Input values for the food chain model are found in *Radionuclides Background Information Document for Final Rules*.⁵⁸ All agriculture production parameters are assigned default values (Table 18).

11.0 RADIOLOGICAL DOSE ASSESSMENT

Table 17. TRL Source Characteristics for Radionuclide Dispersion Modeling

Parameter	TRL
Stack height	30 m
Stack diameter	1.2 m
Exit gas temperature (°F)	Ambient
Exit gas velocity (m/s)	16.8 m/s

Table 18. Modeling Parameters Used for AIRDOS-EPA*

AIRDOS Symbol	Description	Value
BRTHRT	Breathing rate (cm ³ /hr.)	9.17 × 10 ⁵
T	Surface buildup time (days)	3.65 × 10 ⁴
DDI	Activity fraction after washing	0.5
TSUBH1	Time delay—pasture grass (hr.)	0.0
TSUBH2	Time delay—stored food (hr.)	2.16 × 10 ³
TSUBH3	Time delay—leafy vegetables (hr.)	336
TSUBH4	Time delay—produce (hr.)	336
LAMW	Weathering removal rate factor (hr. ⁻¹)	2.10 × 10 ⁻³
TSUBE1	Exposure period—pasture (hr.)	720
TSUBE2	Exposure period—crops or leafy vegetables (hr.)	1.44 × 10 ³
YSUBV1	Productivity—pasture (dry weight) (kg/m ²)	0.280
YSUBV2	Productivity—crops and leafy vegetables (kg/m ²)	0.716
FSUBP	Time fraction—pasture grazing	0.40
FSUBS	Pasture feed fraction—while pasture grazing	0.43
QSUBF	Feed or forage consumption rate (kg-dry/day)	15.6
TSUBF	Consumption delay time—milk (day)	2.0
UV	Vegetable utilization rate (kg/yr.)	176.0
UM	Milk utilization rate (kg/yr.)	112.0
UF	Meat utilization rate (kg/yr.)	85.0
UL	Leafy vegetable utilization rate (kg/yr.)	18.0
TSUBS	Consumption time delay—meat (days)	20.0
FSUBG	Produce fraction (garden of interest)	1.0
FSUBL	Leafy vegetable fraction (garden of interest)	1.0
TSUBB	Soil buildup time (yr.)	100.0
P	Effective surface density of soil (kg/m ²)	215.0
TAUBEF	Meat herd—slaughter rate factor (d ⁻¹)	3.81 × 10 ⁻³
MSUBB	Mass of meat of slaughter (kg)	200.0
VSUBM	Milk production rate of cow (l/day)	11.0
R1	Deposition interception fraction—pasture	0.57
R2	Deposition interception fraction—leafy vegetables	0.20

*Source: U.S. EPA, 1984a.⁵⁸

11.0 RADIOLOGICAL DOSE ASSESSMENT

Environmental Measurements Method

The amount of radioactivity released from SNL/California is very small—often too small to discriminate between it and background radiation sources. Inhalation doses can be calculated based on field measurements of airborne tritium. The effective dose equivalent for tritium is calculated using the following equation:

$$D(^3\text{H}) = C \times U \times \text{DF},$$

where

$D(^3\text{H})$ = effective dose equivalent from inhalation of ^3H , mrem/yr

C = ^3H concentration in air at receptor location, pCi/m³

U = intake rate (inhalation rate of standard man), 8400 m³/yr

DF = dose conversion factor for ^3H , 9.45×10^{-8} mrem/pCi

By multiplying U and DF , the final, simplified equation becomes:

$$D(^3\text{H}) = C \times 7.94 \times 10^{-4}$$

11.2.3 Ingestion Dose Methods

Potential dose from ingestion of locally produced foodstuff and surface water is estimated by environmental sampling and computer modeling techniques. The dose assessment influences each of the significant agricultural products of the Livermore Valley. These include general vegetation and milk. Figure 23 illustrates the terrestrial food chain pathway analysis. Doses are also calculated for drinking water at each of the eight Livermore Valley water sampling locations. None of these locations are primary sources of drinking water. However, to provide an upper-bound estimate of dose at each location, a hypothetical person is assumed to obtain all his/her drinking water (2 liters per day) from that source.

AIRDOS-EPA Computer Method

The AIRDOS-EPA code is used to calculate ingestion doses based on airborne emission

data. The doses are calculated from deposition of radionuclides on crop land and pasture. AIRDOS-EPA uses the models from the NRC Regulatory Guide 1.109 to estimate annual doses to man from vegetables, meat, and milk consumption.⁵⁷ Dose conversion factors are specified by EPA.

Environmental Measurements Method

Data from the sampling and analysis of water and foodstuffs are also used to estimate dose.

Annual Dose from Potable Water

Assuming that all water sampled is available as drinking water, the annual whole-body dose for tritium is calculated using the following equation:

$$R_{\text{whole body}} = C_w U_w D_w,$$

where

C_w = concentration (pCi/liter),

U_w = intake rate (liters/yr) = 730 liters/yr for maximum exposed individual, and

D_w = dose factor (mrem/pCi) = 6.3×10^{-8} mrem/pCi for the whole-body ingestion pathway for an adult.

$R_{\text{whole body}}$ is the effective dose equivalent in mrem from ingestion of 730 liters of potable water with concentration C_w .

Annual Dose from Forage-Cow Milk Pathway for Tritium in Vegetation

Assuming that all feed for the cattle was pasture grass, the effective dose equivalent per $\mu\text{Ci}/\text{ml}$ of HTO for the maximum exposed individual has been calculated using the following equation:

$$D_{\text{whole body}} = D_{\text{veg}} + D_{\text{meat}} + D_{\text{milk}}$$

Broken down, each of these elements can be expressed as follows.

$$\textcircled{1} \quad D_{\text{veg}} = U_{\text{veg}} \times C_{\text{veg}} \times D_{\text{HTO}},$$

*leafy vegetables

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Figure 23. Dose assessment of terrestrial food chain pathway.

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where

U_{veg} = intake rate (kg/yr) = 64 kg/yr for maximally exposed individual,

C_{veg} = concentration (pCi/kg)
 $= 10^9 \frac{\text{pCi/kg}}{\mu\text{Ci/ml}} \times C_{veg} \mu\text{Ci/ml}$ (measured),

D_{HTO} = dose factor (mrem/pCi)
 $= 6.3 \times 10^{-8}$ mrem/pCi for ^3H for the adult whole-body ingestion pathway.

Thus,

$D_{veg} = 0.40 \times 10^4 C_{veg} \mu\text{Ci/ml}$ (measured).
(mrem/yr)

$$\textcircled{2} \quad D_{meat} = U_{meat} \times D_{HTO} \times C_{meat},$$

where

$U_{meat} = 110$ kg/yr,

$D_{HTO} = 6.3 \times 10^{-8}$ mrem/pCi, and

$C_{meat} = (F_f)(Q_f)(C_{veg}) \exp(-\gamma_1 \tau_s),$

where

F_f = fraction of daily intake of nuclide per kg of animal/fish (pCi/kg in meat per pCi/day ingested by the animal), days/kg,

Q_f = amount of feed consumed (kg/day),

C_{veg} = same as above,

γ_1 = radiological decay constant, day $^{-1}$, and

τ_s = time between slaughter to consumption (days).

Simplified,

$C_{meat} = (1.2 \times 10^{-2} \text{ day/kg}) (50 \text{ kg/day})$
 $(C_{veg} \mu\text{Ci/ml}) (10^9 \frac{\text{pCi/kg}}{\mu\text{Ci/ml}})$
 $\times \exp [-1.5 \times 10^{-4}(20)]$

$= 0.6 \times 10^9 \frac{\text{pCi/kg}}{\mu\text{Ci/ml}} \times C_{veg} \mu\text{Ci/ml}$
(measured).

Thus,

$D_{meat} = 0.41 \times 10^4 C_{veg} \mu\text{Ci/ml}$ (measured).
(mrem/yr)

$$\textcircled{3} \quad D_{milk} = U_{milk} \times D_{HTO} \times C_{milk},$$

where

$U_{milk} = 310$ liters/yr,

$D_{HTO} = 6.3 \times 10^{-8}$ mrem/pCi, and

$C_{milk} = F_m Q_f C_{veg} \exp(-\gamma_1 \tau_f),$

where

F_m = fraction of daily intake of nuclide per liter of milk (pCi/liter in milk per pCi/day ingested by the animal), liters/day,

Q_f = amount of feed consumed (kg/day),

C_{veg} = same as above,

γ_1 = radiological decay constant, days $^{-1}$,

τ_f = transport time from the feed to milk receptor.

Simplified,

$C_{milk} = (1.2 \times 10^{-2} \text{ liters/day}) (50 \text{ kg/day})$
 $(C_{veg} \mu\text{Ci/ml}) (10^9 \frac{\text{pCi/kg}}{\mu\text{Ci/ml}})$
 $\times \exp [1.5 \times 10^{-4}(2)]$
 $= 0.5 \times 10^9 \frac{\text{pCi/kg}}{\mu\text{Ci/ml}} \times C_{veg} \mu\text{Ci/ml}$
(measured).

Thus,

$D_{milk} = 0.97 \times 10^4 C_{veg} \mu\text{Ci/ml}$ (measured).
(mrem/yr)

11.0 RADIOLOGICAL DOSE ASSESSMENT

Combining all three elements, the final equation becomes:

$$\begin{aligned} D_{\text{whole body}} &= 0.40 \times 10^4 C_{\text{veg}} \mu\text{Ci/ml (measured)} \\ &\quad + 0.41 \times 10^4 C_{\text{veg}} \mu\text{Ci/ml (measured)} \\ &\quad + 0.97 \times 10^4 C_{\text{veg}} \mu\text{Ci/ml (measured)} \\ &= 1.78 \times 10^4 C_{\text{veg}} \mu\text{Ci/ml (measured)}. \end{aligned}$$

Annual Dose from Milk

The radiation dose (mrem) from tritium in milk is calculated using the annual average HTO concentration in Livermore Valley milk samples collected during the year. The following equation is used:

$$D_{\text{milk}} = U_{\text{milk}} \times D_{\text{HTO}} \times C_{\text{milk}},$$

where

$$U_{\text{milk}} = 310 \text{ l/yr},$$

$$D_{\text{HTO}} = 6.3 \times 10^{-8} \text{ mrem/pCi, and}$$

$$C_{\text{milk}} = \text{annual average HTO concentration in milk, in pCi/l.}$$

By multiplying U and D , this equation simplifies to:

$$D_{\text{milk}} = C_{\text{milk}} \times 2 \times 10^{-5}$$

11.3 Estimating Radiological Impact

11.3.1 Maximally Exposed Individual Dose

The maximally exposed individual dose represents the maximum credible dose to a hypothetical member of the general public. It includes contributions from all potential exposure pathways and is derived using conservative but realistic exposure data and assumptions. The hypothetical person is assumed to reside at the point of highest ground-level, radionuclide air concentration continuously for 24 hours a day, 365 days a year. During this occupancy period, a portion of the person's diet consists of locally produced foodstuffs and drinking water containing the highest measured radionuclide concentration. Rainwater is specifi-

cally excluded as a source of drinking water in these calculations. Thus, this dose is not actually received by any individual—it is a conservative estimate (i.e., over-estimate) of the highest possible dose that could be received by a member of the public.

The maximum dose is calculated by summing the doses from all credible exposure pathways. This can be expressed as:

$$D_{\text{max}} = D_{\text{external}} + D_{\text{inhalation}} + D_{\text{ingestion}}.$$

11.3.2 Collective Population Dose

The collective population dose is the dose for all individuals residing within an 80-km radius of the site. The area is divided into sectors, and the dose is calculated by summing the average individual dose for each sector multiplied by the number of individuals residing in the sector. The collective population dose is referred to as the "collective effective dose equivalent." It is expressed in terms of person-rem.

The effective dose equivalents in this report have been calculated according to models and methods consistent with the NRC Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluent*.⁵⁷ The dose and dose-rate conversion factor used in these calculations were obtained from the committed dose equivalent tables for DOE dose calculations. These dose conversion factors are consistent with those specified in ICRP 30.⁵⁵

For population dose, the diffusion parameters and population figures for a sector, i , within 80 km of SNL/California are summed over all directions, n .

$$D_{\text{(person-mrem)}} = 32.17 \times 10^4 \left[\sum_i^n (\chi/Q) P_i \right] Q U D$$

where

$$\left[\sum_i^n (\chi/Q) P_i \right] = \text{Sum of the } (\chi/Q) \text{ for sector, } i, \text{ times the population in sector, } i, \text{ for all regions, } n, \text{ persons—s/m}^3.$$

$$Q = \text{release rate, in Ci/yr,}$$

11.0 RADIOLOGICAL DOSE ASSESSMENT

- U = inhalation rate, average individual (adult),
D = dose factor, in mrem/pCi, and
 P_i = the population of the i th sector.

11.4 Results

Table 19 shows the calculated doses for the maximally exposed off-site individual for 1987–90. These doses should be compared to NESHAPs, which specifies that the dose to any individual from the air pathway not exceed 10 mrem per year.⁴

Different assumptions were used to arrive at the values in Table 19. Assumptions were changed during some years to improve the accuracy of the calculations or in response to guidance from DOE.

Table 19. Calculated Radiation Dose to the Maximally Exposed Off-site Individual, 1987–91

Year	Maximum Off-site Dose
1987	0.49 mrem
1988	1.40 mrem
1989	0.36 mrem
1990	0.15 mrem
1991	0.25 mrem

11.5 Recommendations

The nearest residence to the TRL (which is used for calculating the maximum off-site dose) lies in one of the least prevalent wind directions, as determined by on-site meteorological monitoring. Also, calculations show that the area of highest tritium-in-air concentrations from a TRL stack release is considerably farther away than 1 km. The doses to residences in a predominantly down-wind direction and near the distance of the maximum concentration value (approximately 2 km) should be calculated to determine if they represent more accurate estimates of the maximum dose from the facility.

To make the radiological impact assessment more realistic, site-specific exposure parameters should be used instead of model default values.

12.0 DATA MANAGEMENT

12.1 SNL/California

SNL/California has developed a Quality Assurance Management Plan for the ES&H and Facilities Center (Appendix C). This plan does not specifically address data review and management practices for the portions of the environmental monitoring system under SNL/California's direct control. The Environmental Monitoring Program has written a Quality Assurance Project Plan (Appendix B) and has drafted an Operating Procedure, OP-EM-9, *Data Validation and Verification*.⁷ These documents describe data management activities.

Data from the stack and LECS monitoring at the TRL are entered into a database maintained by the Health Physics Representative (HPR). The HPR is responsible for inspecting the data before it is entered into the database. (See Section 7.0 for more details.)

The Environmental Protection Department is responsible for maintaining data from the meteorological tower. These data are archived on floppy diskettes, which are stored in two locations, as described in Section 8.0.

Data from the LECS analyses and sewer outfall analyses are kept in a hard-copy file maintained by the Environmental Protection Department. The data are also available in spreadsheet format on a personal computer in the Environmental Protection Department.

12.2 LLNL

Data management done by LLNL is covered by the *Environmental Quality Verification Group Quality Assurance Plan*,⁵⁹ and procedure EMP-QA-D.⁶⁰ These documents meet the requirements of ANSI/ASME NQA-1,⁶¹ DOE, and EPA

for data analysis. In general, scientific personnel in the Environmental Monitoring Group review the data as they are received from the analytical laboratories. The Group compares them to past data for the particular location and analysis and to regulatory limits, if they exist. If the data are unusual, LLNL personnel investigate why (including re-analysis, resampling, examination of records). They determine and document the final disposition of the data according to regulatory guidelines.³

The data for the current calendar year for each type of monitoring are kept in the office of the appropriate scientist until the annual *Site Environmental Report* is completed,⁶² at which time the data is microfilmed. The microfilm is kept on file in the Environmental Monitoring Group, and the originals are sent to a different location for permanent storage.

12.3 Recommendations

The data exchange agreement between LLNL and SNL/California should be formalized. Data from LLNL are transmitted to SNL/California on paper. LLNL's EMG maintains most of its data in a computerized database. To more efficiently transmit data to SNL/California scientists who need it, SNL/California personnel should have computer access to this database. This procedure would also make data transfer from LLNL more timely.

Databases should be established for all data generated by SNL/California.

All data should be reviewed according to a set schedule.

13.0 RECORDS AND REPORTS

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

- an annual site environmental report, prepared annually and a draft submitted to DOE by June 1 of the following year; this report summarizes all environmental monitoring data and all environmental activities at the SNL/California site;
- quarterly groundwater monitoring reports, submitted to the RWQCB. 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.
- semiannual categorical process reports, prepared biannually and sent to the City

of Livermore; 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;²⁵

- an annual report of the total radioactive effluents, sent to the DOE Waste Information Systems Branch;
- a monthly report on the results of the sewer monitoring program, sent to the LWRP; and
- an annual radionuclide air emissions report for compliance with NESHAPs, sent to the EPA detailing emissions from the TRL.

Table 20 summarizes the Environmental Monitoring Program's reporting requirements.

Table 20. 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 Effluent Information System Report	Annually	April 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
Sewer Monitoring Report	Monthly	20th of the month	LWRP	Transmittal of sewer outfall self-monitoring data
Semiannual Categorical Process Report	Semiannually	Jan. 15, July 15	LWRP	Required by Federal Pretreatment Standards; Title 40 CFR, Part 403.12; and LWRP Wastewater Discharge Permit
Radionuclide Air Emissions Report	Annually	April 18	EPA	Required by Title 40 CFR, Part 61, Subpart H (NESHAPs)

14.0 DOCUMENT CONTROL

14.1 SNL/California

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 ES&H and Facilities Center (Appendix C) includes details of a document control system. The system includes guidance on safeguarding, handling, and archiving documents. Each department in the ES&H and Facilities Center is responsible for determining which of its records are to be classified as Quality Assurance Records.

The ES&H and Facilities Center has established 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.

14.2 LLNL

LLNL's EMG controls documents according to the provisions of either the EMG Quality Assurance Plan or the Quality Assurance Program Plan for RASL.⁶³ These plans detail the procedures for controlling documents and procedures. In general, all operational procedures and design documents must be independently verified by a knowledgeable person and then approved for use by management. Copies of the procedures are numbered and issued to personnel. This process assures that personnel doing the work are using the most current version of the procedure. All revisions to procedures must receive the same level of approval as the original document. All obsolete documents are kept in an historical file to maintain continuity.

15.0 QUALITY ASSURANCE

15.1 SNL/California

The ES&H and Facilities Center of SNL/California issued its first Quality Assurance Management Plan in April 1991. This plan met the requirements of DOE Order 5700.6B.¹⁰ It represented the inception of the ES&H Quality Assurance Program

Since April 1991, a quality assurance framework has been created to better control and document ES&H activities. Thirteen Implementing Procedures (IPs) have been written (Table 21) to provide specific control requirements.

A new Quality Assurance Management Plan is being reviewed. It was revised to address the new DOE quality assurance requirements contained in Order 5700.6C.⁶⁴ It also incorporates lessons learned in the first years of the quality assurance program. The draft ANSI/ASQC E-4 was used to apply EPA quality requirements, where appropriate.⁶⁵ Facilities' requirements have also been added; the Center for ES&H and Facilities now operates under one Quality Assurance Program.

The Program is now phasing into implementation. IPs will be modified to accommodate Facilities' requirements. Recently issued IPs will be implemented so as to be consistent with other requirements for organizations. The Quality Assurance Program will continue to be upgraded to meet new requirements and to improve existing processes.

Much work has been accomplished already. The Environmental Monitoring Program Man-

Table 21. Quality Assurance Implementing Procedures

ID#	Title
IP-1.01	Development of the Quality Assurance Plan
IP-2.01	Qualification and Training (Issue B)
IP-4.01	Development of Implementing Procedures
IP-4.02	Development of Operating Procedures
IP-4.03	Document Control
IP-4.04	Records Management
IP-5.01	Identification and Control to Technical Data
IP-5.02	Identification and Control
IP-5.03	Control of Measuring and Test Equipment
IP-7.01	Procurement
IP-9.01	Management Assessment
IP-10.01	Independent Assessment

ager has written a Quality Assurance Project Plan to describe specifically how to apply quality assurance requirements to environmental monitoring activities. More than 130 implementing procedures have been approved and issued to control tasks. Another 50 have been drafted. Several operating procedures for the Environmental Monitoring Program have been issued. They incorporate chain-of-custody procedures, quality control samples to be collected, and details required for controlling "special processes."

15.2 LLNL

The collection of environmental samples by LLNL's EMG is covered by the *Environmental Quality Verification Group Quality Assurance Plan*.⁵⁹ This plan meets the requirements of DOE/EH-0173T,³ ANSI/ASME NQA-1,⁶¹ and EPA guidelines for the preparation of quality assurance program plans. The provisions of this plan have been implemented through the *Environmental Quality Verification Group Procedures Manual*.⁶⁶

Environmental sample processing done by LLNL's Nuclear Chemistry Division is covered by the *Radiological Analytical Services Laboratory Quality Assurance Project Plan*.⁶³ This plan also meets the requirements of DOE/EH-0173T,³ ANSI/ASME NQA-1,⁶¹ and EPA guidelines for preparing quality assurance program plans.

Contract laboratories doing analyses for LLNL and 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.

15.3 Recommendations

Sandia should increase its oversight and assessment of LLNL's environmental sampling and analysis programs. Quality assurance programs for the on-site laboratories should be implemented. During the records archiving process, all environmental monitoring data, procedures, and plans were designated quality assurance records.

REFERENCES

1. U. S. DOE, Order 5400.1, *General Environmental Protection Program* (November 1988).
2. U. S. DOE, Order 5400.5, *Radiation Protection of the Public and the Environment* (March 1988).
3. U. S. DOE, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T (1991).
4. U. S. EPA, Title 40 Code of Federal Regulations (CFR), Part 61, Subpart H, *National Emission Standards for Hazardous Air Pollutants (NESHAPs)* (1989, latest amendment).
5. U. S. EPA, *Quality Assurance Handbook for Air Pollution Measurement Systems*, Vol. IV, EPA 600/9-76-005 (1989).
6. U. S. EPA, Title 40 CFR, Part 58, *Ambient Air Quality Surveillance* (1987, latest amendment).
7. R. C. Holland, *Data Validation and Verification*, Operating Procedure OP-EM-9 (March 1993).
8. U. S. DOE, Order 5480.1B, *Environment, Safety and Health Program for Department of Energy Operations* (September 1986).
9. U. S. DOE, Order 5000.3A, *Unusual Occurrence Reporting System* (November 1984).
10. U. S. DOE, Order 5700.6B, *Quality Assurance* (March 1989).
11. U. S. EPA, Title 40 CFR, Part 50, *National Ambient Air Quality Standards* (1987, latest amendment).
12. U. S. EPA, Title 40 CFR, Part 60, *Performance Standards for New Stationary Sources* (1987, latest amendment).
13. U. S. EPA, Title 40 CFR, Parts 122-25, *National Pollutant Discharge Elimination System* (1990, latest amendment).
14. U. S. EPA, Title 40 CFR, Part 129, *Toxic Pollutant Effluent Standards and Prohibitions* (1977).
15. U. S. EPA, Title 40 CFR, Part 403, *General Pretreatment Regulations for Existing and New Sources of Pollution* (July 1983).
16. U. S. EPA, Title 40 CFR, Parts 413 and 459, *Point Source Categories* (1986, latest amendment).
17. State of California, Title 18 California Code of Regulations (CCR), *Air Toxics "Hot Spots" Information and Assessment Act* (1987).
18. Title 23 CCR, Division 3, Chapter 1, *State Water Resources Board and Regional Water Quality Control Boards* (1981).
19. Title 23 CCR, Division 3, Chapter 9, *Designation, Reportable Quantities, and Notification* (1990, latest amendment).
20. Title 17 CCR, *Public Health*, Chapter 5, Subchapter 4, "Radiation" (1945, as amended).
21. U. S. EPA, *Safe Drinking Water and Toxic Enforcement Act of 1986* (1986).
22. State of California, Environmental Protection Agency (Cal EPA), *California Clean Air Act* (1988).
23. State of California, Bay Area Air Quality Management District (BAAQMD), *Rules and Regulations* (January 1980).
24. City of Livermore, Municipal Code Section 13.32, *General Discharge Prohibitions* (1983).
25. U.S. EPA, Title 40 CFR, Part 433, *Metal Finishing Point Source Categories* (1983).
26. U.S. DOE, Sandia National Laboratories, *ES&H Manual*, MN471001 (February 1990).
27. R. C. Holland and D. D. Brekke, *Environmental Protection Implementation Plan*, Sandia National Laboratories/California (October 1992).
28. U.S. DOE, Order 5400.4, *Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)* (October 6, 1989).

REFERENCES

29. Frank J. Gouveia and K. Renee Chapman, *The Climatology of Lawrence Livermore National Laboratory*, UCID-21686 (September 1989).
30. Environmental Sciences Associates, Inc., *Sandia National Laboratories—Livermore Environmental Field Investigations*, San Francisco, CA (1990).
31. C. I. Busby, and D. M. Garaventa, *A Cultural Resources Overview and Historic Preservation Regulatory Analysis of Sandia National Laboratories, Livermore Facility, Alameda County, California*, Basin Research Associates, San Leandro, CA (1990).
32. C. I. Busby, D. M. Garaventa, and R. M. Harmon, *A Cultural Resources Assessment of Sandia National Laboratories, Livermore Facility, Alameda County, California*, Basin Research Associates, San Leandro, CA (1990).
33. U.S. DOE, Order 5820.2A, *Decommissioning of Radioactively Contaminated Facilities* (1989).
34. U.S. DOE, Sandia National Laboratories/California, *TRL Quarterly Health Physics Compliance Report* (sent to DOE quarterly).
35. U.S. DOE, Sandia National Laboratories/California, *Effluent Information System Report* (annual).
36. D. D. Brekke and R. C. Holland, *Site Environmental Report for 1991*, Sandia National Laboratories/California, SAND92-8001 (October 1992).
37. D. D. Brekke, *Wastewater Discharge Program Plan*, Sandia National Laboratories/California (April 1993).
38. U.S. Congress, *Clean Air Act Amendments of 1977*, PL95-95, specifically the "National Ambient Air Quality Standards" (NAAQSs).
39. M. Merry, *Meteorological Monitoring Plan and Draft Operating Procedures* (March 1993).
40. U.S. Nuclear Regulatory Commission (NRC), *Regulatory Guide 4.13, Performance, Testing, and Procedural Specifications for Thermoluminescent Dosimetry: Environmental Applications*, Revision 1 (1977).
41. American National Standards Institute (ANSI), *Performance, Testing, and Procedural Specifications for Thermoluminescent Dosimetry: Environmental Applications*, ANSI-N545 (1975).
42. U.S. EPA, *Test Methods for Evaluating Solid Waste—Physical/Chemical Methods*, Third. Ed., SW-846 (1986).
43. A. T. Leo, *Groundwater Protection Program Plan*, Sandia National Laboratories/California (September 1990).
44. A. T. Leo, *Groundwater Investigation Reports*, Sandia National Laboratories/California (quarterly, 1990–91).
45. U.S. DOE, Lawrence Livermore National Laboratory, *Analysis of Uranium and Gamma in Air Particulates*, Radiological Analytical Services Laboratory, TIP-RASL-008 (Draft, November 1991).
46. U.S. DOE, Lawrence Livermore National Laboratory, *Tritium Analysis of Water Samples*, Radiological Analytical Services Laboratory, TIP-RASL-011 (Draft, November 1991).
47. U.S. DOE, Lawrence Livermore National Laboratory, *Arroyo Sediment Tritium Determination*, Radiological Analytical Services Laboratory, TIP-RASL-003 (Draft, November 1991).
48. U.S. DOE, Lawrence Livermore National Laboratory, *Plutonium and Gamma Analysis of Soil and Sediment Samples*, Radiological Analytical Services Laboratory, TIP-RASL-009 (Draft, November 1991).

REFERENCES

49. U.S. DOE, Lawrence Livermore National Laboratory, *Tritium Analysis of Vegetation Samples*, Radiological Analytical Services Laboratory, TIP-RASL-005 (Draft, November 1991).
50. U.S. DOE, Lawrence Livermore National Laboratory, *Tritium and Gamma Analysis of Milk Samples*, Radiological Analytical Services Laboratory, TIP-RASL-006 (Draft, November 1991).
51. U.S. DOE, Lawrence Livermore National Laboratory, *Tritium and Gamma Analysis of Wine Samples*, Radiological Analytical Services Laboratory, TIP-RASL-013 (Draft, November 1991).
52. U.S. DOE, Lawrence Livermore National Laboratory, *Tritium Analysis of Honey Samples*, Radiological Analytical Services Laboratory, TIP-RASL-012 (Draft, November 1991).
53. U.S. DOE, Sandia National Laboratories, Livermore, *Metals Analysis*, Draft Operating Instruction (July 1991).
54. International Commission on Radiological Protection, *Recommendations of the International Commission on Radiological Protection*, ICRP 26 (1977).
55. International Commission on Radiological Protection, *Limits of Intakes of Radionuclides by Workers*, ICRP 30 (1980).
56. U. S. DOE, Oak Ridge National Laboratory, *RSIC Computer Code Collection*, "CAAC, Code System for Implementation of Atmospheric Dispersion Assessment Required by the Clean Air Act," CCC-476 (1986).
57. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluent for the Purpose of Evaluation Compliance with 10 CFR Part 50, Appendix 1* (1977).
58. U.S. EPA, *Radionuclides Background Information Document for Final Rules* (1984a).
59. Robert C. Holland, *Environmental Quality Verification Group Quality Assurance Plan*, Lawrence Livermore National Laboratory, UCAR-10203 (1987).
60. U.S. DOE, Sandia National Laboratories/California, *Data Analysis*, EMP-AQ-D (Draft).
61. American Society of Mechanical Engineers, *Quality Assurance Program Requirements for Nuclear Facilities*, ANSI/ASME NQA-1 (1986).
62. G. M. Gallegos et al., *Environmental Report for 1991*, Lawrence Livermore National Laboratory, UCRL-50027-91 (1992).
63. J. Merrigan, *Radiological Analytical Services Laboratory Quality Assurance Project Plan*, Lawrence Livermore National Laboratory (1991).
64. U. S. DOE, Order 5700.6C, *Quality Assurance* (August 1991).
65. American National Standards Institute, *Quality Assurance Program Requirements for Environmental Programs*, ANSI/ASQC E-4-19xx (ASQC-wide review draft, September 1991).
66. D. D. Brekke, M. G. Brown, T. M. Carlsen, and R. C. Holland, *Environmental Quality Verification Group Procedures Manual*, Lawrence Livermore National Laboratory, UCAR-10254 (1988).

ACRONYMS AND ABBREVIATIONS

AIP	Agreement in Principle
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
CAAC	Clean Air Act Code
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
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
GPS	Gas Purification System
HEPA	High-efficiency particulate air (filter)
HPR	Health Physics Representative
HT	elemental tritium (gas)
HTO	tritium oxide (tritiated water)
ICRP	International Commission on Radiological Protection
LECS	Liquid Effluent Control System
LLNL	Lawrence Livermore National Laboratory
LWRP	Livermore Water Reclamation Plant
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
POTW	Publicly-Owned Treatment Works
RASL	Radiological Analytical Services Laboratory (LLNL)
RWQCB	Regional Water Quality Control Board
SNL	Sandia National Laboratories
TDS	total dissolved solids
TLD	thermoluminescent dosimeter
TOC	total organic carbon
TRL	Tritium Research Laboratory
TSS	total suspended solids
TTO	total toxic organics
VERS	Vacuum Effluent Recovery System

Appendix A

Sandia National Laboratories/California Permits

SNL/CALIFORNIA PERMIT DATA

Source #*	Description	Substance	BAAQMD Regulation
Air (cont.)			
Sources 6 & 7 Stacks P6 and P7	Boilers #1 & 2 5MM BTU/hr max	natural gas or #2 diesel oil	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations
Exempt Source 9 Stack P9 Abatement Device A2	Dust Collector 4 tons/hr. max. Abated by baghouse with reverse air	particulates	Reg 6, Particulate Matter & Visible Emissions
Source 12 Stack P12	Incinerator/ BAYCO Reclamation Furnace Multiple chamber 2025 BTU/hr max	#2 diesel oil	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations
Source 16 Stack P16	Paint Spray Booth	paint solvent/ lacquer thinner	Reg 8, Rule 4, General Solvent and Surface Coating Operations Reg 8, Rule 19, Surface Coating of Misc. Metal Parts and Products
Source 20	Cold Cleaner Zep-Dyna Degreaser	CSD-43 solvent (perchloro-ethylene)	Reg 8, Rule 16, Solvent Cleaning Operations
Source 21	Cold Cleaner Zep-Dyna Degreaser	Voltz solvent (mineral spirits)	Reg 8, Rule 16, Solvent Cleaning Operations
Source 22	Boiler 1.2 M BTU/hr max	natural gas or #2 diesel oil	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations
Sources 23 & 24	Boilers 1 & 2 2.5 MM BTU/hr max	natural gas or #2 diesel oil	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations
Source 25	Boiler 3.2 MM BTU/hr max	natural gas or #2 diesel oil	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations
Sources 26 & 27	Boilers 1 & 2 3.0 MM BTU/hr max	natural gas or #2 diesel oil	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations
Sources 28 & 29	Boilers 1 & 2 3.5 MM BTU/hr max	natural gas or #2 diesel oil	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations

*Source numbers apply to air permits only.

Source #	Description	Substance	BAAQMD Regulation
Air (cont.)			
Exempt Source 30	Diesel Fuel Dispensing Tank	#2 diesel oil	Exemption based on Reg 2-1-123.3.2, Liquid Storage and Loading Equipment
Exempt Source 31	Diesel Fuel Dispensing Tank	#2 diesel oil	Exemption based on Reg 2-1-123.3.2, Liquid Storage and Loading Equipment
Source 32	Gasoline Dispensing Facility; Service Station #G8307	gasoline	Reg 8, Rule 7, Gasoline Dispensing Facilities
Source 33	Vapor Degreaser Tool Tronics VC-1618	AP-20 (90% trichloroethylene)	Reg 8, Rule 16, Solvent Cleaning Operations
Source 34	Vapor Degreaser Tool Tronics VC-100-US	1,1,1 trichloroethane	Reg 8, Rule 16, Solvent Cleaning Operations
Source 35	Cold Parts Cleaner with Vapor Recovery Still, Zerpa, Recyclene RS-14	methylene chloride	Reg 8, Rule 16, Solvent Cleaning Operations
Source 36	Ultrasonic Cleaner—Crest Model HNT 415, 5 gal. with Solvent Recovery Still, Branson, Model 111	1,1,1 trichloroethane	Reg 8, Rule 16, Solvent Cleaning Operations
Source 37 P-37, A 37, A 38	Tritium Research Laboratory abated by Gas Purification System (GPS) and Vacuum Effluent Recovery System (VERS)	tritium	Reg 2, Rule 5, Toxic Air Contaminants
Source 38	Tritium Research Lab, Tritium Wastewater Evaporator	tritium	Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 39	Potassium Gold Cyanide Plating Operation	potassium gold cyanide	Exempt based on Reg 2-1-127.3, Chemical Processing Equipment
Exempt Source 40	Branson Ultrasonic Cleaner	Radiacwash non-VOC cleaner	Not a source of air contaminants
Exempt Source 41	Vapor Phase Reflow Soldering Unit		Exempt based on Reg 2-1-128.11, Miscellaneous Equipment
Exempt Source 42	Traveling Furnace		Exempt based on Reg 2-1-116.8, Furnaces, Ovens and Kilns
Exempt Source 43	Wipe Cleaning Operation, Laser Plasma Lab	solvents/ozone precursors	Exempt based on Reg 2-1-118.7, Surface Preparation and Cleaning Equipment
Exempt Source 44	Plastics Lab Ovens		Exempt based on Reg 2-1-116.5, Furnaces, Ovens and Kilns
Exempt Source 45 (Exempt)	Photo Lab, Photo Developing Operations		Exempt based on Reg 2-1-127.2, Chemical Processing Equipment
Exempt Source 46 Stack P-20, A-4	Low-pressure Flat Flame Burner abated by scrubber	hydrogen cyanide modification to use 1-3 butadiene	Exemption requested pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment For modification exemption, request based on Reg 1, 111.1, Experimental Operations
Exempt 48	AB Dick Offset Printing Press	VOCs	Exempt based on Reg 2-1-119.6, Surface Coating and Printing Equipment
Source 49	Monograph Offset Printing Press	VOCs	Reg 8, Rule 20, Graphics Arts Printing and Coating Operations
Exempt Source 50	Explosive Test Facilities Explosive Test Cell	byproducts of explosive detonations	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants

Source #	Description	Substance	BAAQMD Regulation
Air (cont.)			
Exempt Source 51	Explosive Test Facilities Explosive Test Cell	byproducts of explosive detonations	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 52	Explosive Test Facilities Trio-Tech Centrifuge	byproducts of explosive detonations	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 53	Spin Facility	byproducts of explosive detonations	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 54	Liquid Propellant Gun Process	byproducts of explosive detonations	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Source 55 P-55, A-55	Decontamination Sink in Fume Hood abated by HEPA Filters	depleted uranium	Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Source 56 P-56, A-56	Waste Compactor abated by HEPA Filter	particulates	Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 57 P-57	Foams Development Lab	toluene diisocyanates, styrene, methylene chloride	Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 58	Walk in Oven		Exemption request based on Reg 2-1-116.5, Furnaces, Ovens and Kilns
Exempt Source 59	Vacuum Oven		Exemption request based on Reg 2-1-116.5, Furnaces, Ovens and Kilns
Source 60	Drum Crusher	particulates	Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 61	Laser Chemistry Lab	benzene, methylene chloride, vinyl chloride, 1-3-butadiene, 1,4-dioxane, acetaldehyde, phenol, methylene chloride -d2	Exemption request based on Reg 1, 111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 62	Chemical Dynamics Lab	benzene, chloroform, carbon tetrachloride, ethylene oxide, methyl bromide	Exemption request based on Reg 1, 111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 63	Cluster Chemistry Lab	no pollutants released, exemption requested due to the use of a TAC in wipe cleaning operation; see Source 64	Exemption request based on Reg 1, 111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants

Source #	Description	Substance	BAAQMD Regulation
Air (cont.)			
Exempt Source 64 P-64	Cluster Chemistry Lab Wipe Cleaning Operation	carbon tetrachloride	Exemption request based on Reg 1, 111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Abatement Device 65	Scrubber for the Gas Phase Materials Synthesis Laboratory	none, chlorosilanes and HCL are scrubbed from the effluent, which is otherwise not regulated	Reg 2-1-112, New Abatement Device
Exempt Source 65 P-65	Gas Phase Materials Synthesis Laboratory, an exempt source	none, chlorosilanes and HCL are scrubbed from the effluent which is otherwise not regulated	Exemption requested pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment
Exempt Source 66	Hybrid Microcircuit Lab, Ammonia Based etching	ammonia	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment
Exempt Source 67	Hybrid Microcircuit Lab, Micro Pen Printer	cadmium, lead, gold, VOCs	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 68	Hybrid Microcircuit Lab, Screen Printer	cadmium, lead, gold, VOCs	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 69	Hybrid Microcircuit Lab, Despatch Oven	cadmium, lead, gold, VOCs	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 70	Hybrid Microcircuit Lab, Infrared Oven	cadmium, lead, gold, VOCs	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 71	Ultrafast Phenomena Lab		Not a source of air contaminants
Pending Exempt Source 72	Chemical Kinetics Lab Experiments	hydrazine	Exemption requested pursuant to Reg 1, Rule 1.111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Pending Exempt Source 73	Chemical Kinetics Lab Mixing operation	chloroform	Exemption requested pursuant to Reg 1, Rule 1.111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants
Exempt Source 74	Macro Molecular Chemistry Laboratory	carbon tetrachloride, 1,4 dioxane, styrene, benzene, ethylene dichloride, acrylamide, methylene chloride, 1,3 butadiene, chloroform, formaldehyde, trichloroethylene,	Exemption requested pursuant to Reg 1, Rule 1.111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants

Source #	Description	Substance	BAAQMD Regulation
Air (cont.)			
(Exempt Source 74, cont.)	(Macro Molecular Chemistry Laboratory)	acrylonitrile, ethyl acrylate, chloroprene, nitrobenzene, xylenes, di (2-ethylhexyl) phthalate, p-dichlorobenzene, hydrazine, inorganic lead, toluene diisocyanate, allyl chloride, benzyl chloride, chlorobenzene, cresol, glycol ethers, maleic anhydride, phenol, chlorinated dioxins, benzo(a) pyrene, mercury, PAHs, PCBs	(Exemption requested pursuant to Reg 1, Rule 1.111.1, Experimental Operations Required a health risk screening evaluation according to Reg 2, Rule 5, Toxic Air Contaminants)
Exempt Source 76	Inorganic Synthesis and Vacuum Analytical Laboratory	benzene, carbon tetrachloride, chloroform, chromium (VI), formaldehyde, methylene chloride, trichloroethylene	
Source 77	Hard Chrome Plating Bath	hexavalent chromium	Reg 11, Rule 8, Hexavalent Chromium
Source 79	Wipe Cleaning Operations	more than 5 gal/yr of solvents used for wipe cleaning	Reg 8, Rule 16, Solvent Cleaning Operations
Sources 81 & 82	Boiler #2 Cleaver-Brooks CB200 7,320,000 BTU/hr 175 boiler hp	NO _x	Reg 6, Particulate Matter & Visible Emissions Reg 9, Rule 1, Sulfur Dioxides Reg 9, Rule 3, Nitrogen Oxides from Heat Transfer Operations
Exempt Source 83	Instapak Foam Machine	isocyanates	Reg 1-110.6, Exclusions—Emission point that is not an intentional opening and from which no significant quantities of air contaminants are emitted
Pending Source 84	Vapor Degreaser	1,1,1-trichloroethane	Reg 8, Rule 16, Solvent Cleaning Operations
Source 85	Ammonia-based Etchant	ammonia	
Exempt Source 86	Turbulent Combustion Laboratory	halon	Exemption granted pursuant to Reg 2, Rule 2-1-126.2, Testing Equipment and Reg 2, 2-1-114.1, General Combustion Equipment
Pending Source 87	Portable Abrasive Blaster	particulates	Reg 6, Particulate Matter & Visible Emissions Reg 12, Rule 4, Misc. Standards of Performance, Sandblasting
Pending Source 89	Abrasive Blaster	particulates	Reg 6, Particulate Matter & Visible Emissions Reg 12, Rule 4, Misc. Standards of Performance, Sandblasting

Source #	Description	Substance	BAAQMD Regulation
Air (cont.)			
Pending Source 90	Waste Handling Station, Tritium Research Lab	tritium	Reg 2, Rule 5, Toxic Air Contaminants
Pending Source 91	Abrasive Blaster	particulates	Reg 6, Particulate Matter & Visible Emissions Reg 12, Rule 4, Misc. Standards of Performance, Sandblasting
Wastewater			
	Wastewater Discharge	Hazardous, toxic, and radioactive materials	City of Livermore, Municipal Code, Section 13.32
	Electroplating Laboratory	Metals in plating baths	Title 40 CFR, Parts 403, 413, and 459
	Printed Wiring Facility	Metals, VOCs	Title 40 CFR, Parts 403, 413, and 459
Hazardous Waste			
	Waste Management	Hazardous waste	Title 40 CFR, Part 264; Title 22 CCR, Parts 2611–2714
	Waste Management	Extremely hazardous waste transport	Title 22 CCR, Part 66570(b)
	Underground Storage Tank	Diesel fuel	Title 22 CCR, Parts 2611–2714

Appendix B

Quality Assurance Project Plan

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Environmental Monitoring Program Quality Assurance Project Plan

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ENVIRONMENTAL MONITORING PROGRAM QUALITY ASSURANCE PROJECT PLAN

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ABSTRACT

The Quality Assurance Project Plan (QAPP) is intended to document the quality assurance of the Environmental Monitoring Program. The Quality Assurance Project Plan has two parts and is written to become a chapter in the *Environmental Monitoring Plan*. Part A describes the management responsibilities and activities performed to assure the quality of the Environmental Monitoring Program. Part B covers the documentation requirements for changes in the Monitoring Program, and provides details on control of the design and implementation of quality assurance activities.

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ENVIRONMENTAL MONITORING PROGRAM QUALITY ASSURANCE PROJECT PLAN

The Environmental Monitoring Program ensures that SNL/California complies with Federal, State, and local regulations, and DOE Orders governing emissions to the environment. The Program monitors airborne emissions sources, wastewater discharges, and the environment of the Laboratory and nearby vicinity to verify compliance. The program also provides training to line organizations on issues concerning discharges to the air and sanitary sewer.

The Environmental Monitoring Program is part of the Environmental Protection Department within the Center for Environment, Safety & Health (ES&H) and Facilities. The *Environmental Monitoring Plan*, a document required by DOE Order 5400.1 that must be reviewed annually, describes the Environmental Monitoring Program in detail.^{1,2}

The Quality Assurance Project Plan (QAPP) is intended to document the quality assurance of the Environmental Monitoring Program, following guidance presented in DOE Order 5700.6C and ANSI/ASQC-E4-19xx.^{3,4} The Quality Assurance Project Plan has two parts and is written to become a chapter within the *Environmental Monitoring Plan*. Part A describes the management responsibilities and activities performed to assure the quality of the Environmental Monitoring Program. Part B covers the documentation requirements for changes in the Monitoring Program, and provides details on control of the design and implementation of quality assurance activities.

PART A — MANAGEMENT SYSTEMS

Management Commitment and Organization

The manager of the Environmental Protection Department is fully committed to implementing the Center for ES&H and Facilities *Quality Assurance Management Plan (QAMP)*.⁵ Pursuant to this commitment, he directed development of this QAPP to implement the QAMP within the Environmental Monitoring Program.

The Department Manager retains ultimate responsibility for implementing this Quality Assurance Project Plan (QAPP). The Environmental Monitoring Program Manager is responsible for ensuring the application of QAPP provisions to daily Program activities.

The primary responsibility, however, for the quality of the work within the Environmental Monitoring Program rests with the individual performing the work. No individual will work on a project for which he or she is not qualified. Each individual is responsible for understanding and complying with the quality assurance requirements for any task performed.

Figure 1 shows the organizational structure of the Environmental Monitoring Program and its relationship to the Environmental Protection Department.

The Environmental Monitoring Program also interfaces with other organizations within and outside of Sandia:

- Lawrence Livermore National Laboratory (LLNL) conducts most of the off-site environmental monitoring. Monitoring Program personnel receive LLNL

Figure 1. Organizational structure of the Environmental Protection Department.

off-site monitoring data to review ongoing environmental quality and to prepare the annual Site Environmental Report.

- The on-site Atmospheric Release Advisory Capability (ARAC) system provides meteorological data as inputs to computer dose modeling programs.
- The Environmental Technology Program of the Environmental Protection Department performs metals analyses of the wastewater samples collected from the Liquid Effluent Control Systems (LECS).
- The ES&H and Facilities Management Center Quality Assurance Organization provides independent oversight for and assessment of the implementation of this QAPP.
- Off-site analytical laboratories analyze environmental samples and support sample collection activities.

Quality Assurance Program Description

The Quality Assurance Program for the Environmental Monitoring Program includes:

- The ES&H and Facilities Center QAMP and its Implementing Procedures (IPs), and
- This QAPP and the Operating Procedures written to support its implementation.

The QAMP covers quality assurance traits common to all functions of the Center for ES&H and Facilities. These standardized functions include management assessment, personnel qualifications and training, procurement policies, and document control.

This QAPP applies to all program specific activities necessary to produce the desired type and quality of environmental monitoring data. These activities include: sample collection, data validation, data manipulations, equipment calibration, dose calculations, and reports.

The Operating Procedures will be established in accordance with IP 4.02, *Development of Operating Procedures*.⁶ The procedures will cover the following areas:

- Data analysis
- Meteorological monitoring
- Direct radiation monitoring
- Sewer monitoring
- Liquid Effluent Control System monitoring (LECS)
- Stormwater runoff monitoring
- Annual off-site radiological dose assessment
- Sampling process wastewater for federal categorical pretreatment regulation compliance.

Planning documents and operating procedures, as described in the QAMP and this QAPP, will be developed before any new activity affecting quality is undertaken. These documents and procedures serve to ensure the data produced are of the required type and accuracy commensurate with the importance of the activity.

Personnel Training and Qualification

The qualifications and training of Environmental Monitoring Program personnel conform to the requirements of QAMP Section 2, and IP 2.01, *Qualifications and Training*.⁷ This IP requires that training documentation or training exemption documentation be maintained for all personnel and procedures. Table 1 lists job descriptions and qualifications within the Environmental Monitoring Program.

In accordance with IP 2.01, the Environmental Monitoring Program Manager is responsible for assuring and documenting that Program personnel receive appropriate training for their duties. The Program Manager maintains training records for all personnel and keeps copies for quality assurance records, as specified in IP 4.04, *Records Management*.⁸ Table 2 shows the training required of all Monitoring Program personnel. Table 3 shows additional training that may be required of individual Monitoring Program personnel, depending on their assigned duties.

Table 1. Job Descriptions and Qualifications

Position	Qualifications
Environmental Monitoring Program Manager Responsible for the overall management of the Environmental Monitoring Program, including sampling strategies and methods, preparing required reports, interacting with regulatory agencies, and informing management of Environmental Monitoring activities.	Master's degree in Environmental Science, Biology, Health Physics, or related biological or physical science. Minimum of five years' experience in environmental monitoring, meteorological monitoring, radiological dose assessment, or related environmental field.
Task Leader Responsible for a given task or a particular project. Responsibilities include performing all technical aspects of the given task in compliance with DOE Orders, Federal, State, or local regulations, and Sandia procedures, as appropriate.	Bachelor's degree in Environmental Science, Biology, Health Physics, or related biological or physical science, or equivalent experience. Minimum of two years' experience in environmental monitoring, meteorological monitoring, radiological dose assessment, or related environmental field.
Task Support Responsible for assisting Task Leaders and the Program Manager as assigned.	Bachelor's degree in Environmental Science, Biology, Health Physics, or related biological or physical science, or equivalent experience. Minimum of two years' experience in environmental monitoring, meteorological monitoring, radiological dose assessment, or related environmental field.
Technical Support Responsible for field monitoring, sample collecting, handling, storage, shipping to appropriate analytical facilities, analyzing report verification, and maintaining sampling equipment.	Two-year technical degree, or the equivalent. Minimum of two years' experience in either environmental sampling or installing and maintaining mechanical or electrical systems.

Table 2. Mandatory Training Requirements for Environmental Monitoring Personnel

Training	Frequency
Radiation Safety Orientation	Biannual
Fire Extinguisher Awareness	Annual
Occurrence Reporting Procedures	Biannual
Lockout/Tagout Awareness	Annual
Emergency Preparedness Awareness	Annual
ES&H Rights Self-Study	Annual
Quality Assurance Project Plan Orientation	Upon hire, or changes to the QAPP

Table 3. Individual Training Requirements for Environmental Monitoring

Training	Frequency
Data Validation and Verification	Upon assignment of responsibility or update of the procedure.
Control of the LECS	Upon assignment of responsibility or update of the procedure.
Operation of the B. 913 LECS	Upon assignment of responsibility or update of the procedure.
Operation of the B. 906 LECS	Upon assignment of responsibility or update of the procedure.
Operation of the B. 910 LECS	Upon assignment of responsibility or update of the procedure.
Operation of the B. 968 LECS	Upon assignment of responsibility or update of the procedure.
TLD Collection	Upon assignment of responsibility or update of the procedure.
Meteorological Program Performance Checks	Upon assignment of responsibility or update of the procedure.
Data Analysis	Upon assignment of responsibility or update of the procedure.
Sanitary Sewer Outfall Monitoring	Upon assignment of responsibility or update of the procedure.
Dose Assessment	Upon assignment of responsibility or update of the procedure.
Stormwater Runoff Monitoring	Upon assignment of responsibility or update of the procedure.
Federal Categorical Process Monitoring	Upon assignment of responsibility or update of the procedure.

Management Assessment

The Director of the Center for ES&H and Facilities is responsible for management assessment of the operations of the Environmental Monitoring Program. These duties and responsibilities are detailed in IP 9.01, *Management Assessment*.⁹

Environmental Monitoring Program personnel are responsible for cooperating with the management assessment teams. This cooperation includes allowing access to files and equipment, and permitting physical inspection of work activities in progress.

Procurement of Items and Services

IP 7.01, *Procurement*, describes the steps necessary to assure the quality of purchased items and services.¹⁰

Typical items and services procured by the Monitoring Program include:

- Laboratory analyses of environmental samples;
- Calibration services for meteorological sensors;
- Flow measuring, pH measuring, and proportional sample collecting equipment for sewer monitoring; and
- Consulting services for specialized tasks.

IP 7.01 requires that quality assurance requirements for procurements be documented to ensure that these items and services meet the quality requirements of the Monitoring Program.

Document Control and Records

The ES&H and Facilities Management Center Document Control System controls Documents and Records generated by the Monitoring Program, as detailed in IP 4.03, *Document Control*, and IP 4.04, *Records Management*.^{11,8}

The following items, produced by the Environmental Monitoring Program, are considered quality assurance records. Therefore, they are subject to the conditions specifying retrievability, safeguards, and retention time.

- All data generated by environmental sampling.
- All chain-of-custody forms, field notebooks, and other documents associated with environmental sampling.
- All documents specifying the design or rationale of environmental monitoring systems.
- All Operating Procedures, both current and superseded.
- All reports, plans, and other forms of data transmittal, intended for either internal or external purposes.

Use of Computer Hardware and Software

The Environmental Monitoring Program uses only standard hardware and software. No software is developed specifically for the Monitoring Program.

Work Processes and Operations

Work processes and operations include all Monitoring Program activities that affect the quality of the data produced. These activities include: sampling, dose modeling, data analysis, and equipment calibrations. All Operating Procedures are developed in accordance with IP 4.02, *Development of Operating Procedures*.¹² The following areas are addressed:

- **Sampling.** Environmental sampling activities are described in Operating Procedures (as specified in Section 2). The Operating Procedures specify necessary quality control checks and acceptance criteria.
- **Dose Modeling.** Dose modeling activities are described in an Operating Procedure. This procedure includes necessary quality control checks and acceptance criteria.
- **Data Analysis.** Data manipulation is described in an Operating Procedure. This procedure includes: data validation and verification, data quality objectives (developed in accordance with IP 5.04, *Data Quality Objectives Process*),¹³ data tracking and trending, quality control data analysis, developing summary statistics, and comparing data to specified regulatory limits.
- **Equipment Calibrations.** Calibration of measuring and test equipment is described in Operating Procedures. These procedures follow the guidance

provided in IP 5.03, *Control of Measuring and Test Equipment*.¹⁴ These procedures incorporate guidance from the equipment manufacturers as appropriate. The procedures include acceptance criteria. Calibrations are traceable to a national standard (such as National Institute for Standards and Technology—NIST).

The Center for ES&H and Facilities Quality Assurance organization independently assesses the implementation of Quality Assurance for work processes, in accordance with IP 10.01, *Independent Assessment*.⁹

The ES&H Assessments Department (Organization 7001) performs independent technical assessments. These technical assessments use procedures developed by the ES&H Assessments Department.

Quality Improvement

The Environmental Monitoring staff constantly strive to improve the quality of Program operations. Improvement is accomplished through the following actions:

- *Management and Independent Assessments:* Recommendations from both outside organizations and internal management assessments (see Part B, Section 5) are implemented as soon as is reasonably achievable. Recommendations are tracked in order to identify any trends adverse to quality.
- *Design Reviews:* All revisions or additions to the design of environmental monitoring operations receive peer review by a qualified individual and a management review up to the level of the Director, ES&H and Facilities Management Center.
- *Corrective Action:* Necessary corrective actions (identified during Program assessments) are carried out in a timely fashion. These corrective actions are documented by memorandum to file. If the corrective action requires a change in the Monitoring Program, these changes will be documented as specified in Part B of this QAPP.

All personnel are encouraged to identify and correct problems. Staff are encouraged to offer ideas for improvement to the Monitoring Program.

Nonconforming data and equipment may be detected in two ways: 1) through routine inspections, calibrations, or usage; and 2) through management assessments. For the purposes of this QAPP, nonconformances are defined as deficiencies in procedure, characteristic, or documentation, which render the quality of an item unacceptable or indeterminate.

Disposition of nonconforming equipment is covered in the Operating Procedure for calibration of the equipment. This procedure also includes guidelines for use of data collected during the period when the equipment was not performing within specifications.

The disposition of nonconforming data (i.e., data that fails to meet established Data Quality Objectives) is covered in IP 5.01, *Identification and Control of Technical Data*, and OP-EM-9, *Data Validation and Verification* (see Part A, Sections 2 and 8).^{15,16}

PART B — TECHNICAL DESCRIPTION AND REPORTING REQUIREMENTS

Planning and Scoping

The *Environmental Monitoring Plan* describes the Environmental Monitoring Program in detail, and includes the rationale for sampling, sampling procedures, analytical procedures, and previous data analysis.² This document is required by DOE Order 5400.1, must be reviewed annually and revised at least once every three years. The latest version of the *Environmental Monitoring Plan* reflects the current status of the Environmental Monitoring Program, and includes the final documentation on all changes.

Between revisions to the *Environmental Monitoring Plan*, Planning and Scoping Packages provide documentation for changes or additions to the Monitoring Program. The following revision of the *Environmental Monitoring Plan* includes all the changes described in the interim Planning and Scoping Packages.

Planning and Scoping Packages receive the same level of review as the *Environmental Monitoring Plan*, up to and including the Manager of the Environmental Protection Department.

Planning and Scoping Packages contain the following information:

- Rationale for the change(s)
- Requirements for the change
 - References
 - Regulations
 - Best practices
 - Data quality objectives (defined in IP 5.04)
- Description of the change
 - Manpower required
 - Equipment required
 - Controlled conditions required (if any)
 - Level of assessment tools required (audits, quality control checks, peer reviews, etc.)
 - Detailed identification of methods required
 - New records required (if any) as quality assurance records
- Independent verification of the change—The Environmental Monitoring Program Manager selects a knowledgeable reviewer not directly involved in producing the change or addition. The review includes documented resolution of the reviewer's comments. A letter to the project file (included in the Planning and Scoping Package) documents the reviewer's qualifications.

All Planning and Scoping Packages are retained permanently as quality assurance records.

Planning and Scoping Packages also include procedures to document and control the conduct of new activities generated by these new changes.

Design of Data Collection Activities

The *Environmental Monitoring Plan* describes the design of environmental monitoring operations. Like Planning and Scoping packages, Design Packages provide for changes or additions to the design of the Monitoring Program between revisions to the *Environmental Monitoring Plan*. These design changes are also included in the next revision of the *Environmental Monitoring Plan*.

Design Packages receive the same level of review as the *Environmental Monitoring Plan*, up to and including the Manager of the Environmental Protection Department.

A Design Package is generated with Planning and Scoping documents and contains the following information:

- Sample type
- Sampling locations
- Sample handling and custody requirements
- Personnel qualifications and requirements
- Health and safety requirements
- Analytical methods—selection and requirements
- Analytical facility requirements
- Quality control sample requirements
- Analytical instrumentation and/or sampling equipment requirements
- New data reduction or validation requirements
- Review plans for system readiness prior to collecting samples
- Independent verification by a knowledgeable reviewer not directly involved in producing the new design.

All Design Packages are retained permanently as quality assurance records.

Design Packages include procedures to document and control the conduct of new activities created by these new changes.

Implementation of Planned Operations

The Center for ES&H and Facilities uses Implementing and Operating Procedures developed to support this QAPP. The Operating Procedures written to date include:

- OP-EM-1 *Sanitary Sewer Outfall*
- OP-EM-3 *Control of the LECS*
- OP-EM-4 *Operation of the B. 913 LECS*
- OP-EM-5 *Operation of the B. 906 LECS*
- OP-EM-6 *Operation of the B. 910 LECS*
- OP-EM-9 *Data Validation and Verification*
- OP-EM-10 *Quarterly Replacement of Perimeter Thermoluminescent Dosimeters*
- OP-EM-11 *Response to Sewer Anomalies*
- OP-EM-12 *Data Manipulation*

Assessment of Data Usability

Data Quality Objectives (DQOs) are used to validate all environmental monitoring data per IP 5.04, *Data Quality Objective Process*.¹³ OP-EM-9, *Data Validation and Verification*, specifies verification and validation techniques.¹⁶ OP-EM-12, *Data Manipulation*, further specifies how to apply statistical methods correctly to monitoring data. The Operating Procedures include provisions for marking, segregating, and limiting the use of data that do not meet the DQOs, or fail the verification and validation tests.

All reports containing data generated by the Environmental Monitoring Program are independently reviewed to ensure the accuracy of the data. The Environmental Monitoring Program Manager must also approve these reports prior to release or distribution.

Quality Assessment and Response

The Quality Assurance Group in the ES&H and Facilities Management Center is responsible for assessing the compliance of the Environmental Monitoring Program with this QAPP and with the ES&H QAMP. These assessments are done in accordance with IP 10.01, *Independent Assessment*.⁹

Environmental Monitoring Program personnel cooperate fully with the Quality Assurance Group by providing access to records, personnel, and equipment. Program personnel are also required to provide timely responses to the deficiencies identified in the assessments.

The Environmental Protection Department Manager (or designee) performs Internal Management Assessments annually. Management assessments gauge how well the integrated quality assurance program works, and identify management problems that hinder the organization from achieving the required quality, safety, and environmental objectives. The results of these assessments and any follow-up action taken are documented and retained as quality assurance records.

REFERENCES

1. U. S. Department of Energy (DOE) Order 5400.1, *General Environmental Protection Program* (November 1988).
2. R. C. Holland, *Environmental Monitoring Plan*, Sandia National Laboratories, SAND91-8013 (1992).
3. DOE Order 5700.6C, *Quality Assurance* (1991).
4. American Society for Quality Control, *Quality Assurance Program Requirements for Environmental Programs*, ANSI/ASQC-E4-19xx (review draft, 1991).
5. R. C. Holland, *Quality Assurance Management Plan*, Sandia National Laboratories (1992).
6. Implementing Procedure (IP) 4.02, *Development of Operating Procedure*, Sandia National Laboratories (1992).
7. IP 2.01, *Qualifications and Training*, Sandia National Laboratories (1992).
8. IP 4.04, *Records Management*, Sandia National Laboratories (1992).
9. IP 9.01, *Management Assessment*, Sandia National Laboratories (1992).
10. IP 7.01, *Procurement*, Sandia National Laboratories (1992).
11. IP 4.03, *Document Control*, Sandia National Laboratories (1992).
12. IP 4.02, *Development of Operating Procedures*, Sandia National Laboratories (1992).
13. IP 5.04, *Data Quality Objectives Process*, Sandia National Laboratories (1992).
14. IP 5.03, *Control of Measuring and Test Equipment*, Sandia National Laboratories (1992).
15. IP 5.01, *Identification and Control of Technical Data*, Sandia National Laboratories (1992).
16. Operating Procedure OP-EM-9, *Data Validation and Verification*, Sandia National Laboratories (1992).

GLOSSARY AND LIST OF ACRONYMS

ARAC	Atmospheric Release and Advisory Capability. A DOE-operated emergency response system designed to provide meteorological modeling and dose calculation capabilities in the event of an accidental release of radionuclides at a DOE facility.
Calibration	Testing or resetting a measuring instrument against a national standard (such as NIST) to ensure it is functioning correctly and accurately.
Data Validation and Verification	Actions taken to assure the quality of environmental monitoring data, such as analyses of: duplicate samples, spiked samples, blanks, and inter-laboratory comparison samples.
Data Manipulation	The development of summary statistics to describe environmental monitoring data sets. Statistical tests performed to compare environmental monitoring data sets to determine significant differences and trends.
ES&H	Environment, Safety, and Health.
Implementing Procedures (IPs)	Procedures written to implement the provisions of the QAMP. The Environment, Safety & Health and Facilities Management Center are required to apply these Implementing Procedures to all their operations. (See also Operating Procedures.)
LECS	Liquid Effluent Control System. Retention tanks designed to contain potentially contaminated, process wastewater until this wastewater can be analyzed and disposed of properly.
NIST	National Institute for Standards and Technology (formerly the National Bureau of Standards).
Nonconformance	A deficiency in characteristic, documentation, or procedure that renders the quality of an item unacceptable or indeterminate. Examples of nonconformance include: physical defects, test failures, incorrect or inadequate documentation, and/or deviations from prescribed processing, inspection, or test procedures.
Operating Procedures	Procedures covering actual daily activities. Operating procedures also implement the provisions of the QAMP and this QAPP. (See Implementing Procedures.)
QAMP	Quality Assurance Management Plan. The quality assurance document covering the operations of the Environmental Protection Department.
QAPP	Quality Assurance Project Plan. A quality assurance document describing the specific quality assurance activities performed by the Environmental Protection Department to implement the provisions of the QAMP.
Quality assurance records	Documentation generated by Environmental Monitoring Program operations required by Federal, State, local regulation, or by DOE Order, and retained for a specific time. Storage conditions and methods may also be specified

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Appendix C

Quality Assurance Management Plan

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SANDIA NATIONAL LABORATORIES, LIVERMORE

ENVIRONMENT, SAFETY, AND HEALTH

DEPARTMENT 8540

**QUALITY ASSURANCE MANAGEMENT
PLAN**

REVISION - 0

EFFECTIVE DATE* - 04/23/91

8540 - QAMP, R0

Approved by:

Richard W. Rohde, Department Manager, 4/12/91
Date

* For this initial version of the QAMP, the effective date refers specifically to the approved use of the document for further 8540 QA Program development and training. The effective date on subsequent revisions will refer to the mandatory deadline for compliance with stated requirements.

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QUALITY ASSURANCE MANAGEMENT PLAN	REVISION RECORD	8540-QAMP REVISION 0
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QAMP Revision Number

8540-QAMP, R0

Effective Date

04/23/91

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QUALITY ASSURANCE MANAGEMENT PLAN	PREFACE	8540-QAMP REVISION 0
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This document is the initial version of the Quality Assurance Management Plan (QAMP) of the Environment, Safety, and Health (ES&H) Department (8540) at Sandia National Laboratories, Livermore. It establishes requirements for the development, implementation, and verification of the 8540 Quality Assurance Program. The QA Program is designed to achieve and document 8540 compliance with DOE/AL Order 5700.6B.

The requirements of the 8540 QAMP and its supporting QA and operational procedures apply to Department 8540 personnel and on-site contractors. It is also applicable to external vendors and suppliers performing work or providing products to the Department when specified in purchase orders or other contractual documents. The QAMP is not applicable to SNL staff and contractors beyond the authority of Department 8540, even where compliance with 8540 QA Program requirements utilizes the services of such personnel. In these instances, applicable personnel are governed by the requirements of their own SNL departments or by overall SNL requirements.

None of the requirements or descriptions of 8540 QA Program elements established by this document are intended to conflict with or replace directives for quality awareness, quality improvement, or other compliance requirements issued at management levels above 8540. Where such conflicts may be perceived, the higher-tier directive shall take precedence. At such time as the authority for a SNL-wide or SNL,L-wide QA program (for regulatory compliance) is established, this document shall be revised to demonstrate compliance with applicable requirements.

Major additions, deletions, and/or other changes to this QAMP since its last issued revision shall be summarized in this space in subsequent revisions.

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QUALITY ASSURANCE MANAGEMENT PLAN	STATEMENT OF DEPARTMENT POLICY	8540-QAMP REVISION 0
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The SNL, Environment, Safety, and Health Department (8540) endorses the application of quality management principles and recognizes the role of a coordinated quality assurance management program in helping to achieve its commitment to provide the highest quality ES&H work. In compliance with Department of Energy, Albuquerque Operations Office (DOE/AL) Order 5600.6B, 8540 uses ASME NQA-1-1989 (NQA-1) as the basis of its QA Program.

One goal of the 8540 QA Program is to implement those elements of NQA-1 which apply to 8540 activities, integrated with appropriate additional requirements of the various ES&H regulatory and guidance documents, which best help to provide verifiable quality-affecting work and a management structure and attitude that encourages attention to quality. For the purpose of the 8540 QA Program, quality is defined as conformance to specified requirements. The achievement of quality is the responsibility of all personnel assigned to the Department and shall be accorded a top priority. Inside 8540, the QA verification of the achievement of quality is the responsibility of the 8540 Quality Assurance Coordinator.

Full 8540 authority and organizational freedom is provided to the 8540 Quality Assurance Coordinator to identify quality problems, identify or assist in recommendation of solutions, verify corrective actions, and recommend cessation of unacceptable activities or practices that may affect quality.

This Quality Assurance Management Plan (QAMP) establishes and presents the framework of requirements that shall be met by all 8540 personnel in the planning, accomplishment, documentation, and verification of 8540 quality-affecting activities.

Richard W. Rohde

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QUALITY ASSURANCE MANAGEMENT PLAN	INTRODUCTION	8540-QAMP REVISION 0
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Sandia National Laboratories, Department 8540 is responsible for conducting a wide variety of ES&H activities at Livermore. The need for a comprehensive management control system for these activities, commensurate with the work to be performed, has been identified by the U.S. Department of Energy (DOE) in various orders, communications, and Tiger Team interpretations. In compliance with DOE/AL 5700.6B, Department 8540 management has directed the development and execution of a quality assurance (QA) program based on national consensus standard ASME NQA-1-1989 (NQA-1) to meet this need. The 8540 QA Program will function as an integral part of the Department's management structure to assure the inclusion of the controls necessary to adequately plan, implement, and document its ES&H activities.

The "upper tier" requirements of the 8540 QA Program are presented in this document; the 8540 Quality Assurance Management Plan (QAMP). As applicable, subservient "lower tier" activity plans (including QA plans) shall be developed and implemented when necessary to detail more specific requirements or when the non-applicability of QAMP requirements can be justified. QAMP requirements are mostly derived from the eighteen criteria of NQA-1, as applicable to the specific needs of 8540. Lower tier plans shall integrate requirements of other regulatory guidance documents, as applicable to each ES&H activity.

The provisions of the 8540 QA Program apply to all activities performed by Department 8540 that could affect quality. It is also applicable to 8540 contractors and vendors except where such contractors and vendors are governed by their own 8540-approved QA programs. It is anticipated and expected that the requirements presented in the QAMP, other 8540 planning documents, and in the procedures that direct the implementation of the requirements, will undergo continued review and scrutiny for appropriateness, accuracy, and other concerns. Questions, comments, or suggested changes should be addressed to the 8540 QA Coordinator or other responsible 8540 staff, as appropriate. Revisions to planning and implementation documents shall be issued as warranted.

A glossary of terms and definitions used throughout this document is included as Appendix A.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 1 ORGANIZATION	8540-QAMP REVISION 0
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1.1 PURPOSE

This section describes the organization of the 8540 QA Program and establishes the authority and responsibility for its development, implementation, and verification.

1.2 APPLICABILITY

This section is applicable to all 8540 personnel, contractors, and vendors performing quality-affecting work for the Department. Other SNL personnel that may perform or contribute to 8540 quality-affecting activities are not subject to the requirements of this section or this total QAMP, but are governed by their own department requirements as well as applicable SNL-wide directives. The relationships between 8540 personnel and other SNL staff described herein are only for the purpose of defining the 8540 QA Program. Other organizational authority and interface is not presented.

1.3 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

The structure of Department 8540 as it relates to QA management is shown in Figure 1-1. Individual responsibilities are described below.

Delegation of the functional accomplishment of the quality-affecting activities described in paragraphs 1.3.1 - 1.3.3 below and throughout this QAMP may be assigned to appropriate qualified 8540 personnel; however, the applicable Manager, Supervisor, or Coordinator retains management responsibility for such functions.

1.3.1 Department Manager

The 8540 Department Manager is responsible for the overall direction of all 8540 activities, including the establishment and execution of the QA Program and the assignment of the 8540 QA Coordinator. The Department Manager has direct responsibility for cost, schedule, technical performance, quality, and other activities performed in support of the QA Program. The Department Manager is also responsible for the implementation of the QAMP and for those 8540 quality-affecting activities associated with its implementation. The Department Manager shall assure that the 8540 QA Coordinator has sufficient authority, access to work areas and personnel, and organizational freedom to fulfill the responsibilities assigned to the position. The Department Manager has ultimate 8540 responsibility for directing corrective actions and for the resolution of disputes arising from differences of opinion between the QA Coordinator and other 8540 personnel.

1.3.2 Division Supervisors

Division Supervisors within 8540 have direct management responsibility for the implementation of the 8540 QA Program as it relates to their division. This includes responsibility for obtaining appropriate personnel qualification and training, development of operational procedures for the performance of quality-affecting work, identification of applicable regulations of external ES&H authorities and inclusion of same in activity plans,

Environment, Safety & Health, Department 8540

Key: — 8540 Functional Line Authority
 — 8540 QA Program Interaction (The QA Coordinator has direct access to all 8540 personnel, and vice versa, for all 8540 QA Program matters)

Services provided to 8540 by other SNL organizations are not shown - refer to text for explanation.

Figure 1-1

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 1 ORGANIZATION	8540-QAMP REVISION 0
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reporting of QA Program deficiencies or other problems with the potential to affect quality, undertaking appropriate corrective actions, cooperation with audit and surveillance processes, and performing 8540 quality-affecting activities in compliance with applicable QA Program requirements.

1.3.3 Quality Assurance Coordinator

The 8540 QA Coordinator is responsible for the development and maintenance of the 8540 QA Program. The QA Coordinator is also responsible for internal 8540 QA Program verification functions, not including those quality control or other checks that are normally part of activity accomplishment processes nor audit systems directed by other SNL organizations. The QA Coordinator is responsible for reviewing and approving corrective action documents and assisting 8540 personnel in QA matters through guidance, consultation, and participation in training activities, document reviews, meetings, presentations, and task forces. The QA Coordinator is sufficiently independent of direct 8540 line management authority for the performance of 8540 operational responsibilities, including cost, schedule, and other performance constraints. Strictly for the purposes of the 8540 QA Program, the position of QA Coordinator is at least functionally and organizationally equivalent to those positions directly responsible for operational performance (Division Supervisors) within 8540. This situation shall not affect existing administrative or personnel office position requirements.

1.3.4 All 8540 Personnel

All 8540 and applicable contractor and vendor staff performing 8540 activities affecting quality are responsible for assuring that operational (technical) procedures are developed and complied with for their assigned tasks; that applicable quality standards have been established and complied with; that they possess appropriate qualifications and training for their assigned tasks; and that QA Program deficiencies and other problems are promptly reported and addressed.

1.4 **REQUIREMENTS**

1.4.1 Plans and Procedures

Responsibilities and organizational structures specific to individual requirements and subject areas of the 8540 QA Program shall be described in appropriate plans and/or procedures as cited in Section 5 of this QAMP.

1.4.2 Personnel and Organization Responsibility

The organizational structure and responsibility for assignments shall be clearly established to obtain the following results:

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 1 ORGANIZATION	8540-QAMP REVISION 0
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- a. That quality is achieved and maintained by those who have been assigned responsibility for performing quality-affecting work (this includes those checks and approvals by other line personnel necessary to give confidence in results).
- b. That overall quality achievement is verified by persons not directly responsible for performing the work.

1.4.3 Coordination with Non-8540 SNL Organizations

When other SNL organizations (outside 8540) contribute to or provide services to 8540 activities affecting quality, they shall be governed by the requirements of their own SNL organizational units; however, their interfaces with 8540 shall be described in appropriate 8540 plans/procedures to the extent necessary to assure that the quality-affecting responsibilities of 8540 personnel are adequately documented.

1.4.4 Records

Documentation that demonstrates compliance with the requirements of this section shall constitute QA records and shall be maintained in accordance with the requirements of Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 2 QUALITY ASSURANCE PROGRAM	8540-QAMP REVISION 0
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2.1 PURPOSE

This section establishes the requirements for planning, controlling, and documenting those factors affecting the quality and reliability of 8540 activities.

2.2 APPLICABILITY

This section applies to all 8540 personnel involved in activities affecting quality, and those 8540 personnel involved in supporting QA activities such as program development and personnel qualification and training.

2.3 RESPONSIBILITIES

2.3.1 Department Manager

The 8540 Department Manager is responsible for:

- a. Establishing and implementing (overall) the 8540 QA Program.
- b. Ensuring that 8540 management assessments to determine the effectiveness of the QA Program are conducted periodically.
- c. Establishing and directing the coordination of those personnel qualification and training functions related to the 8540 QA Program over which 8540 has control.
- d. Establishing and directing the coordination of those document control and records management functions related to the 8540 QA Program over which 8540 has control.

2.3.2 Division Supervisors

8540 Division Supervisors are responsible for:

- a. Implementing the 8540 QA Program, as applicable to their division.
- b. Determining the need for plans/procedures/instructions for their quality-affecting activities.
- c. Assuring that appropriate plans/procedures/instructions are developed for applicable activities.
- d. Assuring that personnel performing quality-affecting activities are qualified for their specific job responsibilities.
- e. Identifying the job requirements and training needs of their staff.

2.3.3 Quality Assurance Coordinator

The 8540 QA Coordinator is responsible for:

- a. Developing the 8540 QAMP and its corresponding QA Implementing Procedures (QAIPs).

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 2 QUALITY ASSURANCE PROGRAM	8540-QAMP REVISION 0
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- b. Reviewing and approving lower-tier 8540 QA plans.
- c. Reviewing operational plans/procedures/instructions to assure inclusion of QA requirements.
- d. Conducting independent surveillances of 8540 quality-affecting activities.
- e. Reviewing and participating in 8540 procurement activities to assure inclusion of QA requirements.
- f. Providing guidance and consultation for the implementation of the 8540 QA Program.

2.4 REQUIREMENTS

2.4.1 Quality Assurance Management Plan

One purpose of the 8540 QA Program is to select QA requirements and methods that are consistent with 8540's ES&H objectives. The overall requirements of the 8540 QA Program shall be defined in a governing planning document. This 8540 QAMP has been developed by selective applications of NQA-1 requirements to the overall activities to be performed.

2.4.2 QA Planning

When necessary to establish QA requirements at a more detailed level than those described by the 8540 QAMP, lower-tier QA plans shall be developed by the cognizant 8540 Divisional groups. Planning activities shall be documented to assure a systematic approach leading to the identification of methods and responsibilities in procedures. Application of QA requirements to 8540 activities shall be planned and documented to assure that a beneficial and systematic approach is used. Planning shall be performed as early as practical, and prior to the start of activities that are to be controlled, in order to assure interface compatibility and adequate implementation of quality requirements. Planning shall be accomplished to the extent necessary to provide:

- a. Identification and documentation of the methods and organizational responsibilities that are necessary to assure a systematic approach to and compliance with the requirements of the 8540 QAMP.
- b. Assurance that activities requiring special procedures, QA plans, peer reviews, work instructions, drawings, controls, processes, equipment, or personnel training/skills to attain the requisite quality are identified, developed, and implemented.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 2 QUALITY ASSURANCE PROGRAM	8540-QAMP REVISION 0
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2.4.3 Applicability of the 8540 QA Program

Whether 8540 QA requirements are applied to specific 8540 activities shall depend on the applicability of the factors listed below, at a minimum, as determined by appropriate qualified personnel:

- a. Consequence of failure.
- b. Importance of the data.
- c. Complexity of function.
- d. Reliability of process.
- e. Reproducibility of results.
- f. Uniqueness of product.
- g. Degree of standardization.
- h. Impact on schedule or cost to replace in the event of failure.
- i. Necessity of special controls or processes.
- j. Significance to regulatory processes.

2.4.4 Orientation and Training

Personnel involved in 8540 activities affecting quality shall receive sufficient training to assure proper understanding of 8540 QA Program requirements prior to initiation of those activities. *[Note: QA Program requirements include both those QA management requirements developed specifically for the 8540 QA Program as well as operational (technical) requirements for the performance of 8540 ES&H activities.]* An introduction to the 8540 QA Program shall be provided to 8540 personnel as a formal orientation classroom session by the 8540 QA Coordinator. Specialized training shall be provided to assure that personnel achieve and maintain suitable proficiency in the quality-affecting activities they perform. Training is provided at SNL,L by Division 8524 (outside Department 8540) in compliance with their own requirements. The 8540 Department Manager shall assure that 8540 training needs are identified and assignments are made by 8540 Division Supervisors or other applicable personnel. Division Supervisors shall assure that assigned staff complete training commensurate with the scope and complexity of their assigned tasks.

2.4.5 Qualification of Personnel

In addition to those personnel qualification functions administered by Division 8522 (outside Department 8540) and to the extent that the 8522 requirements are not compromised, the 8540 Department Manager shall assure that an appropriate personnel qualification system is established. 8540 Division Supervisors or other applicable personnel are responsible for assuring that personnel performing activities affecting quality are properly qualified as identified in job descriptions. Supervisors shall also assure that documentation is available that indicates the verification of education and experience required for quality-affecting job functions.

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2.4.6 Proficiency Evaluation

8540 Division Supervisors or other applicable personnel shall assure that the job proficiency of personnel performing quality-affecting activities is adequately monitored and is documented at least annually according to the personnel qualification system.

2.4.7 Independent Verification

Compliance with the requirements of the 8540 QA Program shall be independently verified by persons or organizations not directly responsible for performing quality-affecting activities in question. Independent verification methods may include, as appropriate, audits, surveillances, peer reviews, technical reviews, design reviews, and management assessments. Independent verification does not include those compliance checks, quality control, or hold-point inspection activities performed by or for individuals or groups responsible for quality-affecting activities. Internal 8540 independent surveillance activities shall be performed by or otherwise provided by the 8540 QA Coordinator. Other SNL organizations may conduct verification activities of 8540 operations in accordance with their own requirements and the internal 8540 verification system is not intended to replace or interfere with these activities.

2.4.8 Management Assessments

Two organizations (8011, 7301) outside 8540 may conduct periodic management assessments of 8540 activities. These assessments are not governed by the requirements of this QAMP.

The adequacy and effectiveness of the 8540 QA Program shall also be determined by conducting specific internal 8540 management assessments on a periodic basis (at least annually). These assessments shall consider the following:

- a. Effectiveness of controls that achieve and assure quality.
- b. Adequacy of resources and personnel provided to the QA Program.
- c. Appropriateness of personnel training.

The 8540 Department Manager shall conduct or otherwise provide the management assessment, independent of 8540 personnel responsible for achieving quality (Division Supervisors and staff) or assuring quality (QA Coordinator and staff). Assessments shall include the following, at a minimum:

- a. Review of management reports (status reports, technical reports, etc.).
- b. Review of quality verification reports (audit reports, surveillance reports, inspection reports, test reports, etc.).
- c. Review of corrective action reports, including trend analysis reports.
- d. Performance of interviews and independent assessments of compliance.

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2.4.9 Subcontractor/Vendor QA Programs

8540 shall perform assessments of the quality-affecting activities of all organizations external to SNL contributing supportive work to 8540. Subcontractors, vendors, or other organizations interfacing with 8540 on quality-affecting activities shall develop and implement applicable QA programs that shall be approved by 8540 prior to use; or shall abide by the provisions of the 8540 QAMP and implementing procedures.

2.4.10 Records

The documentation requirements identified in this section constitute QA records and shall be maintained in accordance with the requirements identified in Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 3 PLANNING CONTROL	8540-QAMP REVISION 0
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3.1 PURPOSE

This section describes the requirements for the control and verification of 8540 quality-affecting planning activities. For the purposes of the 8540 QA Program, planning control refers to the planning phase of such 8540 activities as ES&H investigations, analyses, report preparation, or other regulatory compliance actions. *Note: 8540 does not perform hardware design.*

3.2 APPLICABILITY

The requirements of this section are applicable to 8540 planning activities, including initial planning, changes to planning, planning interfaces, and the conduct of technical, readiness, and peer reviews of planning activities.

3.3 RESPONSIBILITIES

3.3.1 Division Supervisors

8540 Division Supervisors are responsible for:

- a. Coordinating planning activities.
- b. Reviewing planning inputs, outputs, and reports.
- c. Participating in planning verification, as appropriate.
- d. Implementing configuration management and planning procedures, as appropriate.

3.3.2 Quality Assurance Coordinator

The 8540 QA Coordinator is responsible for monitoring planning activities through participating in planning review activities.

3.4 REQUIREMENTS

3.4.1 Planning Inputs

Planning inputs refer to the criteria, parameters, or other planning requirements upon which the final detailed plan is based. Planning inputs shall be established in written, controlled documents that have unique identification and revision status, and are authorized prior to issue. Planning inputs such as planning bases, performance and regulatory requirements, codes and standards, and safety criteria shall be identified and recorded. Planning input selection shall be appropriately reviewed and approved. Changes from approved planning inputs, including reasons for the changes, shall be identified, approved by the original staff member, documented, controlled, and made retrievable.

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3.4.2 Planning Outputs

Planning outputs, such as drawings, specifications, results of scientific investigations, computer programs, etc., shall be established in formal written documents that have unique identification and revision status and are approved prior to issue. Planning output documents shall relate to the planning input in sufficient detail to permit planning adequacy verification/evaluation. Planning output documents shall show evidence that the required reviews and approvals have been accomplished prior to release for use in other planning activities.

3.4.3 Planning Verification

8540 planning verification shall be performed by technically competent, independent reviewers other than those involved in the original planning activity, although they may be from the same division or group. Planning verification shall be accomplished by planning/technical review, alternate calculation and analyses, or by peer review.

The competency (education and/or work experience) of the individuals performing the verification shall be equal to or greater than that of the planning originators. Assessment of their independence and competency shall be documented. Verification may be performed by the originator's supervisor, providing the supervisor did not establish the planning inputs, or when necessary, if the supervisor is the only competent individual available. cursory supervisory reviews are considered to be unacceptable. Where state-of-the art technology is involved, a peer review shall be considered.

3.4.4 Planning Review/Technical Review

A planning/technical document review is an independent, documented verification process that ensures that the review material (report, plan, work assessment, data, analysis assessment, or evaluation, etc.) is technically adequate to satisfy applicable requirements. Planning reviews shall address the following, as a minimum:

- a. Were the planning inputs correctly selected?
- b. Are the assumptions that were necessary to perform the planning activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent reverifications when detailed planning activities are completed?
- c. Was an appropriate planning method used?
- d. Were the planning inputs correctly used in the design activity?
- e. Are the necessary planning input and verification requirements specified in the planning document or in supporting procedures and instructions?

3.4.5 Alternate Calculations and Analyses

Alternate calculations may be used to verify the correctness of the original calculations or analyses. The alternate method may be simpler and less rigorous, such as a hand calculator

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used to check a computer analysis. The review shall be performed by an independent individual to determine the adequacy of assumptions, input data, and the computer program or other calculation methods.

3.4.6 Peer Reviews

When activities involve state-of-the-art or untried technologies, peer reviews of data, reports, conceptual planning, etc. shall be performed. A peer review team shall be appointed by the Division Supervisor. The peer review team shall consist of qualified subject experts who are independent of the information and activities to be reviewed. The review and approval of the team members' credentials, including verification of education and experience, shall be documented. A peer review plan/checklist shall be prepared by the peer review team leader, and approved by the applicable supervisor. During the conduct of the peer review, review comments, and comment resolution shall be documented. Minority dissenting opinions which cannot be resolved shall also be clearly indicated.

3.4.7 Planning Change Control

When an approved and verified final planning requires changes, the proposed changes shall be justified and subject to control measures commensurate with those applied to the original planning.

3.4.8 Records

Documentation generated in compliance with the requirements of this section, shall be considered QA records and shall be maintained in accordance with Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 4 PROCUREMENT DOCUMENT CONTROL	8540-QAMP REVISION 0
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4.1 PURPOSE

This section establishes the requirements for the control of 8540 procurement documents associated with the purchase of quality-affecting items or services for 8540.

4.2 APPLICABILITY

These requirements are applicable to the procurement of 8540 items or services. These requirements shall be implemented by 8540 personnel in conjunction with SNL, Procurement Services Division 8534 (outside 8540) policies and procedures and are not intended to replace, contradict, or interfere with those requirements. For the purposes of the QA Program, "procurement" means the requisitioning of items and services that are purchased for 8540 by the SNL Procurement Services Division 8534.

4.3 RESPONSIBILITIES

4.3.1 Division Leaders

8540 Division Supervisors are responsible for assuring that 8540 procurement documents include the appropriate technical, regulatory, Procurement Services Division, and QA requirements applicable to a requested item or service. Assistance with this responsibility shall be provided by the 8540 Budget and Contracts Coordinator.

4.3.2 Quality Assurance Coordinator

The 8540 QA Coordinator is responsible for monitoring the 8540 procurement process to assure that applicable procurement documents/procurement actions include appropriate QA requirements.

4.4 REQUIREMENTS

4.4.1 Initiation of Procurement Document Packages

8540 Division Supervisors are responsible for initiating and maintaining a procurement document package containing a copy of all documentation for the procurement. Quality-affecting procurement documents shall be controlled to ensure that the procurement cycle has been implemented effectively. The procurement cycle begins when the need for an item or service has been identified and the decision has been made to purchase from a qualified subcontractor or vendor. The appropriate procurement requirements are then developed.

4.4.2 Review of Procurement Document Packages

8540 Division Supervisors are responsible for assuring that a review of procurement documents and changes thereto is made. The review ensures that documents transmitted to subcontractors include provisions that services and associated deliverables will meet specified requirements. Reviews shall also verify that procurement documents contain

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applicable regulatory requirements. Furthermore, the review shall verify that procurement documents contain provisions for requiring subcontractors to implement appropriate QA programs when, and if, initially requested as part of the technical requirement.

4.4.3 Approval of Procurement Documents

After appropriate review, Division Supervisors and the 8540 Budget and Contracts Coordinator are responsible for the 8540 approval of all procurement documents prior to submittal to Division 8534.

4.4.4 Procurement Document Changes

Changes to procurement documents shall be subjected to the same review and approval process as required for the preparation of the original document.

4.4.5 QA Records

8540 procurement records shall include all appropriate documentation, including all documentation submitted to or received from Division 8534, and shall be maintained in accordance with the requirements identified in Section 17 of this QAMP.

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5.1 PURPOSE

This section establishes 8540 requirements for the origination, review, approval, and revision of 8540 procedures and instructions.

5.2 APPLICABILITY

These requirements apply to the generation, review, approval, and/or revision of 8540 procedures and instructions specifically corresponding to internal 8540 quality-affecting activities. This includes 8540 QA Implementing Procedures, 8540 Operational (Technical) Procedures, and 8540 instructions pertaining specifically to internal quality-affecting activities. These requirements are not applicable to the development of other SNL procedural or planning documents with authority or applicability extending beyond Department 8540 personnel, nor is this section intended to replace or otherwise change overall SNL requirements for such documents.

5.3 RESPONSIBILITIES

5.3.1 Department Manager

The 8540 Department Manager is responsible for reviewing and approving all 8540 procedures and instructions and revisions thereto issued at Department level.

5.3.2 Division Supervisors

8540 Division Supervisors are responsible for reviewing and approving all 8540 procedures and instructions and revisions thereto issued at Division level.

5.3.3 Quality Assurance Coordinator

The 8540 QA Coordinator is responsible for reviewing and concurring with all 8540 quality-affecting procedures and for approving all QA Implementing Procedures and instructions.

5.4 REQUIREMENTS

5.4.1 Preparation of Procedures/Instructions

8540 procedures/instructions shall be prepared for each 8540 quality-affecting activity to the level of detail required to ensure that the activity can be performed as required. Procedures/instructions shall include or refer to appropriate quantitative or qualitative acceptance criteria for determining that prescribed activities have been completed as specified. Procedures/instructions shall be uniquely identified, retrievable, and reproducible.

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5.4.2 Procedure Format

Procedures/instructions shall be formatted to include the following elements as a minimum:

- a. Unique identifier, including revision.
- b. Purpose statement. A short statement of why the procedure/instruction was written and what it contains.
- c. Applicability or scope. A short description of groups/positions to which the requirements apply.
- d. References. Identification of the source of requirements.
- e. Responsibilities. Description of specific positions/groups identified within the procedure.
- f. Definitions. Descriptions of unique acronyms or unique terms that are not included in the overall 8540 QA Program Glossary (Appendix A). Definitions can be based on reference to standards, codes, regulations, DOE Orders, SNL practices, etc.
- g. Procedure. Description of the actions necessary to accomplish the objectives identified in the purpose statement.
- h. QA Records. Identification of QA records produced/retained by compliance with the procedure.
- i. Approval signatures and effective date.

5.4.3 Review

8540 procedures/instructions shall be reviewed for applicable technical and administrative details. These reviews shall be performed and documented by the appropriate Department Manager, Division Supervisor and/or QA Coordinator to evaluate the adequacy of the requirements and/or responsibilities for implementing the instruction/procedure.

5.4.4 Approval

8540 procedures and instructions, and subsequent revisions or cancellation, shall be approved by the Department Manager, Division Supervisor, and/or QA Coordinator responsible for the document prior to use. Signatures shall be included on the title page of the procedure/instruction.

5.4.5 Control and Issue

Approved 8540 procedures or instructions shall be issued through the 8540 document control process identified in Section 6 of this QAMP.

5.4.6 Revisions

Revisions to procedures and instructions shall be controlled by the same process used to review and approve the original procedures/instructions. The document author shall

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identify changes on the revised procedure/instruction. When a revision incorporates a substantial change, a summary of the changes shall be issued with the revised procedure or instruction.

5.4.7 Quality Assurance Records

Documentation generated in compliance with this section shall be designated as QA records in accordance with Section 17 of this QAMP.

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6.1 PURPOSE

This section establishes the requirements and outlines general methods for control of the preparation, issue, and change of 8540 documents that specify 8540 QA requirements or prescribe 8540 activities affecting quality.

6.2 APPLICABILITY

This section applies to plans, procedures, instructions, original data documents, decision documents including correspondence, and other designated controlled documents, including changes, that specify QA requirements or prescribe quality-affecting activities internally specific to 8540. It is not intended to replace or change SNL-wide requirements for document control and applies only to documents specifically generated for compliance with the 8540 QA Program.

6.3 RESPONSIBILITIES**6.3.1 Supervisory Personnel**

Appropriate 8540 personnel (e.g., Department Manager, Division Supervisor, QA Coordinator) are responsible for identifying those documents which require "controlled" status, identifying recipients, and for the review and approval of applicable documents.

6.3.2 8540 Personnel

Any 8540 staff member using, receiving, reviewing, approving, or identifying controlled documents is required to implement 8540 controlled document practices.

6.3.3 Document Control Coordinator

The 8540 Document Control Coordinator is responsible for maintaining the document control system, including issuing 8540 controlled documents to recipients identified on distribution lists and assuring revised documents are identified according to their revision status, superseded, destroyed, or otherwise handled, as appropriate.

6.4 REQUIREMENTS**6.4.1 Document Preparation, Revision, Review, and Approval**

Documents that specify 8540 QA requirements or prescribe 8540 quality-affecting activities shall be prepared, revised, and reviewed for adequacy, completeness, and correctness; approved; and released for issuance and distribution in accordance with 8540 procedures. Procedures for the preparation and revision of procedures, instructions, reports, and other documents shall address, as a minimum, the following requirements:

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- a. Identification of 8540 personnel responsible for the preparation, revision, review, approval, and release of the document.
- b. Review by individuals with responsibility for implementation of documents affecting quality.
- c. Review by individuals other than the author of the document, of documents affecting quality.
- d. Sufficient access by the reviewer to pertinent background data or information to assure a complete review.
- e. Resolution of the review comments (for which resolutions are considered mandatory) by the reviewer prior to approval and issuance of the document. Review comments and resolutions shall be documented and maintained.
- f. Unresolved issues shall be elevated to appropriate management for resolution.

6.4.2 Document Issuance and Distribution

Control of documents involves issuing the correct revisions of the document to the designated individuals at the designated locations, and assuring that current documents are available prior to commencing work and are available at the location where work is to be performed. Document control procedures shall have provisions for inclusion of the following:

- a. Identifying and marking documents.
- b. Maintaining controlled document distribution lists.
- c. Marking, removing, or destroying obsolete or superseded documents.
- d. Maintaining an index of revision status for controlled documents.
- e. Using receipt acknowledgement document transmittal forms, as applicable.

Controlled document recipients shall be responsible for acknowledging document receipt; assuring that the latest authorized documents are in use and returning obsolete or superseded documents.

6.4.3 Quality Assurance Records

Records generated as a result of the 8540 document control process shall be designated as QA records and shall be maintained in accordance with Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 7 CONTROL OF PURCHASED ITEMS AND SERVICES	8540-QAMP REVISION 0
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7.1 PURPOSE

This section establishes 8540 requirements for the control of quality-affecting purchased items and services and defines 8540 responsibilities for the control of activities associated with the procurement cycle.

7.2 APPLICABILITY

These requirements apply to the specification and acceptance of 8540 quality-affecting purchased items, documents, and services. These requirements shall be implemented by 8540 personnel in conjunction with SNL, L Procurement Services Division 8534 (outside 8540) policies and procedures and are not intended to replace, contradict, or interfere with those requirements.

7.3.2 Division Supervisors

8540 Division Supervisors are responsible for the processes utilized to procure 8540 items or services in their Division and for 8540 acceptance of items, services or other products from vendors and contractors.

7.3.3 Quality Assurance Coordinator

The 8540 QA Coordinator is responsible for the coordination of appropriate 8540 contractor/vendor QA surveillance/audit processes, approval of contractor/vendor qualifications, and review of contractual documents for inclusion of appropriate QA provisions.

7.4 REQUIREMENTS

7.4.1 Procurement Planning

The procurement activities of 8540 personnel shall be planned and documented to assure that a systematic approach to the procurement process is accomplished. Planning shall be accomplished as early as practical, and no later than at the start of procurement activities. Planning shall result in the documented identification of methods in procurement activities, the sequence of actions, and milestones indicating the completion of these activities. Planning shall also result in the preparation of applicable procedures prior to the initiation of each individual activity listed below. Planning should provide for integration of these activities, as applicable:

- a. Procurement requisitioning document preparation, review, and change control.
- b. Recommendation of procurement sources.
- c. Purchaser monitoring of vendor technical performance.
- d. Verification of OA compliance.

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- e. Control of nonconformances.
- f. Corrective action.
- g. Acceptance of item or service.
- h. Quality Assurance records.

7.4.2 Selection of Contractors/Vendors

Selection of contractors/vendors to participate in 8540 quality-affecting activities shall be based on evaluation of their capability to provide items, services, or other products in accordance with the requirements of procurement documents prior to award of contract. Selection is coordinated with 8534.

Measures for evaluation and selection of procurement sources and the results therefrom shall be documented and shall include one or more of the following options:

- a. Evaluation of the contractor's/vendor's history/capability of providing the service or product required by the purchaser.
- b. Contractor's/vendor's current QA records supported by documented qualitative and quantitative information which can be objectively evaluated.
- c. Contractor's/vendor's technical and QA capability as determined by evaluation of the facilities and implementation of their QA program.

7.4.3 Verification of Acceptability of Contractor/Supplier Performance

The extent of verification activities shall be a function of the relative importance, complexity, and quantity of the item or services procured, and the contractor's/vendor's QA performance. Verification activities shall be accomplished by qualified personnel assigned to monitor these activities through inspection, surveillance, audit, or test. Verification activities shall be coordinated with 8534.

7.4.4 Acceptance of Items or Services

Methods for acceptance of 8540 items or services shall be identified in 8540 implementing procedures and shall subsequently be incorporated into contractual agreements. Methods for accepting final products include:

- a. Receipt inspection through technical or peer review of the information.
- b. Receipt inspection through physical inspection of the product.
- c. Acceptance of Certificates of Conformance from the supplier.
- d. Posted testing of item, software, or other product.
- e. Surveillance or audit of activity.
- f. Technical verification of data produced.
- g. Review of objective evidence for conformance to the procurement document requirements such as certifications, reports, etc.

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7.4.5 Control of Contractor/Supplier Nonconformances

8540 implementing procedures shall identify methods for disposition of items and services that do not meet contractual documentation requirements. Methods include acceptance of the product through technical evaluation, rejection of the product, or repair/incorporation of comments in reports, etc.

7.4.6 QA Records

Documentation of acceptance of contractor's/vendor's product and other applicable documentation shall be retained as 8540 QA records in accordance with Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 8 IDENTIFICATION AND CONTROL OF ITEMS	8540-QAMP REVISION 0
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8.1 PURPOSE

This section establishes the requirements for the identification and control of 8540 items (materials, components, samples, data) which affect quality such that only correct and accepted items are used for internal 8540 activities.

8.2 APPLICABILITY

This section applies to the identification and control of items used specifically on internal 8540 quality-affecting activities. SNL items not specifically the responsibility of 8540 are not covered by these requirements.

8.3 RESPONSIBILITIES

8.3.1 Division Supervisors

8540 Division Supervisors are responsible for assuring that only properly identified and controlled items are used in 8540 quality-affecting activities.

8.4 REQUIREMENTS

8.4.1 Engineered Items

Items which have been specifically designed to 8540 specifications, and that require traceability shall be assigned a unique identification through the use of identification numbers, color coding, or similar means.

8540 procurement documents shall require that the unique identification be applied to the item and/or the container, as well as to support documentation. Identification shall be maintained on or near the item and in documents traceable to the item, for the life of the item.

8.4.2 Non-Engineered Items

Commercially available items that are procured as standard "off-the shelf" items shall have the identification requirements established by 8540. These requirements shall be included in procurement documents if traceability is to be maintained. Identification shall be maintained on installed items and in documents traceable to these items.

8.4.3 Data

Data generated as a result of 8540 scientific investigations, sampling, monitoring or remedial activities shall be identified in all documents, information systems, or both, in which such data appear. The identification of 8540 research data shall include reference to

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the origin of the data (task, test, experiment, report, publication, etc.) Verification of the identification shall be completed prior to release for use in order to assure traceability to the source(s).

Data shall be considered QA records in accordance with Section 17 of this QAMP.

8.4.4 Samples

The following requirements are applicable to the identification of samples:

- a. Any geological, environmental, or radiological samples obtained by 8540 shall have unique identification which traces the samples to the source(s), and shall also relate to the method(s), date, and conditions prevailing at the time of sampling, as well as other pertinent information.
- b. Samples shall be identified and controlled in a manner consistent with the intended use, and in compliance with any applicable regulatory guidelines. Samples shall be identified by placing the identification directly on the sample or container, or on records traceable to the samples.
- c. If it is impractical to place all the identification on the sample, methods shall be described in implementing procedures to assure that samples are not mixed with like samples, and that the correct identification of samples is verified and documented prior to release for use. The unique sample identification shall be assigned and coordinated, and shall remain as the identification number from the point of sample collection through processing, storage, and archiving up to and including disposal.

8.4.5 Physical Identification of Items

Physical identification of items shall be used to the maximum extent possible. Identifying markings shall be permanent and legible and shall not adversely affect the function, service, or archival life of the item. When identification on the item is impractical, physical segregation, record traceability, or other methods shall be described in implementing procedures.

Each part/piece of an item, when removed from the sample lot, shall be identified with the appropriate unique, traceability number, which shall be protected to avoid obliteration or other degradation which could effect the visibility/traceability of the identification.

8.4.6 Adhesive Labels

If adhesive labels are selected as a method of item identification, the labels shall be evaluated for compatibility with the environment to which they will be exposed (radiation,

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temperature, weather, etc.) as well as the chemical composition of the adhesive on the labels to avoid contamination of the sample.

8.4.7 Tags and Markers

Only tags which can be attached to an item without damaging the item shall be used. The material that attaches the tag to the item must be evaluated to assure that it will not chemically alter the item.

When items are identified through the use of markings or paints, these shall be analyzed for chemical composition to preclude affecting/damaging the items which are being identified and controlled.

8.4.8 Control of Items with Finite Shelf Life

Items with finite shelf life shall be controlled and physically identified to assure that they are provided the maximum protection for their shelf lives. Procedures shall identify the methods for dispositioning of items with expired shelf lives.

8.4.9 Records

The documentation requirements identified in this section constitute QA records and shall be maintained in accordance with the requirements identified in Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 9 CONTROL OF SPECIAL PROCESSES	8540-QAMP REVISION 0
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9.1 PURPOSE

This section describes the requirements for controlling processes which affect the quality of items (materials, equipment, components, samples, data) for which such quality cannot be readily determined by routine inspection or testing.

9.2 APPLICABILITY

These requirements apply to all special or unusual processes conducted or controlled by 8540 personnel, including, but not limited to, applicable biological sampling activities and collection, and radiological and geological sampling and handling.

9.3 RESPONSIBILITIES

9.3.1 Division Supervisors

8540 Division Supervisors are responsible for:

- a. Identifying the special processes that may be utilized by 8540 personnel.
- b. Assuring that assigned personnel are trained and qualified, as applicable to the activity.
- c. Reviewing and approving applicable special process procedures.

9.4 REQUIREMENTS

9.4.1 Personnel

Personnel performing or controlling 8540 special processes shall be qualified. Qualification records for individuals who perform or control special processes shall include results of a written proficiency examination, and/or results of a practical examination in which the process was performed, which shall be evaluated by appropriate supervisory personnel.

9.4.2 Procedure

8540 special process procedures shall be written per the requirements of an applicable code. These procedures should address the following:

- a. Acceptance criteria.
- b. Ambient conditions and requirements as defined by the applicable specifications and/or codes.
- c. Qualification requirements for procedures, specifications, and personnel.
- d. Equipment and/or calibration requirements.
- e. Parameters and attributes for which verification and/or documentation is required.

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9.4.3 Records

Documentation of procedure and personnel qualification shall be maintained as QA records in accordance with the requirements of Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 10 INSPECTION	8540-QAMP REVISION 0
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10.1 PURPOSE

This section establishes the requirements for performing inspections of 8540 quality-affecting activities and for the qualification of 8540 inspection personnel. For the purposes of the 8540 QA Program, "inspection" refers to those quality control or other checking functions performed by line staff as an integral part of their activities and to the 8540 acceptance of purchased items or services.

10.2 APPLICABILITY

These requirements are applicable to the planning and conduct of internal 8540 inspections of quality-affecting activities.

10.3.1 Division Supervisors

8540 Division Supervisors are responsible for assuring that only qualified personnel perform inspections and that applicable inspections are performed at appropriate activity intervals.

10.3.2 8540 Personnel

8540 personnel assigned to inspection functions are responsible for providing and demonstrating confidence of activity results and correct purchases.

10.4 REQUIREMENTS

10.4.1 Personnel Qualification and Independence

8540 personnel who verify conformance of work activities or purchased items and services for purposes of acceptance shall be qualified to perform the assigned task. Purchased items or services shall be accepted for use in 8540 quality-affecting activities by the original requestor whenever possible. Other qualified staff may be assigned as necessary. Secretarial, loading dock, or other simple delivery acknowledgment is not sufficient for 8540 QA Program purposes.

8540 personnel assigned to quality control or other checks of ongoing or completed quality-affecting activities shall be independent of performance or responsibility for the activity being checked.

10.4.2 Inspection Planning

Planning for inspection shall be accomplished concurrent to planning the work activities. Planning shall consider the following:

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- a. **Inspection Hold Points:** If mandatory inspection hold points are required beyond which work shall not proceed without the specific consent of 8540 representatives, these specific hold points shall be indicated in appropriate documents.
- b. **Sampling:** When a sample is used to verify acceptability of a group of items, the sampling procedure shall be based on accepted sampling practices.
- c. **Documentation:** Documentation shall identify characteristics, methods, and acceptance criteria, and shall provide for recording objective evidence of inspection results.

10.4.3 Inspection Process

The inspection process involves the real time examination and/or observation of activities and items to acceptance criteria defined in specifications, drawings, checklists, etc. A combination of inspection and process monitoring methods, when used, shall be performed in a systematic manner to assure that the specified requirements for control of the process and quality of the item are being achieved throughout the duration of the process. Controls, where required, shall be established and documented for the coordination and sequencing of these activities at established inspection points during successive stages of the conducted process or construction. When final inspections are performed, they shall include a records review of the results and resolution of nonconformances identified in prior inspections. The acceptance of items shall be documented and approved by authorized personnel.

10.4.4 Records

QA records generated by this section shall be handled in accordance with Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 11 TEST CONTROL	8540-QAMP REVISION 0
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11.1 PURPOSE

This section establishes the requirements for the control of test activities related to 8540 investigations, analyses, or other regulatory compliance actions.

11.2 APPLICABILITY

This section applies to test planning, test approval and authorization, test performance, test documentation, test evaluation, and disposition of final test results for 8540 quality-affecting activities.

11.3 RESPONSIBILITIES

11.3.1 Division Supervisors

8540 Division Supervisors are responsible for the development of test plans, overseeing testing activities, assuring that test results are properly documented, and assuring that personnel are qualified for conducting tests.

11.4 REQUIREMENTS

11.4.1 Test Plans

8540 testing activities shall be planned by appropriate 8540 personnel prior to commencing test activities. Test plans shall establish an agreement as to what characteristics are to be verified. Test plans shall include or refer to test objectives and make provisions for assuring that proper instrumentation is available and is used, necessary monitoring is performed, and suitable environmental conditions are maintained to avoid degradation of the test item. Test plans shall also address:

- a. Qualification requirements of test personnel.
- b. Type of testing and measuring equipment required and their calibration requirements.
- c. Testing parameters and acceptance criteria.
- d. Environmental conditions.

11.4.2 Performance of Test Activities

8540 personnel shall conduct test activities in accordance with the requirements identified in 8540 plans and procedures. Personnel shall assure that proper environmental conditions are maintained in the requisite activities and any deviations or nonconformances that may occur during these tests are documented and dispositioned in accordance with the requirements identified in Section 15 of this QAMP.

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11.4.3 Test Results

Test results shall be documented and evaluated by responsible and qualified personnel in order to assure that test requirements have been met. Test records shall contain as a minimum:

- a. Item, system, or sample tested.
- b. Date of test.
- c. Unique identification of item and test equipment.
- d. Tolerance requirements and acceptance criteria.
- e. Results and acceptability.
- f. Deviations and actions taken with regard to the deviations.
- g. Names of personnel performing tests.
- h. Names of personnel evaluating results.

11.4.4. Records

Documentation generated as a result of the planning, performance, or reporting of testing activities shall be considered QA records and shall be maintained in accordance with the requirements of Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 12 CONTROL OF MEASURING AND TEST EQUIPMENT	8540-QAMP REVISION 0
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12.1 PURPOSE

This section establishes the 8540 requirements for the use of measuring and test equipment (M&TE).

12.2 APPLICABILITY

These requirements are applicable to the selection and use of M&TE utilized to perform 8540 quality-affecting activities. Most SNL M&TE calibration is performed by or otherwise procured by Division 8285, Measurement Standards, Calibration, and Photo (outside 8540) and these requirements do not directly apply to their functions except to describe 8540 interaction responsibilities. These requirements do apply to MT&E which needs user calibration prior to each operation.

12.3 RESPONSIBILITIES

12.3.1 Division Supervisors

8540 Division Supervisors are responsible for assuring that 8540 M&TE used in the acceptance of 8540 quality-affecting data are properly selected, used, and calibrated and that measurements are performed with equipment that was out of calibration is promptly reported in compliance with Section 15 of this QAMP.

12.3.2 8540 Personnel

Applicable 8540 personnel are responsible for:

- a. Selecting the appropriate M&TE for a task and using this equipment in an appropriate manner.
- b. Identifying M&TE that requires calibration.
- c. Registering appropriate M&TE with Division 8285.
- d. Complying with the Division 8285 recall system and calibration policies.
- e. Identifying the need for M&TE which requires calibration by the user.

12.4 REQUIREMENTS

12.4.1 Selection

8540 M&TE selection and procurement processes shall assure that such items are of proper type, range, accuracy, and tolerance to accomplish the function of determining conformance to specified requirements.

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12.4.2 Identification

8540 Division Supervisors are responsible for assuring that all 8540 M&TE are identified. This may be accomplished through controlled inventory and physically marking the equipment with a unique identification number, status tag, color code, and/or calibration sticker. The identifier shall be recorded on the data sheet, log book page, etc. along with the data taken when using that item. An M&TE inventory shall be maintained and shall include:

- a. A brief description of the item.
- b. Unique identifier on the item.
- c. Calibration recall frequency.
- d. Date of last calibration.
- e. Next calibration recall date.
- f. Date of each inventory/log entry and the individual recording the entry.

12.4.3 Calibration

As applicable per paragraph 12.2 above, 8540 M&TE shall be calibrated, adjusted, and maintained at prescribed intervals or, prior to use, against certified equipment having known valid relationships to nationally recognized standards such as the National Institute for Standards and Technology (formerly known as National Bureau of Standards.) If no nationally recognized standards exist, the basis for calibration shall be documented.

12.3.3 Nonconformance

Prior to use of M&TE, 8540 personnel shall verify that the calibration recall date has not expired. If it is past the date of recall, the item shall be removed from service, tagged, and segregated if possible, and reported in accordance with Section 15 of this QAMP.

If, upon any recalibration, M&TE is found to be out of calibration, it shall be immediately removed from service, tagged, and segregated if possible. An evaluation to determine the effect and significance of the use of suspect data shall be performed and documented. If the evaluation discloses an adverse effect on items/work/data previously accepted, appropriate corrective action shall be undertaken.

12.4.5 Handling and Storage

8540 Division Supervisors shall assure proper protection, storage, handling, and environmental conditions are maintained for all M&TE. The effects of environment or other factors on an item's uncertainty shall be considered when calibration specifications are established. Limitations on the handling, use, and storage of items shall be defined in the applicable calibration procedures, in the applicable test procedures, and in the applicable item-specific M&TE implementing procedures.

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12.4.6 Records

Documentation generated as a result of control, use, or calibration of M&TE shall be considered QA records and shall be maintained in accordance with the requirements of Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 13 HANDLING, STORAGE, AND SHIPPING	8540-QAMP REVISION 0
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13.1 PURPOSE

This section establishes the requirements for the handling, storage, and shipping of 8540 items to ensure that items which affect quality are controlled to prevent damage or loss and to minimize deterioration.

13.2 APPLICABILITY

These requirements apply to handling, storage, packaging, shipping, or receiving of 8540 items which if damaged, lost, or deteriorated, could affect quality.

13.3 RESPONSIBILITIES

13.3.1 Division Supervisors

8540 Division Supervisors are responsible for assuring that procedures are generated for handling, storage, and shipping items; maintaining inventories of items stored and shipped to other locations; and maintaining proper environmental conditions for items in storage.

13.4 REQUIREMENTS

13.4.1 Procedures

Handling, storage, and shipping of items shall be conducted in accordance with established instructions or procedures specified for use in conducting the activity.

13.4.2 Special Equipment

When required for particular items, special equipment (such as containers, shock absorbers, and accelerometers), special protective environments (such as inert gas atmosphere), specific moisture content levels, and temperature levels shall be provided, and the conditions verified.

13.4.3 Shipping of Items

All items to be shipped shall be processed by appropriate assigned 8540 personnel. The cognizant individual shall assure that appropriate documentation (e.g. carrier shipping forms, chain-of-custody forms, labels, property release forms) is prepared and, if required, signed by the appropriate person(s). Shipping documentation shall accurately reflect tag and serial numbers for tagged items. Traceability shall be maintained at all times for the items to be shipped, from the point of origination to the final receipt of the item or material.

13.4.4 Storage of Items

Specific, limited access areas shall be designated for storage of quality related items. These areas shall be controlled by 8540 personnel.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 13 HANDLING, STORAGE, AND SHIPPING	8540-QAMP REVISION 0
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13.4.5 Packaging

Packaging requirements shall be specified for protection against corrosion, contamination, physical damage, or any effect which would effect the item or cause deterioration during the time it is handled, stored or shipped.

13.4.6 Records

Documents generated as a result of handling, storage, and shipping of items shall be considered QA records subject to the requirements identified in Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 14 INSPECTION, TEST, AND OPERATING STATUS	8540-QAMP REVISION 0
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14.1 PURPOSE

This section establishes the requirements for the use of physical status indicators and/or supporting documentation for inspection, test, operating, and other related 8540 activities.

14.2 APPLICABILITY

These requirements are applicable to the identification of the status of 8540 items or systems, and to the use of material, operating systems, or work areas with status indicators.

14.3 RESPONSIBILITIES

14.3.1 Division Supervisors

8540 Division Supervisors have the responsibility for controlling status indicators and for assuring that personnel adhere to the instructions on the status indicators.

14.4 REQUIREMENTS

14.4.1 Level of Control

The level of control required for 8540 inspection, test, and operating status activities shall be proportional to the importance of an item's prescribed function, the results it is intended to produce, and the consequence of its inadvertent use.

14.4.2 Status Identification

The status of 8540 inspection and test activities shall be identified either on the items or in documents traceable to the items where it is necessary to assure that required inspections and tests are performed, and to assure that items which have not passed the required inspections and tests are not inadvertently installed, used or operated. Physical status indicators (e.g., markings, tags, and other identification) and status documentation shall address:

- a. The operating status of the system or component.
- b. Activities which require the use of these indicators.
- c. Proper unique identification to provide for traceability.
- d. Out-of-service conditions.

The use of these indicators shall not adversely affect the characteristics or function of the item.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 14 INSPECTION, TEST, AND OPERATING STATUS	8540-QAMP REVISION 0
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14.4.3 Removal of Status Indicators

The removal of status indicators shall be strictly controlled to assure that only authorized personnel remove status indicators.

14.4.4 Experimental Activities

The use of physical status indicators is necessary to assure that operational, support and experimental activities important to health, safety, and security are properly controlled. The following items and systems shall be identified with a physical status indicator when they do not conform to specified requirements or when out-of-normal conditions exist:

- a. Facility or experimental systems.
- b. Security systems.
- c. Emergency systems.
- d. Environmental or biological samples taken from geological sources.

14.4.5 Tags

Examples of physical status indicators stemming from operational, support or experimental activities include: Do Not Operate, Caution, Radiation Area, Warning, Hold, Hazardous Material Tag, etc.

14.4.6 Records

Documents generated as a result of controlling test and operating status shall be considered QA records and shall be controlled per the requirements of Section 17 of this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 15 CONTROL OF NONCONFORMANCES	8540-QAMP REVISION 0
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The system for control of nonconformances for all of SNL is authorized and managed by Directorate 7300, Quality Improvement. The Quality Improvement system includes requirements for the identification, control, evaluation, and resolution of conditions adverse to quality or potentially adverse to quality. Department 8540 has no authority for management of this system, however, where situations involving 8540 occur, the QA Coordinator and applicable Division Supervisors shall monitor 8540 activities.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 16 CORRECTIVE ACTION	8540-QAMP REVISION 0
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The system for control of corrective action for conditions adverse to quality for all of SNL is authorized and managed by Directorate 7300, Quality Improvement. The Quality Improvement system includes requirements for the identification, control, evaluation, and resolution of conditions adverse to quality or potentially adverse to quality. Department 8540 has no authority for management of this system, however, where situations involving 8540 occur, the QA Coordinator and applicable Division Supervisors shall monitor 8540 activities.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 17 QUALITY ASSURANCE RECORDS	8540-QAMP REVISION 0
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17.1 PURPOSE

This section establishes the 8540 requirements for the generation, control, validation, maintenance, and disposition of QA records.

17.2 APPLICABILITY

These requirements are applicable to the generation, processing, and verification of documents and other records that demonstrate 8540 quality-affecting activities. They apply only to the internal needs of 8540. Transfer of archival records or other contact with other SNL organizations regarding records management practices shall be handled in accordance with the requirements of the applicable authority and is not governed by the 8540 QAMP.

17.3 RESPONSIBILITIES

17.3.1 Department Manager

The 8540 Department Manager is responsible for establishing a records management system covering the generation, receipt, control, and maintenance of 8540 QA records.

17.3.2 Division Supervisors

8540 Division Supervisors are responsible for assuring that 8540 personnel generate, process, validate, maintain, classify, and transmit QA records in accordance with the requirements of this QAMP.

17.3.3 Records Coordinator

The 8540 Records Coordinator is responsible for the direction and coordination of the 8540 QA records management system.

17.4 REQUIREMENTS

17.4.1 Records Management System

The 8540 records management system shall be described in a Records Management Plan and implementing procedures. The Records Management Plan and implementing procedures shall be consistent with the requirements of this QAMP.

17.4.2 Generation of Records

Documents which support or provide objective evidence of the planning and accomplishment of 8540 quality-affecting activities shall be designated as 8540 QA records. Documents designated as QA records shall identify a document title and a unique identification number.

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17.4.3 Acceptance Criteria

Documents which specify qualitative or quantitative acceptance criteria shall identify the required types of records to furnish documentary evidence of the achievement of the specified requirements.

17.4.4 Record Validation

The originator of records shall authenticate, by signature, any document which is designated as a QA record. Documents are authenticated to assure that those records designated as official QA records are legible, complete, and of microfilm quality. Authentication may occur at time of issue or prior to transmittal to records management personnel. Records may be originals or reproduced copies.

17.4.5 Record Index

Records management personnel shall generate a records index which identifies the record type, unique identifier, record retention time, and location of the record within the record system.

17.4.6 Record Classification

8540 Division Supervisors shall classify records as to their retention status. Possible classification criteria include; lifetime/permanent records, nonpermanent records, and records with limited storage and retention requirements. The retention periods for these records shall be identified by records type in the Records Management Plan and implementing procedures, as appropriate.

17.4.7 Records Revisions or Corrections

The Records Management Plan and implementing procedures shall identify the methods for correcting records once the documents have been designated as QA records, and these records shall provide protection from damage or loss during the time that the records are in the possession of the individuals who are revising the records.

17.4.8 Records Receipt

The Records Management Plan and implementing procedures shall address the requirements and methods for receipt of QA records. A system shall be identified for receipt control of records for permanent and temporary storage which shall include:

- a. A method for designating the required records.
- b. A method for identifying records received.
- c. Procedures for receipt and inspection of incoming records.

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- d. A method for submittal of completed records to the storage facility without unnecessary delay.
- e. A method for dual record copy retention, as necessary.

17.4.9 Records Storage, Preservation, and Safekeeping

Records shall be stored in a manner that protects them against damage from moisture, temperature, pressure, larceny, rodents, sunlight, and other environmental considerations. The Records Management Plan and procedures shall address the storage facility and measures to be taken for safekeeping of these records. Records storage systems shall provide for retrieval times based upon the record type. A list shall be maintained designating those personnel who shall have access to the QA record files.

17.4.10 Records Disposition

The Records Management Plan and procedures shall establish the methods for dispositioning records and shall specify when records may be purged from the system, records turnover requirements, and permanent records storage. The frequency of record turnover to records management personnel shall be identified. Interaction with other SNL authorities (outside 8540) for records management shall be described.

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QUALITY ASSURANCE MANAGEMENT PLAN	Section 18 AUDITS/ SURVEILLANCES	8540-QAMP REVISION 0
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18.1 PURPOSE

This section establishes the requirements and responsibilities for quality verification activities directed by the 8540 QA Coordinator.

18.2 APPLICABILITY

These requirements are applicable to personnel performing 8540 QA Program internal surveillance or other QA Coordinator directed verification activities. It does not apply to checking and other quality control activities administered by 8540 Divisions. Audits of 8540 activities are performed by various SNL authorities outside the responsibility or applicability of the 8540 QAMP. These requirements are not intended to conflict, interfere, or replace overall SNL requirements.

18.3 RESPONSIBILITIES

18.3.1 Department Manager

The 8540 Department Manager has overall responsibility for assuring that 8540 personnel are made available to support 8540 quality verification activities, as necessary. The Department Manager shall certify the qualifications of the QA Coordinator to independently perform 8540 surveillances.

18.3.2 Division Supervisors

8540 Division Supervisors are responsible for providing input into surveillance schedules, assuring the availability of personnel participating in these activities, and for corrective actions in response to deficiencies identified during these activities.

18.3.3 Quality Assurance Coordinator

The 8540 QA Coordinator is responsible for:

- a. Developing 8540 surveillance activity schedules.
- b. Selecting, training, and certifying surveillors, as applicable.
- c. Reporting results of 8540 surveillances to the Department Manager.
- d. Verifying corrective action implementation.

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18.4 REQUIREMENTS

18.4.1 Scheduling

The 8540 QA Coordinator is responsible for developing comprehensive surveillance schedules. Surveillances shall be scheduled in a manner to provide coverage and coordination with ongoing 8540 QA Program activities. Division Supervisors shall review schedules and provide inputs to assure that surveillances are timely, and are conducted at proper intervals commensurate with the importance and complexity of the activities.

18.4.2 Personnel Selection and Training

Personnel selected as 8540 surveillors or other evaluators shall have training and experience commensurate with the scope and complexity of the activities to be evaluated. Individuals participating in 8540 surveillances shall be independent of any direct responsibility for performance of the activities which they evaluate.

Surveillors shall have appropriate training and be qualified for conducting 8540 surveillance activities.

The QA Coordinator shall prepare implementing procedures which provide specific requirements and methods for training, qualifying, and certifying surveillance personnel.

18.4.3. Preparing for Surveillances

The 8540 QA Coordinator shall assure that personnel performing quality verification activities have made the necessary preparation for the activity. Preparation activities include:

- a. Notice of surveillance activities. This can be accomplished by documented telephone notice of the activity for quick turn around tasks, or through memorandum or letter providing written notification of the activity.
- b. Development of surveillance plans. The plans shall identify the scope, requirements, personnel, and activities to be evaluated, organization to be notified, applicable documents, schedule, and written procedures or checklists.
- c. Instruction of personnel. The QA Coordinator has the responsibility for assuring that personnel participating in surveillances are instructed in the requirements for conducting these activities.

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18.4.4 Performing Surveillances

8540 surveillances shall be performed in accordance with written procedures or checklists. The activities/tasks to be evaluated shall be evaluated against specific requirements, criteria, and objectives. Objective evidence shall be reviewed to the maximum extent possible, to assure that results are objective and reflect the intentions of planned activities.

18.4.5 Corrective Actions

Conditions requiring corrective action shall be identified and actions taken to correct the immediate situation as well as similar conditions, and actions to prevent recurrence shall be specified and initiated as soon as practical. Conditions requiring prompt corrective action shall be reported immediately to the QA Coordinator and the Division Supervisor(s) and/or Department Manager, as appropriate.

18.4.6 Reporting

Surveillance reports shall be written in a format that provides the most appropriate information to the target audience. Reports shall include the following as a minimum:

- a. Description of the surveillance scope.
- b. Identification of the surveillors.
- c. Identification of persons contacted during the surveillance activities.
- d. Summary of surveillance results, including a statement on the effectiveness of the QA Program elements that were evaluated.
- e. Description of each reported adverse audit finding in sufficient detail to enable corrective action to be taken by the responsible organization.

18.4.7 Responses

Management of the organizations that receive surveillance reports shall investigate adverse findings, schedule corrective action, including measures to prevent recurrence, identify the probable root cause of the problem, and notify the QA Coordinator in writing of the planned action or the action taken to correct the problem. Personnel involved in the surveillance shall evaluate the response(s) for adequacy.

18.4.8 Follow-Up and Closure

The 8540 QA Coordinator shall follow-up on corrective action responses to assure that responses are received on a timely basis, and that committed corrective actions are completed per the planned completion milestones. The QA Coordinator shall verify implementation of corrective action prior to closure of the findings, problems, or reports.

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18.4.9 Records

Documentation related to 8540 surveillances shall be considered QA records and shall be collected and retained in accordance with the requirements of Section 17 in this QAMP.

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QUALITY ASSURANCE MANAGEMENT PLAN	Appendix A GLOSSARY OF TERMS	8540-QAMP REVISION 0
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ACTIVITY - Any time consuming effort (operation, task, function, or service) which influences or affects the achievement or verification of the objectives of Department 8540.

APPROVAL - An act of endorsing or adding positive authorization as shown by signature/initial and date.

AUDIT - A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established procedures, instructions, and other applicable documents, and the effectiveness of implementation. An audit should not be confused with inspection activities performed for the sole purpose of process control or product acceptance.

CERTIFICATES OF CONFORMANCE - A written statement, signed and dated by a qualified party, certifying that items or services comply with specific requirements.

CERTIFICATION - The act of determining, verifying, and attesting in writing to the qualifications of personnel, processes, procedures, or items in accordance with specified requirements.

COMPLIANCE - Conformance to a code, specification, or procedure.

CONFIGURATION MANAGEMENT - The systematic process of identification, control, and accounting of the relative arrangement of activity products (and their component parts) from the point of their initial definition and proceeding throughout their intended life.

CONTRACTOR/VENDOR - Any individual or organization furnishing items or services in accordance with a procurement document.

CONTROLLED AREA - An enclosed area to which entry is controlled.

CORRECTIVE ACTION - Measures taken to rectify conditions that are adverse to quality and, where necessary, to preclude repetition.

DISPOSITION - The action taken to resolve a non-conforming condition and to restore acceptable conditions.

DOCUMENT - Any written, pictorial or electronically stored information describing, defining, specifying, reporting, or certifying activities, requirements, plans, procedures, or results. A document is not considered to be a QA record until it satisfied the definition of a QA record.

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DOCUMENTATION - Any written or electronically stored information describing, defining, specifying, reporting or certifying activities, procedures or results.

EXAMINATION - Specific actions by qualified personnel using qualified procedures to verify that items are in conformance with specified requirements.

EXPERIENCE - Knowledge, skill, or practice derived from direct participation in identified activities.

HOLD POINT - A designated stopping place during or following a specific activity at which inspection or examination is required before further work can be performed.

INSPECTION - Quality control or other checking activities to verify conformance to specific requirements.

ITEM - An all inclusive term used in place of any of the following: appurtenance, assembly, component, data, equipment, material, module, part, sample, structure, sub-assembly, subsystem, system, or unit.

NON-CONFORMANCE - A deficiency in characteristic, documentation, or procedure which renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformance include: physical defects, test failures, incorrect or inadequate documentation, or deviation from prescribed procedures.

OBJECTIVE EVIDENCE - Any documented statement of fact, other information, or record, either quantitative or qualitative, that pertains to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

PEER - A person having technical expertise in the subject matter to be reviewed (or a critical subset of the subject matter to be reviewed) to a degree at least equivalent to that needed for the original work.

PEER REVIEW - A documented, critical review performed by peers who are independent of the work being reviewed. The peer's independence from the work being reviewed means that the peer (a) was not involved as a participant, supervisor, technical reviewer, or advisor in the work being performed, and (b) to the extent practical, has sufficient freedom from funding considerations to assure the work is impartially reviewed. A peer review is an in-depth critique of assumptions, calculations, extrapolations, alternate interpretations, methodology, and acceptance criteria employed, and of conclusions drawn in the original work. Peer reviews confirm the adequacy of work.

PEER REVIEW GROUP - An assembly of peers representing an appropriate spectrum of knowledge and experience in the subject matter to be reviewed and varying in size based on the subject matter and importance of the subject matter to safety or environmental concerns.

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PLANNING INPUT - Those criteria, parameters, bases or other planning requirements upon which a detailed final plan is based. For the purposes of the 8540 QA Program, planning includes such activities as investigations, analyses, report preparation or other regulatory compliance actions.

PLANNING OUTPUT - Documents defining technical requirements of 8540 investigations, analyses, report preparations, or other regulatory compliance actions.

PROCEDURE - A document that specifies or describes how an activity is to be performed.

PROCUREMENT - Purchasing of items or services from vendors and contractors.

PROCUREMENT DOCUMENTS - Contractually binding documents that identify and define the requirements which items or services must meet in order to be considered acceptable by the purchaser.

QUALIFICATION OF PERSONNEL - Determination that the knowledge, skills, and abilities gained through training and experience, as measured against established requirements, qualify an individual to perform a required job or task in a safe and proficient manner.

QUALITY - Conformance to specified requirements.

QUALITY-AFFECTING ACTIVITIES - Activities that, if not performed properly, could compromise the validity of information or data, could result in an unacceptable risk to health or safety of the public or the workers involved, or could have a detrimental effect on the achievement of the objectives of Department 8540.

QUALITY ASSURANCE - All those planned and systematic actions necessary to provide adequate confidence that an activity, item, or facility will perform satisfactorily in service.

QUALITY ASSURANCE MANAGEMENT PLAN - The document that describes the 8540 QA Program, the applicable QA requirements, and the responsibility for the implementation of the Program and compliance with the requirements.

QUALITY ASSURANCE PLAN - A document which identifies the requirements judiciously selected from the overall 8540 QA Program that are applicable to a particular activity or project, and provide an index or a description of the procedures that implement these and any necessary supplementary requirements. The document also includes specific responsibilities and authorities for the implementation of the activity/project. A QA plan may be a part of an activity/task plan.

QUALITY CONTROL - Those actions which provide a means of control and measurement of the characteristics of an item, process, or facility to established requirements.

REVIEW - A documented examination/evaluation of a QA program element.

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SPECIAL PROCESS - A process in which the results are highly dependent on the control of the process or skill of the processor, or both.

SURVEILLANCE - The act of monitoring or observing to verify whether or not an item or activity conforms to specified requirements. For the purposes of the 8540 QA Program, surveillances may also assess requirement effectiveness.

TESTING - An element of verification for the determination of the capability of an item to meet specified requirements by subjecting the item to a set of physical, chemical, environmental, or operating conditions.

TRACEABILITY - The ability to verify the history, location, or application of an item by means of recorded identification.

TRAINING PROGRAM - An identifiable group of training activities that consists of one or more training courses or classes which make up a total learning process.

VERIFICATION - The act of reviewing, inspecting, testing, checking, auditing, or otherwise determining and documenting whether items, processes, services, or documents conform to specified requirements.

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