SLAC-R-572

Annual Site Environmental Report

January—December 2000

Prepared for the Department of Energy, under contract number DE-AC03-76SF00515

Environment, Safety, and Health Division

November 2001

STANFORD LINEAR ACCELERATOR CENTER

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Site Environmental Report
(January—December 2000)

**ENVIRONMENT, SAFETY,
AND
HEALTH DIVISION**

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STANFORD LINEAR ACCELERATOR CENTER
Stanford University Stanford, California

Department of Energy
Oakland Operations Office
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NOV 07 2001

Subject: 2000 Annual Site Environmental Report for the Stanford Linear Accelerator Center

This report, prepared by the Stanford Linear Accelerator Center (SLAC) for the U.S. Department of Energy (DOE), Stanford Site Office (SSO), provides a comprehensive summary of the environmental program activities at SLAC for calendar year 2000. Annual Site Environmental Reports (ASERs) are prepared for all DOE sites with significant environmental activities, and distributed to relevant external regulatory agencies and other interested organizations or individuals.

To the best of my knowledge, this report accurately summarizes the results of the 2000 environmental monitoring, compliance, and restoration program at SLAC. This assurance can be made based on DOE and SLAC review of the ASER, and quality assurance protocols applied to monitoring and data analyses at SLAC.

A reader survey form is provided with the ASER to provide comments or suggestions for future versions of the report. Your response is appreciated. Questions or comments regarding this report may also be made directly to DOE, by contacting Dave Osugi of the SSO at (650) 926-3305, or by mail to the address above.

Sincerely,

John S. Muhlestein
Director
Stanford Site Office

Certification of Accuracy for:

2000 Site Environmental Report of the Stanford Linear Accelerator Center.

I certify that the information submitted herein is true, accurate, and complete, based on my familiarity with the information and my inquiry of those individuals immediately responsible for obtaining the information.

[signature] Date 11/5/01

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Executive Summary

This report provides information about environmental programs and compliance with environmental regulations during 2000 at the Stanford Linear Accelerator Center (SLAC). In addition, updates that may be of special interest, which occurred beyond 2000, are included.

The most noteworthy information in this report is summarized in this section. This summary demonstrates the effective application of SLAC environmental management systems in meeting the site's Integrated Safety Management System (ISMS) goals.

Environmental Compliance

Section 2 contains the complete Environmental Compliance information.

Program Summary

In 2000, SLAC operated under the Work Smart Standards (WSS) Set, which is incorporated in the SLAC Management and Operating contract. The WSS Set includes all applicable statutory and regulatory requirements for public and worker safety and environmental protection. The WSS Set also includes a number of industry standards that were found to be necessary to control specific hazards present at SLAC.

Releases

Air

No notices of violation (NOVs) or notices to comply (NTCs) were received from the Bay Area Air Quality Management District (BAAQMD) during 2000.

Industrial Wastewater

No wastewater discharge permit violations occurred during 2000.

Stormwater

One release resulted in the notification of the Regional Water Quality Control Board (RWQCB) in 2000. The release was due to a crack in the transite coupling of a 12 inch vertical return pipe at a cooling tower (CT 101), which resulted in 20,000 gallons of cooling tower water entering the storm drain system. (For more information, see section 2.3.5.2 on page 31.)

Environmental Non-Radiological Program

Section 3 contains the bulk of the environmental non-radiological information. Section 5 contains the bulk of the groundwater program information.

Air Quality

A total of 25 air emission sources were included in the SLAC Permit to Operate from the Bay Area Air Quality Management District (BAAQMD) at year-end. BAAQMD conducted an annual inspection of SLAC on November 15, 2000. No instances of non-compliance were noted. All permitted emission sources were operated in compliance with their respective emissions limitations in 2000.

During 1999, BAAQMD revised its regulations implementing Title V of the Clean Air Act. As a result, SLAC became subject to the Title V permitting program and was required to take one of the following actions by October 20, 2000:

- Apply for a Major Facility Review Permit
- Demonstrate that the SLAC "potential to emit" is below the major facility thresholds defined in BAAQMD Regulation 2-6-312
- Apply for and receive a Synthetic Minor Operating Permit (SMOP).

SLAC completed phase two of a baseline air emissions inventory during CYOO. Based on the results of this inventory, SLAC chose to apply for a SMOP as its Title V compliance strategy. The SLAC application, submitted on June 1, 2000, was found to be complete by BAAQMD on July 11, 2000, and was pending final approval at year end.

The major change that will be necessitated by the forthcoming SMOP will be the upgrading of the chemical information management systems at SLAC. A short-term solution of modifying the existing Peoplesoft® purchasing software was underway by year-end and was expected to be complete by mid-2001. A long-term solution of a completely new, web-based, bar-code container tracking system was scheduled to get underway during the latter half of 2001. This new chemical information management system would align the systems at SLAC with those used by its sister DOE facilities in the Bay Area (LLNL, LBNL, and Sandia Labs) and would enable SLAC to fully meet its Title V compliance obligations.

SLAC is expecting the San Mateo County Department of Health Services (the County) to initiate a dialogue in 2001 regarding the California Accidental Release Prevention Program (CalARP) requirements that will be applied to SLAC.

Environmental Restoration

As a part of the SLAC Environmental Protection and Restoration (EPR) Department, the Environmental Restoration Program continued work on site characterization and evaluation of remedial alternatives at four sites with detected volatile organic compounds (VOCs) in groundwater. In addition, EPR continued active participation in various public activities throughout the year.

Hazardous Waste

The San Mateo County Division of Environmental Health conducted a Hazardous Waste Generator Inspection in April of 2000. The report stated: "No violations noted."

As required under federal, state, and local regulations, SLAC complied with all waste management requirements for disposal of non-radioactive hazardous waste in 2000.

Polychlorinated Biphenyls

SLAC removed 41 polychlorinated biphenyls (PCB) capacitors from service during 2000. In addition, a project to reclassify transformer TC #140 to a non-PCB status was completed, and a request to reclassify TC #140 was sent to the US Environmental Protection Agency. TC #140 had previously been retro-flushed (PCB oil was replaced by non-PCB oil), but was still registered as a PCB transformer. The final concentration of the oil was 24 parts per million (ppm). This was the final PCB transformer to be reclassified at SLAC.

Stormwater and Industrial Wastewater

SLAC eliminated 58 unauthorized non-stormwater discharge connections in 2000, bringing the total potential unauthorized non-stormwater discharge connections down from 218 to 160. Weekly meetings between Site Engineering and Maintenance (SEM) and the ES&H Division were initiated to communicate and coordinate projects between the two organizations (such as soil sampling before excavation). As of the publication date of this report, the total number of potential unauthorized non-stormwater discharge connections was 32 (reduced from 160 during Q1 and Q2 of 2001).

Investigations into water reuse and recycling were initiated. Two studies were completed. The focus of the first study was the potential for water reuse at the cooling towers. The second study evaluated several water recycling scenarios and provided a return-on-investment (ROI) analysis for each scenario.

Environmental Radiological Program

Section 4 contains the complete Environmental Radiological information.

Regulatory Limits

SLAC monitors potential radiological releases to the environment through wastewater, air emissions, and direct radiation from accelerator operations. SLAC did not exceed regulatory limits for radioactivity released to the environment in 2000. In addition, there were no known instances of noncompliance for radionuclide air emissions in 2000.

Radioactive Waste

In a continuing effort to clear the site of "legacy wastes," SLAC shipped 960 ft^3 of low-level radioactive waste to the DOE Hanford site in Washington for disposal during 2000. SLAC also found ways to recycle the halon from radiologically activated fire extinguishers and to return some old Zirconium-based research materials to the original manufacturer for reuse.

Groundwater Monitoring Program

The groundwater monitoring program at SLAC was managed through EPR during 2000. Groundwater samples were collected from monitoring wells for surveillance purposes and to investigate the extent of VOCs in groundwater. Both hazardous substances and tritium were monitored under this program.

Assessments

Independent Assessments

URS (formerly known as Dames and Moore) Quality Assurance (QA) environmental assessments were conducted in March of 2000. Safety related QA assessments were conducted in September of 2000. Environmental assessments also were scheduled for the first quarter of 2001.

Self-Assessments

SLAC held its fifth annual Safety and Environmental Discussions (SED) standdown in April of 2000. The discussions provided employees the opportunity to raise safety and environmental concerns. In CYOO, the SED program was expanded to include three choices:

T (Talk) = Traditional safety and environmental discussions.

W (Walk) = A walk-through inspection.

C (Clean) = A site-wide clean up program.

The 2001 program was scheduled to repeat the TWC approach.

Additional Information

A reader's survey has been provided at the end of this document. Additional information about SLAC is available at:

`http://www.slac.stanford.edu/`

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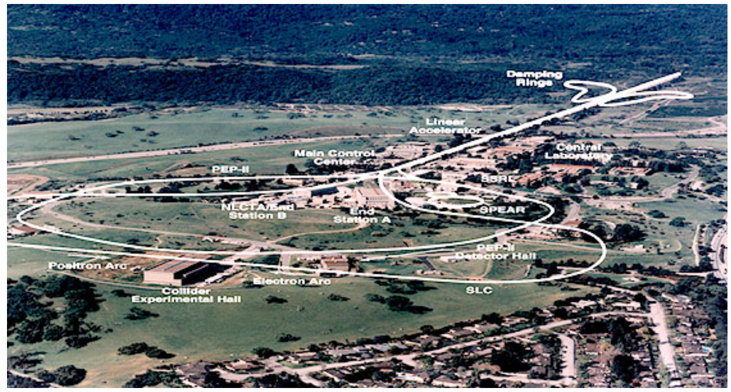

Site Overview

1.1 General

The Stanford Linear Accelerator Center (SLAC) is a national facility operated by Stanford University under contract with the Department of Energy (DOE). SLAC is located on the San Francisco Peninsula, about halfway between San Francisco and San Jose, California (see Figure 1-1).

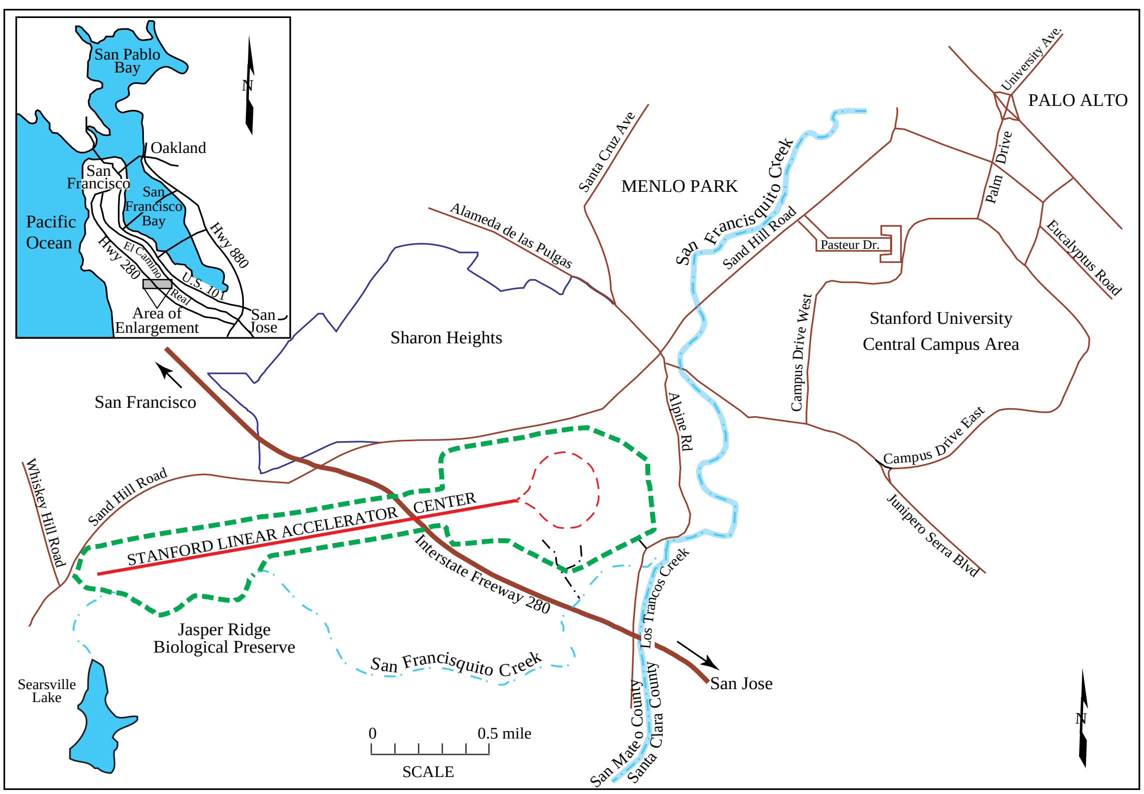

Figure 1-1 SLAC Site Location

The site area is in a belt of low, rolling foothills lying between the alluvial plain bordering San Francisco Bay on the east and the Santa Cruz Mountains on the west. The accelerator site varies in elevation from 53 to 114 meters (m) above sea level. The alluvial plain to the east around the Bay lies less than 46 m above sea level; the mountains to the west rise abruptly to over 610 m (see Figure 1-2).

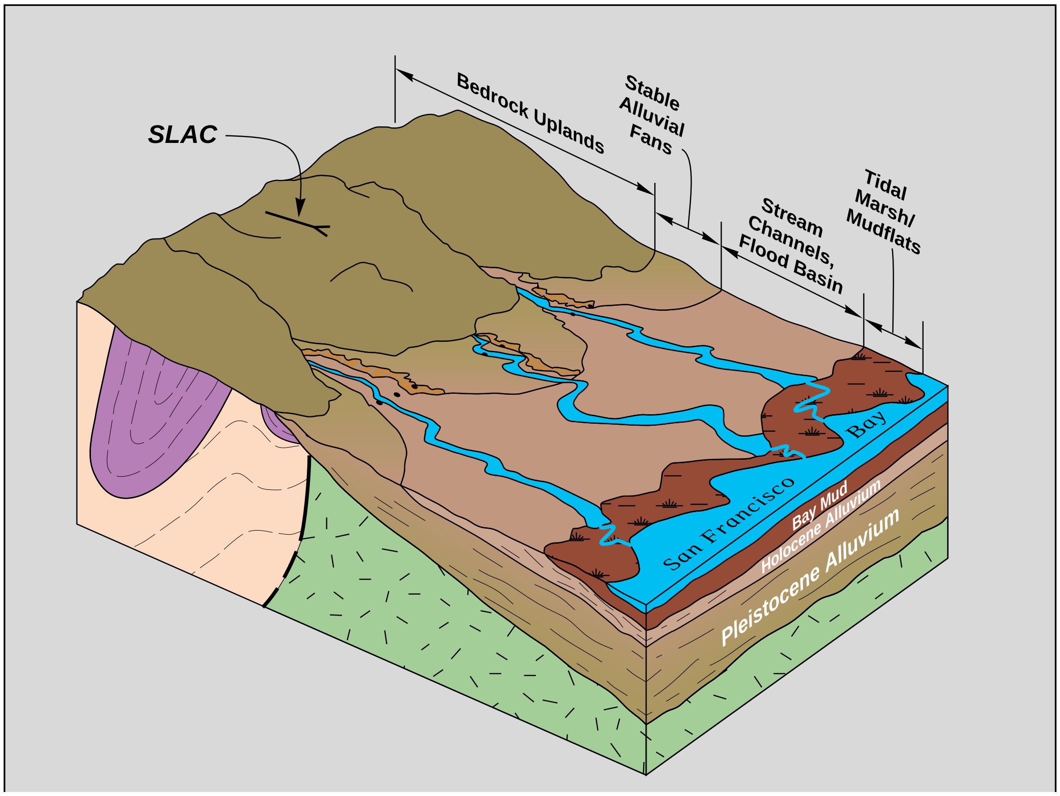

Figure 1-2 Geographic Site Area

The SLAC site occupies 170 hectares of land owned by Stanford University. The property was leased in 1962 for purposes of research in the basic properties of matter. The original lease to the Atomic Energy Commission (AEC), now DOE, was for fifty years. The lease was given for the purpose of researching the basic properties of matter. The land is part of Stanford's "academic reserve," and is located west of the University and the City of Palo Alto in an unincorporated portion of San Mateo County.

The site is bordered on the north by Sand Hill Road and on the south by San Francisquito Creek. The laboratory is located on a parcel roughly 3.2 kilometers (km) long, running in an east-west direction. The parcel widens to about 910 m at the target (east) end to allow space for buildings and experimental facilities.

The SLAC population currently numbers about 1,350 people, of which 150 are Ph.D. physicists. Approximately 800 staff members are professional, composed of physicists, engineers, programmers, and other scientific-related personnel. The balance of the staff is composed of support personnel, including technicians, crafts personnel, laboratory assistants, and administrative associates. In addition to the regular population, at any given time there are between 900 and 1,000 visiting scientists.

1.2 Site Geology

The SLAC site is underlain by sandstone, with some basalt at the far eastern end of the site boundary. In general, the bedrock on which the western half of the SLAC linac rests is the Whiskey Hill Formation (Eocene age), and the bedrock under the eastern half is the Ladera Formation (Miocene age). On top of this bedrock at various places along the accelerator alignment is the Santa Clara Formation (Pleistocene age), where alluvial deposits of sand and gravel are found. At the surface is a soil overburden of non-consolidated earth material averaging from 0.1 to 1.5 m in depth. A more detailed description of the SLAC geology can be found in the *SLAC Hydrogeologic Review Report* (SLAC-I-750-2A15H-002).

1.3 Local Climate

The climate in the SLAC area is Mediterranean. Winters are cool and moist, and summers are mostly warm and dry. Long-term weather data describing conditions in the area have been assembled from official and unofficial weather records at Palo Alto Fire Station Number 3, which is 4.8 km east of SLAC. The SLAC site is 60 to 120 m higher than the Palo Alto Station and is free of the moderating influence of the city; temperatures therefore average about two degrees lower than those in Palo Alto. Daily mean temperatures are seldom below zero degrees Centigrade or above 30 degrees Centigrade.

Rainfall averages about 560 millimeters (mm) per year. The distribution of precipitation is highly seasonal. About 75% of the precipitation, including most of the major storms, occurs during the four-month period from December through March. Most winter storm periods are from two days to a week in duration. The storm centers are usually characterized by relatively heavy rainfall and high winds. The combination of topography and air movement produces substantial fluctuations in intensity, which can best be characterized as a series of storm cells following one another so as to produce heavy precipitation for periods of five to fifteen minutes with lulls in between.

1.4 Land Use

San Mateo County is the ultimate planning authority with respect to University lands that are within the county, but not within an incorporated city. The San Mateo County General Plan is the primary land-use regulatory tool with respect to such lands. Adherence is made to all applicable federal, state, and local regulations, including chemical and sanitary discharges that might (directly or indirectly) adversely affect environmental quality.

The Board of Trustees of Stanford University is responsible for preserving and protecting Stanford's land endowment for the use of present and future generations of students and faculty. While financial and political influences on land-use policy are taken into account, the dominant and prevailing consideration is the appropriateness of those policies in the furtherance of the University's academic mission. Board policies are designed to encourage land uses consistent with the institutional characteristics and purposes of Stanford, and to discourage those uses or claims which do not relate to or support the mainstream activities of the University.

The purpose of the Stanford land endowment is to provide adequate land for facilities and space for instructional and research activities of the University. The use of lands is planned in a manner consistent with the characteristics of Stanford as a residential teaching and research university, and provides flexibility for unanticipated changes in academic needs. Cooperation with adjoining communities is important and the concerns of neighboring jurisdictions are considered in the planning process.

1.5 Description of Program

The SLAC program centers around experimental and theoretical research in elementary particle physics using accelerated electron beams and a broad program of research in atomic and solid-state physics, chemistry, and biology using synchrotron radiation from accelerated electron beams. There is also an active program in the development of accelerators, detectors, and new sources and instrumentation for synchrotron radiation research. Scientists from all parts of the United States and from throughout the world participate in the experimental programs at SLAC.

The main instrument of research is the 3.2-km linear accelerator (linac), which generates high-intensity beams of electrons and positrons up to 50 GeV. These are among the highest-energy electron and positron beams available in the world. The linac is also used for injecting electrons and positrons into colliding-beam storage rings for particle physics research.

The Positron-Electron Project (PEP) storage ring is about 800 meters in diameter. While the original PEP program was completed in 1990, the storage ring has since been upgraded to serve as an Asymmetric *B* Factory (known as PEP-II) to study the *B* meson. PEP-II continued its program with the BaBar detector throughout 2000.

A smaller storage ring, the Stanford Positron-Electron Asymmetric Ring (SPEAR), contains a separate, shorter linac and a booster ring for injecting accelerated beams of electrons. SPEAR is fully dedicated to synchrotron radiation research. The synchrotron light generated by the SPEAR storage ring is used by the Stanford Synchrotron Radiation Laboratory (SSRL) to perform experiments. SLAC is also host of the Next Linear Collider (NLC) test facilities, including the Final Focus Test Beam (FFTB) and the Next Linear Collider Test Accelerator (NLCTA).

1.6 Site Water Usage

SLAC domestic water is furnished via the Menlo Park Municipal Water Department (MPMWD), whose source is the City of San Francisco-operated Hetch Hetchy aqueduct system from reservoirs in the Sierra Nevada. SLAC and the neighboring Sharon Heights development, including the shopping center, receive water service from an independent system (called Zone 3) within the MPMWD. This separate system taps the Hetch Hetchy aqueduct and pumps water up to a 7,600-cubic meter reservoir west of Sand Hill Road.

The Zone 3 system was constructed in 1962 under special agreements between the City of Menlo Park, the developer of Sharon Heights, Stanford University, and the DOE. Since the cost of construction, including reservoir, pump station, and transmission lines, was shared among the various parties, each party has a vested interest in, and is entitled to, certain capacity rights in accordance with these agreements.

Drinking water and process water are supplied to SLAC by the City of Menlo Park from the Hetch Hetchy water system. Drinking water and process water are transported throughout the facility by a distribution system protected by backflow prevention devices. The backflow prevention devices are maintained by the Site Engineering and Maintenance (SEM) Department. There are no drinking-water wells at SLAC. The nearest drinking-water well to SLAC is 1,500 feet from the SLAC border.

Use of water at SLAC is about equally divided between water used to cool equipment (such as the linac) and domestic uses (such as landscape irrigation and drinking water). The average water consumption by SLAC for 2000 was 255,410 gallons per day or 93,480,060 gallons total for 2000.

Since cooling the linac accounts for fully half of the total water consumption, the daily consumption of this component of water usage varies directly with the accelerator running schedule, and hence also varies directly with electric power demand (the domestic water usage is relatively constant and is independent of the accelerator schedule).

The relationship between power and water consumption can be appreciated if one considers that 85% of the power used in linac operation is finally dissipated by water evaporation, in the ratio of about 630 kilowatt-hours (kWh) per cubic meter of water. SLAC now employs six cooling-water towers with a total cooling capacity of 79 megawatts (MW) to dissipate the heat generated by the linac and other experimental apparati.

Power-consuming devices are cooled by a recycling closed-loop system of low-conductivity water (LCW). The LCW is piped from the accelerator (or other devices to be cooled) to the cooling towers, where heat is transferred from the closed system to the domestic water in the towers. Prior to discharge, the LCW from the closed system is sampled and analyzed for radioactivity.

A sizeable portion of the domestic water in each cooling tower reservoir is ultimately evaporated into the atmosphere. Because of this constant evaporation during operation, the remaining water gradually increases in mineral content, and eventually some must be discarded as "blowdown" water and replaced with domestic water. SLAC discharged a total of 17,407,757 gallons of wastewater to the sanitary sewer system in 2000, an average of 46,752 gallons per day.

1.7 Demographics

The populated area around SLAC is a mix of offices, schools, single-family housing, apartments, condominiums, Stanford University, and grazing lands. SLAC is surrounded mainly by five communities: Atherton town, West Menlo Park, Woodside town, Portola Valley town, and Stanford. Population and housing unit data from the 1990 census of these five communities are shown in Table 1-1.

Table 1-1 Demographic Data

Geographic Area	Population (persons)	Pop. Density (per sq mile)	Housing (units)	Land Area (sq mile)
Atherton town	7,163	1,463.32	2,518	4.895
West Menlo Park	3,959	7,086.19	1,701	0.559
Portola Valley town	4,194	458.02	1,675	9.157
Woodside town	5,035	428.88	1,892	11.740
Stanford	18,097	6,569.14	4,770	2.755
Total	38,448	NA	12,556	29.105

An estimate of the population within 80 km of SLAC was determined as part of the required input to the CAP88-PC computer code used to demonstrate compliance with the Clean Air Act (CAA). Population data from the 1990 census of San Mateo County and Santa Clara County were used in this study. The area was divided into 13 concentric circles and 16 compass sectors. The population distribution is summarized in Table 1-2 .

Table 1-2 Radial Population Data for CAP88-PC

0.1 km	0.3 km	0.5 km	1.0 km	2.0 km	4.0 km	6.0 km	8.0 km	10.0 km	30.0 km	40.0 km	60.0 km	80.0 km	Total
0	0	1,214	2,825	14,106	31,679	42,832	131, 629	114,377	665,574	1,232,353	1,716,571	964,283	4,917,443

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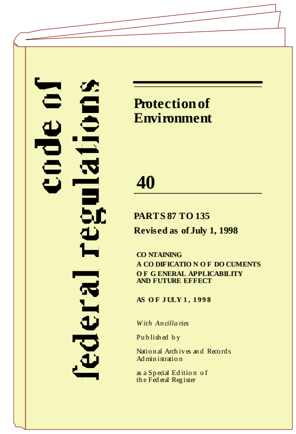

Environmental Compliance

2.1 General

This section provides an overview of the Environment, Safety, and Health (ES&H) Division's organization and its responsibilities for environmental compliance. The ES&H program is designed to ensure that the Stanford Linear Accelerator Center (SLAC) operates in a safe, environmentally responsible manner, and complies with all the applicable ES&H laws, regulations, and standards. Further information about the ES&H Division is
available at:

`http://www.slac.stanford.edu/esh/esh.html`

The environmental management system at SLAC is designed to meet the goals of the Integrated Safety Management Systems (ISMS) designed by the DOE.

2.2 Organizational Overview

The ES&H Division consists of five departments, a division office, and a Program Planning Office. Their shared goal is to help ensure that SLAC operates in compliance with federal, state, and local regulations, as well as Department of Energy (DOE) Orders related to environment, safety, and health. The five departments are:

- Environmental Protection and Restoration (EPR)

  The EPR Department oversees the majority of the SLAC environmental programs, including environmental restoration, air quality, storm water and industrial wastewater, polychlorinated biphenyls and groundwater.

- Operational Health Physics (OHP)

  The OHP Department oversees radiological monitoring and dosimetry at SLAC.

- Radiation Physics (RP)

  The RP Department designs shielding and conducts beam checkouts of new experiments to ensure shielding adequacy for the protection of workers and members of the general public.

- Safety, Health, and Assurance (SHA)

  The SHA Department oversees audits for quality assurance (QA) for ES&H activities and manages the overall safety, health, and QA programs.

- Waste Management (WM)

  The WM Department develops and implements waste minimization and pollution prevention plans and coordinates the disposal of regulated waste.

2.3 Compliance Program Summary

2.3.1 Work Smart Standards Summary

The laws and regulations that specify the environment, safety and health requirements for the laboratory have been identified and are contained in the SLAC Work Smart Standards (WSS) Set. This set of standards was incorporated into the SLAC Management and Operating contract and is reviewed annually.

The WSS Set requirements are based on potential hazards that have been identified by the people who work at SLAC. It is not necessary for every worker to know the details of these laws and regulations; staff in the ES&H Division are available to assist, upon request. However, it ***is*** necessary that workers know about the hazards associated with their jobs and that managers and supervisors know how to get help with understanding the parts of the SLAC WSS Set that apply to them.

2.3.2 Safety Management System Summary

The DOE requires its contractors, including Stanford University for SLAC, to manage and perform work in accordance with a documented Safety Management System (SMS). This directive comes from DOE P 450.4, *Safety Management System Policy*, which commits the DOE to institutionalizing ISMS throughout the DOE complex. The requirement is implemented through incorporation of a contract clause from the DOE Acquisition Regulations (DEAR) 970.5204-2, “Integration of Environment Safety, and Health Into Planning and Execution.” This clause was incorporated into the contract between DOE and Stanford University for operation of SLAC on February 5, 1998.

The contract between Stanford University and the DOE for the operation of SLAC states, in part:

> The Contractor [SLAC] will perform work safely in a manner that ensures adequate protection for employees, the public, and the environment and shall be accountable for the safe performance of work. The Contractor shall exercise a degree of care commensurate with the work and the associated hazards. The Contractor shall ensure that management of environment, safety, and health (ES&H) functions and activities becomes an integral but visible part of the Contractor’s work planning and execution processes.

The SLAC commitment to integrating ES&H considerations into its mission preceded the establishment of the DOE SMS requirements. This was evident in the strong ES&H Program developed by SLAC long before the SMS clause was incorporated into the operating contract.

The *SLAC Safety Management System* (SLAC-I-720-0A008-001), document describes the SLAC SMS program and how SLAC integrates safety and environmental protection into management and work practices at all levels so that its mission is accomplished while protecting the worker, the public, and the environment.

2.3.3 Environmental Permits and Notifications Summary

The general types of permits held by SLAC in 2000 are shown in Table 2-1. The specific permits held by SLAC in 2000 are shown in Table 2-2.

Table 2-1 General Permits and Notifications

Quantity	Name
25	Sources listed on the Bay Area Air Quality Management District (BAAQMD) Permit-to-Operate (18 Permitted Sources — 7 Exempt Sources) For more information, see Table 3-1.
4	Notifications to US EPA for halogenated solvent cleaning units are under the National Emission Standards for Hazardous Air Pollutants (NESHAP Program). Two of these sources had been permitted by the BAAQMD at year-end and two were pending.
3	Mandatory Wastewater Discharge Permits issued jointly by the South Bayside System Authority (SBSA) and the West Bay Sanitary District (WBSD).
2	Tiered Permits for Fixed Treatment Units (Permit-By-Rule [PBR] Permit)
1	Tiered Permit for Fixed Treatment Units (Conditional Authorization Permit)
1	Industrial Activities Storm Water General Permit
1	Hazardous Waste Generator Environmental Protection Agency (EPA) ID No. CA8890016126

Table 2-2 Specific Permits

Permit From	Permit Type	Permit Number	Expiration Date
BAAQMD	Permit-to-Operate	Plant No. 556, 25 listed sources	July 1, 2001
Department of Toxic Substances Control (DTSC)	Tiered Permit for fixed treatment units	Unit 1—Building 038, PBR Permit for Rinse Water Treatment Plant (RWTP)[a]	March 30, 2001
		Unit 2—Building 038, Sludge Dryer (PBR)	March 30, 2001
		Unit 3—Building 460, Conditional Authorization Permit for Batch Treatment Plant (BTP)[a]	March 30, 2001
WBSD and SBSA	Wastewater Discharge	Permit No. WB970401-F (Flow Meter Station at Sand Hill Road)	March 31, 2002
		Permit No. WB970401-P RWTP	March 31, 2002
		Permit No. WB970401-HX BTP	March 31, 2002
San Francisco Bay Regional Water Quality Control Board (RWQCB)	Industrial Activities Storm Water General Permit	Permit No. CAS000001	July 1, 2002

[a] In the Tiered Permits, this plant is referred to as a facility.

2.3.4 Assessments, Inspections, and Quality Assurance Summaries

2.3.4.1 Assessments

Quarterly conduct-of-operations audits of the Environmental Radiological Program were performed by DOE. In addition, the California Department of Health Services, Radiation Health Branch conducts an ongoing site-boundary radiation monitoring program. There were four thermoluminescent dosimeter change-outs in 2000.

2.3.4.2 Self-Assessment Program

An annual Talk, Walk, Clean (TWC) program is used at SLAC to identify and correct ES&H deficiencies. This program includes the opportunity for all laboratory employees, in small discussion groups, to reflect on the most important ES&H issues and suggest solutions. Divisions may take action on this information directly, or they may develop site-wide corrective action plans. A structured walk-through inspection and a clean-up opportunity were also provided.

2.3.4.3 Inspections

A summary of the enforcement inspections for 2000 is shown in Table 2-3

Table 2-3 Enforcement Inspections

Inspection Date	Inspection Type	Inspection Agency	Findings/Results
November 15, 2000	Annual Air Inspection	BAAQMD	No findings.
April 2000	Hazardous Waste Generator	San Mateo County	No findings.
December 1999	Tiered Permit for fixed treatment units	San Mateo County	No findings.

2.3.4.4 Quality Assurance

The SLAC site-wide Quality Assurance (QA) Program has been influenced by the requirements of DOE Order 414.1. The QA Program is described in the *SLAC Institutional Quality Assurance Program Plan* (SLAC-I-770-0A17M-001). This document was revised in September of 2000. The plan defines the roles, responsibilities, and authorities for implementation of the ten criteria from DOE Order 414.1.

The SHA Department is responsible for:

- Auditing the line QA as well as environment, safety, and health (ES&H) programs.
- Maintaining the *SLAC Institutional Quality Assurance Program Plan*.
- Providing direction for implementation of the ten criteria from DOE Order 414.1.

Independent Assessment Program

A major multi-year program of ES&H assessments is currently in place at the laboratory. This assessment is conducted twice per year by a consulting firm (for 2000, the URS Corporation, formerly Dames and Moore). The assessment personnel are highly qualified ES&H professionals. The URS Corporation assessment activities covered the following topics in 2000:

- Asbestos
- Department of Transportation (DOT) Assessment
- Electrical Safety
- General Health & Safety
- Hazardous Materials Management
- Hazardous Waste Management and Treatment
- Industrial Hygiene
- Non-ionizing Radiation
- Radioactive Material Management Program Assessment
- TSCA/PCBs

Radioanalysis Laboratory

In 2000, SLAC participated in one external blind sample quality assessment program, the DOE Quality Assessment Program (QAP), run by the Environmental Measurements Laboratory (EML).

Participation in the QAP consisted of analyzing water samples provided by EML for tritium and gamma-emitting radionuclides and reporting the results to EML. There were two QAP evaluations in 2000, one in March and one in September.

The radionuclides included in the QAP samples that are found at SLAC are: cobalt-60 (^{60}Co), cesium-137 (^{137}Cs), and tritium (^{3}H). SLAC performance in these evaluations was acceptable.

Environmental Monitoring

Table 2-4 lists the procedures and policies used to support the QA Program for environmental monitoring activities.

Table 2-4 QA Program Documents

Document #	Title
QC-030-004-00-R0	*Radioactive Water Sampling/Analysis Audit Procedure*
SLAC-I-770-0A19C-001	Oversight Procedure
SLAC-I-770-2A19C-004	Non-Radiological Sampling Audit Procedure
SLAC-I-770-0A16Z-001	Establishing Data Quality Objectives

Environmental Restoration Program

The Environmental Restoration Program uses the *Quality Assurance Project Plan for the Remedial Investigation and Feasibility Study* (SLAC-I-750-2A17M-003) for soil and groundwater contamination investigations. This document has most of the components required of Quality Assurance Project Plans according to the EPA; the Comprehensive Environmental Response,
Compensation, and Liability Act (CERCLA, or Superfund); and DOE guidance documents. These components include defining required laboratory and field QA/QC procedures and corrective actions, as well as data validation and reporting.

2.3.5 Environmental Incidents/Releases Summary

Table 2-5 summarizes incidents and releases which exceeded regulatory permit limits or local, state, or federal reporting requirements.

Note: *The releases shown in Table 2-5 were unauthorized non-stormwater discharges under the General Industrial Stormwater Permit.*

Table 2-5 Environmental Incidents/Releases Summary

Date	Material	Amount	Location	Description	Corrective Action Taken/To Be Taken
8-22-00	CT Water	20,000 gallons	CT 101	The vertical pipe for the return line on the CT developed a crack.	The vertical pipe return line was repaired.

2.3.5.1 Radiological Incidents/Releases

There were no reportable quantity releases of radioactive material to the environment exceeding limits in 2000.

2.3.5.2 Non-Radiological Incidents/Releases

There was one release of CT water entering the storm drain (see Table 2-5, "Environmental Incidents/Releases Summary," on page 30). This resulted in the notification of the RWQCB. The water released contained chemicals used at the cooling tower. The release was determined to represent minimal or negligible risk.

2.3.5.3 Program Compliance Summary

Table 2-7, "Compliance Summary," on page 33-34 lists the major statutes, executive orders, and other documents that govern activities at SLAC. It also indicates the location of the data in this document, along with any pertinent comments.

2.4 Training

In 2000, personnel who handled hazardous chemicals and waste received instruction in chemical and waste management, waste minimization, pollution prevention, stormwater protection, on-site transportation of hazardous chemicals and waste, and spill and emergency response. The classroom instruction provided was intended to increase awareness in the aforementioned areas and to ensure environmental compliance.

2.5 Environmental Performance Measures

SLAC evaluates its performance against performance measures. The performance measures included:

- Environmental Violations and Releases
- Environmental Restoration Goals
- Waste Minimization/Pollution Prevention Goals
- Hazardous and Radioactive Waste

2.5.1 Specific Measures

The specific performance measures for FY00 can be found at:

`http://www.slac.stanford.edu/esh/perfmeas/perfmeas.html`

2.5.2 Results

Performance measure results are reported in a fiscal year structure; the SLAC fiscal year 2000 (FY00) covered October 1, 1999 through September 20, 2000. The performance measure results for FY00, as found in the *Stanford Linear Accelerator Center Environment, Safety, and Health Third Quarter Report (July 1—September 30, 2000)* indicated an "exceeds expectations" on violations and releases, as shown in Table 2-6.

Table 2-6 FY00 Performance Measure Results

Performance Measure	Results
Environmental Violations and Releases	Exceeds Expectations
Environmental Restoration Goals	Exceeds Expectations
Hazardous Waste	Far Exceeds Expectations
Radioactive Waste	Outstanding
Waste Minimization/Pollution Prevention Goals	Far Exceeds Expectations

Table 2-7 Compliance Summary

Major Statute/Executive Order	Governing Document	Status	ASER Location	Comments
Superfund Amendments and Reauthorization Act (SARA)/ EPCRA 42 USC, Section 11022 (Tier II)	San Mateo County Ordinance California Health and Safety (CHS), Chapter 6.95; Article 80, Uniform Fire Code	Meets Requirements	Section 3.6.1	The Hazardous Materials Business Plan and Hazardous Material Annual Inventory
Executive Order (EO) #12843/ Emergency Planning and Community Right-to-Know Act (EPCRA)	40CFR372	Meets Requirements	Section 3.6.1	Toxic Release Inventory
Resource Conservation and Recovery Act (RCRA) 40CFR261 and following sections.	Title 22 California Code of Regulations	Meets Requirements	Section 3.5.1	Hazardous Waste Generator requirements
National Environmental Policy Act (NEPA)	NEPA- 42 USC 4321-4347, (40 CFR parts 1500-1508)	Meets Requirements	Section 3.8.1	The final PCB transformer at SLAC has been reclassified.
Clean Air Act 40CFR63 40CFR82	BAAQMD Rules and Regulations	Meets Requirements	Section 3.2.1– Regulatory Framework	SLAC has both a radiological and non-radiological air quality protection programs.
Clean Water Act- Groundwater	Federal Water Pollution Control Act (Clean Water Act) -33 USC 1344 (40 CFR Section 400 et seq.)	Meets Requirements	Section 3.3.1	New wells were installed in 2000 to evaluate specific locations for potential contaminants near SLAC facilities.
Clean Water Act- Surface Water	Stormwater Pollution Prevention Plan (SWPPP)	Meets Requirements	Section 3.2.1– Surface Water	SLAC is in the process of eliminating identified unauthorized non-stormwater connections.
Clean Water Act- Industrial Wastewater	Permit No. WB970401-F Permit No. WB970401-P Permit No. WB970401-HX	Meets Requirements	Section 3.3.4 – Industrial and Sanitary Wastewater	SLAC was in compliance with all specified permit limits in 2000.

Table 2-7 Compliance Summary (continued)

Major Statute/Executive Order	Governing Document	Status	ASER Location	Comments
Safe Drinking Water Act (SDWA)	40CFR141-143	Meets Requirements	Section 3.3.1	SEM maintains a backflow prevention program to protect drinking and process water distribution systems.
Toxic Substances Control Act (TSCA)	40CFR761	Meets Requirements	Section 3.7.1	SLAC submitted a letter requesting approval to reclass the last remaining PCB transformer.
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	7 USC Section 136, and following sections	Meets Requirements	Section 3.3.7	In 2000, SLAC used licensed sub-contractors to apply registered pesticides. As of the publication date of this report, SEM personnel had been trained to take-over day-to-day pesticide application tasks. The contract with licensed sub-contractors will be maintained for occasional use.
Endangered Species Act (ESA) 16 USC, 1531 and following sections	Pre-Construction Notice, US Army Corps of Engineers	Meets Requirements	Section 3.3.6	The California red-legged frog has been designated by the federal government as "threatened."
National Historic Preservation Act (NHPA)	NHPA 16 USC 470f	Meets Requirements	Not Applicable	No eligible NHPA sites at SLAC.
Executive Order 11988, Floodplain Management	Executive Order 11988- Floodplain Management (10 CFR Part 1022	Meets Requirements	Section 3.3.6	According to FEMA, a one-hundred-year flood would be confined to San Francisquito Creek and would not reach the SLAC facility.
Executive Order 11990, Protection of Wetlands	Executive Order 11990- Protection of wetlands	Meets Requirements	Section 3.3.5	Jurisdictional wetlands represent less than one acre of the 426-acre SLAC leaseholding.
Tank Management Above-ground Petroleum Storage Act	CHS Code, Section 25270	Meets Requirements	Section 3.7.2	Next biennial report and fees to State are due on 7/1/2002.

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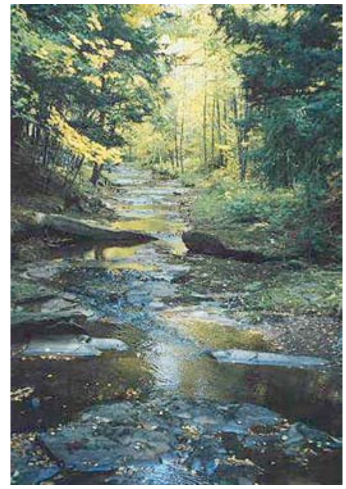


Environmental Non-Radiological Program

3.1 General

This section provides an overview of environmental activities performed at the SLAC in 2000. These activities were designed to comply with laws and regulations, enhance environmental quality, and improve understanding of the effects of potential environmental pollutants that result from site operations.

3.2 Air Programs

3.2.1 Regulatory Framework

In the San Francisco Bay Area, most federal and state air regulatory programs are implemented through the rules and regulations of the Bay Area Air Quality Management District (BAAQMD). Included in the BAAQMD roles and responsibilities are implementation of Title V of the Clean Air Act (CAA). The primary mechanisms by which BAAQMD regulates SLAC air emissions include:

- New source permit evaluations.
- Annual information updates for existing permitted sources.
- Annual information updates for emissions of air toxics as identified by the California Air Resources Board in its *Toxic Substances Check List*.
- Annual enforcement inspections.

On October 20, 1999, BAAQMD adopted significant revisions to Regulation 2, Permits, Rule 6, Major Facility Review. This is the regulation by which BAAQMD implements Title V of the CAA. The net impact of these revisions was that SLAC became subject to the BAAQMD Title V permitting program and was required to take one of the following three actions by October 20, 2000:

- Apply for a Major Facility Review Permit
- Demonstrate that its "potential to emit" is below the major facility thresholds defined in BAAQMD Regulation 2-6-312
- Apply for and receive a Synthetic Minor Operating Permit (SMOP).

SLAC submitted an application for a SMOP to BAAQMD on June 1, 2000; the application review process is ongoing. BAAQMD was legally required to have taken action by December 4, 2000, but that action has been delayed, apparently due to the ongoing California power crises.

SLAC is also subject to air quality regulatory programs that are administered by agencies other than the BAAQMD. These programs include the following.

- The National Emission Standards for Halogenated Solvent Cleaning, under *Title 40 Code of Federal Regulations*, Part 63.460 (40CFR63.460), administered through the Air Division of Region 9 of the US Environmental Protection Agency (EPA).
- The Protection of Stratospheric Ozone requirements (40CFR82) is also administered through the Air Division of EPA Region 9.
- The Toxic Chemical Release Reporting: Community Right-to-Know requirements (40CFR312). SLAC provides the appropriate information to meet these program requirements to Department of Energy at Oakland (DOE/OAK), which in turn provides the information from all DOE facilities under its jurisdiction to the EPA.
- The California Accidental Release Program (CalARP), which combines the requirements of Section 112(r) of the CAA with California-specific requirements, and is administered through the San Mateo County Department of Health Services (SMC/DHS).

3.2.2 Bay Area Air Quality Management District-Implemented Programs

3.2.2.1 Source Permitting

During 2000, SLAC received permits to operate the following sources of air emissions:

- Source S-58, Solvent Cleaning Tank
- Source S-59, Solvent Cleaning Operations
- Source S-60, Ultrasonic Cleaning Tank
- Source S-61, Dynasolve Tank

The location of these units at SLAC are Building 6 (Accelerator Department, Source S-58), Building 31 (Vacuum Assembly Building, Source S-59), and Building 25 (Plating Shop, Sources S-60 and S-61). The first of these sources was a “new” source. The other three were existing sources that were retroactively permitted, based on information collected during the first two phases of a baseline air emissions inventory performed to support the Title V program at SLAC (refer to Section 3.2.2.4).

Each of these sources was a solvent source; examples of the solvents used include trichloroethylene (TCE), methylene chloride, and acetone. Permit conditions were written by BAAQMD for each of the four sources which limited the annual quantities of solvent that could be emitted. Retroactive permit fees were assessed by BAAQMD and paid by SLAC in connection with the latter two sources.

SLAC also applied for and received an “Authority to Construct” permit from BAAQMD for a proposed gasoline dispensing facility (GDF). The GDF consists of one 2000-gallon, above-ground, double walled storage tank with a steel primary tank divided into two sections: 500 gallons for diesel storage and 1500 gallons for unleaded gasoline storage.

The status of the GDF facility at year-end was that the tank had been installed but not yet placed into operating service. BAAQMD required that a source test be performed within 10 business days of startup. SLAC anticipates that startup and the source test would occur during the first half of 2001. Following successful completion of the source test, BAAQMD is expected to issue SLAC a permit to operate the GDF.

Following completion of the permit process for the four solvent sources and the GDF, SLAC had a total of 25 “current” sources listed in its facility-wide Permit to Operate, including 18 permitted and 7 exempt sources. Information regarding these sources is presented in Table 3-1.

Three other source evaluations were completed during 2000 which resulted in SLAC determining that the subject sources were exempt from BAAQMD permitting requirements. A meeting was held with BAAQMD permitting staff regarding one of these sources, the Gamma-Ray Large Area Space Telescope (GLAST). Assembly operations and an information letter from SLAC to BAAQMD was due to be submitted in early 2001.

Completion of these evaluations meant that all “priority sources” (sources categorized as “new source evaluations” or “major historical source evaluations”) identified during the first two phases of the SLAC baseline air emissions inventory had been completed. However, at year-end numerous “non-priority” air emissions sources remained backlogged for evaluation.

3.2.2.2 Annual Update/Air Toxics Reporting

SLAC submitted its Annual Update to BAAQMD on May 12, 2001. The Annual Update is prepared in response to the BAAQMD “Information Update” request for permitted sources, and covers the previous calendar year. Thus, the Annual Update SLAC submitted in 2001 covered the reporting year 2000.

As part of the BAAQMD annual information request, facilities are also required to review the “Toxic Substances Check List” promulgated by BAAQMD to support the California Air Resources Board’s “Air Toxics” program. If facilities emit listed chemicals in quantities greater than the “applicable degree of accuracy” threshold, regardless of whether the emissions originate from a permitted source, then facilities have an obligation to report air toxics usage at the same time of their Annual Update. SLAC provided the following air toxics emissions information to BAAQMD as part of its 2000 Annual Update:

- Miller-Stephenson MS-992 flux remover (contains HCFC-141b, methanol, and nitromethane), 5 gallons.
- Miller-Stephenson MS-943 flux remover (contains HCFC-141b), 15 gallons.
- Trichloroethene (TCE), 3 gallons.
- 3M FC-77 Fluorinert Brand Electronic Liquid (contains perfluorinated compounds) used in heat exchangers for one of the components of the BaBar Detector, 68 gallons.
- H-134a, used in one of the components of the BaBar Detector, 3514 pounds.

- R-11, R-12, and R-22, used in the SLAC refrigeration equipment, 200, 28, and 530 pounds, respectively.
- Gasoline vapor emissions from the SLAC onsite vehicle fueling operations (performed by a contractor with fueling truck); approximately 22,500 gallons of gasoline were dispensed onsite.

Table 3-1 BAAQMD Permitted/Exempt Sources

Source Number	Source Description	Permitted/ Exempt	Emitted Chemicals/ Materials[1]
S-4	Batch Vapor Degreaser	Permitted	Trichloroethane (TCA)
S-5	Paint Spray Booth	Permitted	Paints, Solvents
S-11	Metal Cutting Operations	Exempt	—
S-17	Metal Grinding Operations	Exempt	—
S-21	Anodizing, Pickling, & Bright Dip Operations	Permitted	Sulfuric Acid
S-26	Batch Solvent Cold Cleaner	Permitted	De-Greeze 500
S-34	Batch Solvent Cold Cleaner	Permitted	De-Greeze 500
S-36	Wipe Cleaning Operations	Permitted	Isopropyl Alcohol, Acetone, Methanol, TCA, other solvents
S-37	Batch Solvent Cold Cleaner	Permitted	Isopropyl Alcohol (IPA)
S-42	Diesel Fuel Storage Tank	Exempt	—
S-43	Diesel Fuel Storage Tank	Exempt	—
S-44	Diesel Fuel Storage Tank	Exempt	—
S-45	Diesel Fuel Storage Tank	Exempt	—
S-49	Cyanide Room Scrubber	Exempt	—
S-52	Horizontal Firetube Boiler	Permitted	NO_x, CO_2, CO
S-53	Horizontal Firetube Boiler	Permitted	NO_x, CO_2, CO
S-54	Near Zero Emissions (NZE) Closed Loop Vapor Degreaser	Permitted	Perchloroethylene
S-55	Drift Chamber/*BaBar* Detector	Permitted	Isobutane
S-56	Resistive Plate Chambers *BaBar* Detector	Permitted	Isobutane, H-134a
S-57	Sludge Dryer	Permitted	Cr^{+6}, Cu, Ni, other metals
S-58	Solvent Cleaning Tank	Permitted	Trichloroethene (TCE)
S-59	Solvent Cleaning Operations	Permitted	TCA, Ethanol, Acetone
S-60	Ultrasonic Cleaning Tank	Permitted	IPA
S-61	Dynasolve Tank	Permitted	Methylene Chloride
(Pending)	Gasoline Dispensing Facility	Permitted	Gasoline, Diesel Fuel

[1] Emitted chemicals/materials not listed for exempt sources.

3.2.2.3 Annual Facility Inspection

On November 15, 2000, BAAQMD conducted its annual inspection of SLAC facilities. No Notices of Violation (NOVs) or Notices to Comply (NTCs) were received as a result of the inspection. The BAAQMD inspector was particularly impressed with a pilot project performed by the SEM Department, which successfully imaged more than 1,200 Material Safety Data Sheets (MSDSs) for chemicals currently or formerly managed by SEM, and placed the images on internal SLAC servers where they were retrievable from any onsite computer. SLAC intends to further implement this concept during 2001, in particular for the 800 or so unique chemicals purchased by SLAC since its Peoplesoft® based purchasing system went live at the end of 1997.

3.2.2.4 Baseline Air Emissions Inventory/Title V Permitting

SLAC completed Phase 2 of its baseline air emissions inventory project during the first quarter of 2000. While the SLAC actual emissions appeared to be well below the Title V thresholds, its "potential to emit," particularly with respect to the single Hazardous Air Pollutant (HAP) threshold and also with respect to the total Volatile Organic Compound (VOC) threshold, appeared to equal or exceed the thresholds. Note that calculation of the SLAC "potential to emit" was hampered by the lack of a chemical information management system that would allow SLAC to measure, in an integrated chemical-by-chemical fashion, facility-wide chemical usage quantities.

SLAC chose to apply for a SMOP as its Title V compliance strategy (see Section 3.2.1 for more information) because SLAC felt it could not adequately demonstrate that the "potential to emit" was below the thresholds and because the SLAC actual emissions appeared to be well below the thresholds.

BAAQMD is required by law (BAAQMD 2-6-423.5) to issue a SMOP within 180 days of an application being found to be "complete." Therefore, in order to ensure it could meet the scheduled obligation necessitated by its choice of compliance strategy, SLAC needed to have a "completeness" determination from BAAQMD no later than April 20, 2000. However, SLAC was not able to submit its original SMOP application until June 1, 2000, and did not receive a "completeness" determination until July 11, 2000.

By early 2001, BAAQMD had yet to take action on the SLAC application. This chain of events had the following two implications:

- SLAC was technically in violation of Reg 2, Rule 6, as it did not receive the SMOP by October 20, 2000.
- BAAQMD was technically in violation of Reg 2, Rule 6, for not taking action within 180 days of receiving a completed permit application.

Based on discussions with BAAQMD permit staff, SLAC believed BAAQMD would issue a SMOP to SLAC during the first half of 2001, and that there would be no enforcement action taken with respect to the exceeded schedule. As of the publication date of this report, the application was still pending and expected by SLAC in 2001.

The major change that would result from the SMOP would be improvement of the SLAC chemical information management systems. A 15-member "Chemical Use Tracking Work Group" met regularly during the first half of 2000 to develop a strategy for system improvement, and released a "Scoping

Plan” in June 2000 that was adopted by laboratory management as a blueprint for system development.

The “Scoping Plan” called for a “short-term solution” to adapt the SLAC Peoplesoft® purchasing software so it could track all chemical purchases. This project was well underway by year-end and was anticipated to be complete by mid-2001. The “Scoping Plan” also called for a “long-term solution” of a completely new, web-based, bar-code container tracking system that would align the SLAC chemical information management system with those used by other DOE facilities in the Bay Area (LLNL, LBNL, and Sandia Labs). This project was scheduled to get underway in the latter half of 2001.

3.2.2.5 Asbestos and Demolition Notification Program

Projects that involved the demolition of existing structures or the management of “regulated asbestos containing material” (RACM) were required to provide 10 days advance notice to BAAQMD per Regulation 11, Hazardous Pollutants, Rule 2, Asbestos Demolition, Renovation, and Manufacturing. During 2000, evaluations of approximately 37 construction projects were performed, of which the following five required notifications to be submitted to BAAQMD under the asbestos/demolition notification program.

- Building 220 Demolition.
- Buildings 110 and 114 Demolition.
- Building 6 Canopy Demolition.
- Building 50 Chiller Replacement Project (asbestos insulation).
- Cooling Tower 1202 Replacement (complete demolition, asbestos containing materials).

BAAQMD did not conduct inspections of any of these projects. Further notifications in 2001 were anticipated as SLAC continued with its Seismic Retrofit Project and also prepared for its next major research construction project, the Linac Coherent Light Source (LCLS). The LCLS project has been tentatively scheduled for ground breaking in 2003, which will require many outdated buildings in the SLAC Research Yard to be demolished and/or removed.

3.2.3 United States Environmental Protection Agency-Implemented Programs

3.2.3.1 National Emission Standards for Hazardous Air Pollutants

To-date, SLAC has submitted initial notification letters to the Air Division of EPA Region 9 for four halogenated solvent cleaning units regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP). The semiannual exceedance reports and annual emissions report required under this regulatory program were submitted on time to EPA Region 9.

No exceedances occurred during the covered reporting periods. The four NESHAP units were operated in accordance with their NESHAP emissions limits at all times during the covered reporting periods.

3.2.3.2 Protection of Stratospheric Ozone

No releases of stratospheric ozone depleting substances (ODSs) were reported during 2000 that were sufficiently large to be subject to the release reporting and corrective action requirements in the ODS regulations (40CFR82).

The largest source of historical ODS emissions at SLAC, Source S-4, an open-topped vapor degreaser that used 1,1,1-trichloroethane (TCA), was essentially placed into suspended operations during 2000. This suspension of operations was made possible due to the successful year-round operation of Source S-54, a near-zero emission (NZE) degreaser that used perchloroethylene. SLAC received an environmental quality award from the City of Menlo Park for this successful conversion (see Section 3.4 for more information).

As part of the DOE implementation of Executive Orders 12856 and 13148, SLAC will be required to prepare a Pollution Prevention and Energy Efficiency Plan during 2001. One of the goals to be discussed in the Plan centers around the reduction/elimination of the use of Class 1 ODSs. SLAC has identified four additional projects that, if they were to be successfully completed, would virtually eliminate the use of Class 1 ODSs at SLAC. These four projects include:

- Central Plant (B23) Chilled Water System Upgrade Project.
- Building 117 Chiller Replacement.
- Halon Systems Fire Replacement (2 systems).
- Miscellaneous Heating, Ventilation, Air Conditioning (HVAC) Equipment Replacement (approximately 6 small systems).

The first of these projects, which was the largest and most important from an ODS reduction point of view, was scheduled to be implemented during 2001 and 2002.

3.2.3.3 Toxics Release Inventory Program

SLAC is required by Executive Order 12856 to comply with “Right-to-Know” laws and pollution prevention requirements. One “Right-to-Know” regulatory program was incorporated into the SLAC air quality program, the Toxic Chemical Release Reporting: Community Right-to-Know program’ more commonly known as the Toxics Release Inventory (TRI) program. Based on available information such as Stores distribution records, Purchase Requisitions, and record-keeping performed by certain chemical users, it did not appear that SLAC “otherwise used” any TRI-listed chemical above its threshold quantity during 2000. SLAC anticipates that implementation of the chemical information management systems recommended by its “Chemical Use Tracking Work Group” will significantly increase the degree of certainty that SLAC remains under the TRI threshold reporting quantities.

3.2.4 San Mateo County-Implemented Programs

SLAC submitted its CalARP registration information to the San Mateo County Department of Health Services (the County) on March 3, 1998. The original registration information was subsequently amended on May 15, 1998. The net result of SLAC submittals was that SLAC was registered under the CalARP program for the “Table 3” substances nitric acid and potassium cyanide.

Information received during 1999 from the California Office of Emergency Services appeared to indicate that SLAC had an excellent case for “de-registering” its use of nitric acid. Additionally, a case could be made for de-registering potassium cyanide based on the way SLAC managed and processed the chemical.

If the SLAC CalARP registration status is not changed (for example, SLAC is unable to de-register its use of nitric acid and potassium cyanide), then SLAC will be subject to CalARP program regulations for Table 3 substances. Under this aspect of the CalARP program, the County was required to make a determination regarding whether a Risk Management Plan (RMP) would be required of SLAC. As of 2000 year-end, the County had not made its determination.

If the County makes a determination that a RMP is necessary, then the County is required to give SLAC a minimum of 12 months, and a maximum of 36 months, to submit the RMP. In the event an RMP is required, at minimum SLAC will need to prepare offsite consequence analyses of worst case and alternative release scenarios for its registered CalARP chemicals, accident histories for the registered chemicals, and general descriptions of its prevention programs.

3.2.5 Awards

In November 2000, SLAC submitted an application to the City of Menlo Park for an “environmental quality award” in the category of “resource conservation.” The subject of the SLAC application was its “Air Emissions Reduction Project” that focused on reducing the emissions of chlorinated solvents to the atmosphere from degreasing processes at the SLAC Plating Shop. Specifically, the use of an open-topped vapor degreasing unit was replaced by a new, extremely sophisticated piece of capital equipment called a “near zero emission” (NZE) degreaser. Following several years of planning, installation, testing, and modification, the NZE degreaser was finally placed into regular operating service during 1999, with 2000 as the first full year for which emissions comparisons could be made.

It can be seen from the graph that the successful completion of the project reduced SLAC annual emissions of chlorinated solvent to the atmosphere from a high of more than 8,000 pounds during 1994 to less than 10 pounds during 2000.

SLAC was notified by the City of Menlo Park on January 9, 2001, that it had been selected to receive a “2000 Environmental Quality Award.” The award was presented at the January 23, 2001 meeting of the Menlo Park City Council.

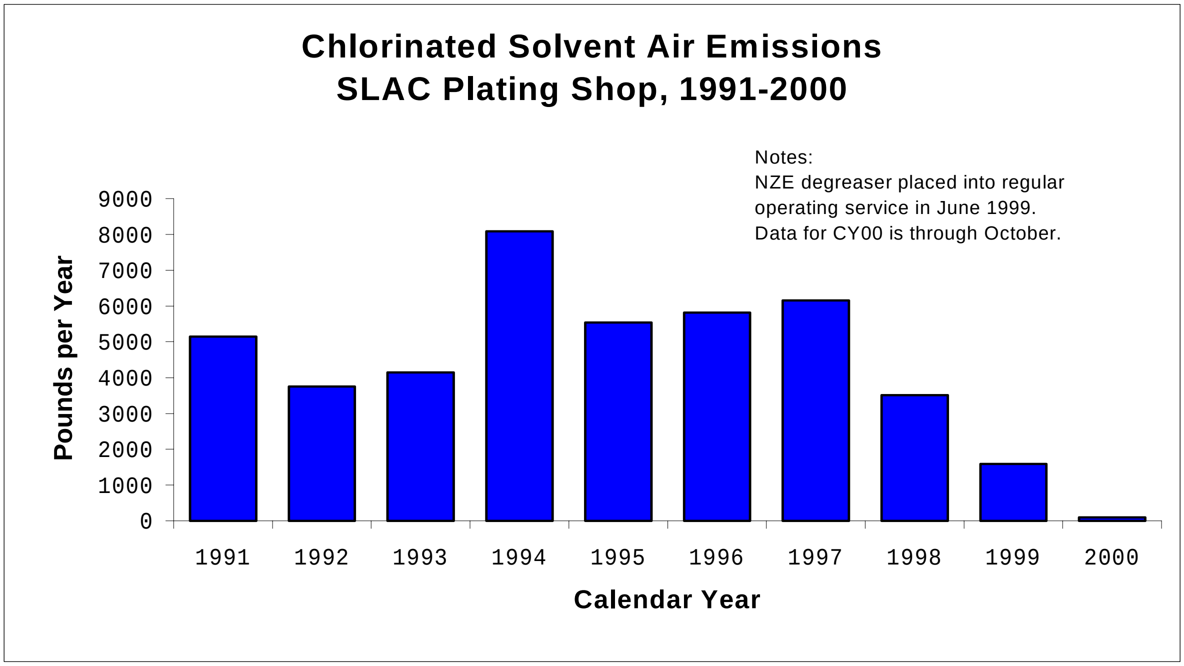


Figure 3-1 SLAC Plating Shop Chlorinated Solvent Air Emissions

3.3 Water Protection Programs

3.3.1 Clean Water Act

The Federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA), was enacted nearly thirty years ago in order to halt the degradation of our nation's waters. Amendments to the CWA in 1972 established the National Pollutant Discharge Elimination System, which regulates discharges of wastewater from point sources such as Publicly Owned Treatment Works and categorically regulated industrial facilities such as electroplating shops. In 1987, the CWA was amended again to include non-point source discharges such as stormwater run-off from industrial, municipal, and construction activities. The CWA is the primary driver behind the SLAC water compliance programs. See Section 5 for information on groundwater.

3.3.2 Surface Water

Federal regulations allow authorized states to issue general permits to regulate industrial stormwater, or non-point source discharges. California is an authorized state, and on November 19, 1991, the State Water Resources Control Board adopted the Industrial Activities Stormwater General Permit (General Permit). SLAC filed a Notice of Intent to comply with the General Permit on March 27, 1992. The General Permit was then re-issued, effective July 1, 1997.

The Stormwater Pollution Prevention Plan (SWPPP), which included Best Management Practices (BMPs) and the Monitoring Plan, was revised per the new General Permit. The annual stormwater report was submitted to the Regional Water Quality Control Board (RWQCB) on July 1, 2000.

The goal of the General Permit was to reduce pollution in the waters of the state by regulating the amounts of pollutants in stormwaters associated with industrial activities. During 2000, SLAC made progress in completing the following items:

3.3.2.1 Unauthorized Non-Stormwater Connections

Consultants reviewed the design for the rerouting of accumulated water in the PEP-II tunnel. The consultants also prioritized the remaining unauthorized non-stormwater connections. The project to reroute water in the PEP-II tunnel was also completed during the year. This project eliminated approximately 80-90% of the unauthorized non-stormwater connections in the PEP-II tunnel. The number of total unauthorized non-stormwater connections eliminated during 2000 was 58. As of the publication date of this report, the remaining number of unauthorized non-stormwater connections was 32.

3.3.2.2 Training

Stormwater pollution prevention training was provided to the SLAC Safeguards and Security Department staff.

3.3.2.3 Storm Drain Installation

Phase two of the three-phase Master Substation Storm Drain Installation project was completed. Also, the drain pipe for Phase 3 had been installed. Upon completion, this project will reduce the amount of rainwater flowing into the Master Substation.

3.3.2.4 Catch Basin Maintenance Program

Fourteen catch basin locations were repaired, completing the corrective actions identified in the site-wide inspection of July 1999.

3.3.2.5 Removal of Abandoned Vehicles

Coordinated efforts were successful in removing numerous abandoned vehicles from the SLAC site. The vehicles removed from the site included six cars, a delivery van, and an old, semi-trailer. All the vehicles were removed, and the semi-trailer was donated to the Jasper Ridge Biological Preserve.

3.3.3 Water Recycling and Reuse

Studies to investigate water conservation, reuse, and recycling began this year. Two studies were completed. The focus of the first study was the potential for water reuse at the cooling towers. The second study evaluated several water recycling scenarios and provided a return-on-investment analysis for each scenario. Using recycled water in the cooling towers and for landscaping provides a good opportunity to conserve water and save money.

3.3.4 Stormwater Monitoring Program

The SLAC stormwater monitoring program consisted of:

1. Two stormwater sampling events per wet season.
2. Monthly visual observations during the wet season.
3. Quarterly visual observations during the dry season.
4. A comprehensive annual site inspection.

During the 2000-2001 wet season (October-May), SLAC analyzed stormwater runoff samples for pH, specific conductance, total petroleum hydrocarbons (TPH) as diesel and motor oil, polychlorinated biphenyls (PCBs), heavy metals, and radioactivity. For more information, see Table 3-3 on page 49.

There were no regulatory limits, but rather numerical objectives which apply to the data collected for this program based on the RWQCB Basin Plan. The data were used as a general reference for determining whether SLAC appeared to be generating stormwater pollutants and whether implementation of BMPs had been effective.

Autosamplers were used to sample storm events and to ensure that samples were collected within the first hour of discharge at all sampling locations. The four sampling locations used, as shown in Figure 3-2 on page 47, were identified as:

- Main Gate
- Northeast Adit
- IR-6
- IR-8

These locations provided a representative picture of the SLAC stormwater discharge. Stormwater results are shown in Table 3-2 on page 48 and Table 3-3 on page 49. To report data in a more timely manner, stormwater data for two consecutive seasons were given in this report. For the 2000-2001 wet season, samples were collected in October and November of 2000. Thus, both data sets were completed within 2000.

Soil erosion and sediment transport were important processes at SLAC because sediment was considered to be as much of a stormwater pollutant as any chemical. In 2000, a major erosion control project was completed on the south side of the linac in Sectors 21-25, just west of Interstate 280. This project involved extensive regrading and additional storm-drain piping to divert surface runoff away from storm drains on the Klystron Gallery road and onto the softscape.

Natural drainages traverse the SLAC facility at several points along the linac, notably Sectors 14 and 18. Erosion control work in these areas is periodically required, but involves a complex and time-consuming permitting process. Accordingly, SLAC is looking into developing an agreement with the US Fish and Wildlife Service to facilitate long-term management of sensitive species associated with natural drainages.

3.3.4.1 Metals

Metals may be both naturally occurring and due to human activities or industrial processes. The metals that may be present due to human activities or industrial processes are:

- Cadmium
- Chromium
- Copper
- Nickel
- Lead
- Silver
- Zinc

Some metals may be due to vehicle emissions associated with:

- Motor oil
- Coolant drippings
- Brake linings
- Tire fines (minute particles produced as vehicle tires wear down)

Although numerical limits do not exist for stormwater, concentrations reported were consistently low, and were similar to those seen in industrial wastewater samples, which were well within regulatory limits.

3.3.4.2 Total Suspended Solids

Significant levels of suspended silt are generated when it rains. Levels of Total Suspended Solids (TSS) continued to vary greatly with each storm event.

TSS values were consistently low, ranging from 5.3 to 68 mg / L. The elevated concentrations measured during autumn of 1999 at IR-6 did not recur during the autumn of 2000.

3.3.4.3 TPH as Diesel

All of the SLAC regular sampling stations received run-off from paved areas such as roads and parking lots. However, no TPH was detected in this season's samples, possibly due to dilution from the substantial rainfall.

3.3.4.4 PCBs

PCBs were below detection limits for both rounds of sampling at IR-6 and IR-8. These were the only two locations monitored for PCBs. See Table 3-1 on page 38 for stormwater data.

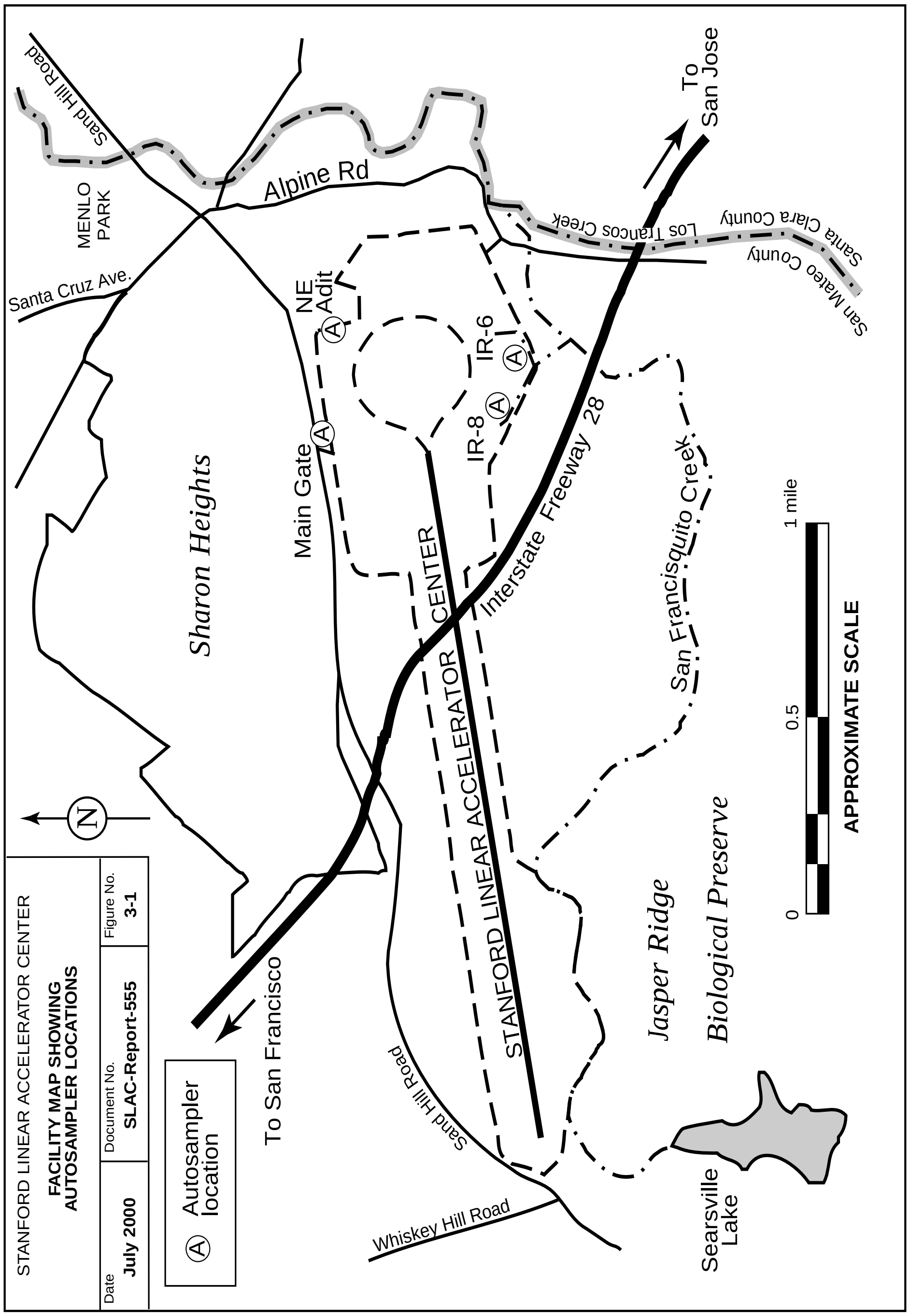


Figure 3-2 SLAC Autosampler Locations

Table 3-2 Stormwater Data for 1999-2000 Storm Season

Date	Main Gate		North Adit		IR-6		IR-8	
	October 28 1999	January 16 2000	November 7 1999	January 16 2000	October 28 1999	January 11 2000	October 28 2000	January 19 2000
Parameter [1]	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event
Metals								
Cadmium	0.0017	0.0005[2]	0.0006[2]	0.0004[2]	0.0049	<0.0040[3]	0.0072	0.00075[2]
Chromium	0.0820	0.0100	<0.0032	0.0400	<0.0032	<0.0040	0.0300	0.0100
Copper	0.0620	<0.003	0.0160	0.0100	0.0700	0.0300	0.1200	0.0280
Lead	0.1170	0.0059	0.0059	0.0320	0.0520	0.0078	0.0620	0.0078
Nickel	0.1060	0.0200	0.0210	0.0400	0.032[2]	0.0100	0.0910	0.020
Silver	<0.0027	<0.003	<0.0027	<0.003	<0.0027	<0.0030	<0.0027	0.0027[2]
Zinc	0.5490	0.120	0.111	0.150	1.95	0.48	1.42	0.22
Non-Metals								
Total Petroleum Hydrocarbons (TPH)	<0.3	2.0	2.8	2.2	3.0	6.9	2.4	3.2
Aroclor [4]1254	NS[5]	NS	NS	NS	0.00064	0.0005	<0.0002	<0.0002
Aroclor 1260	NS	NS	NS	NS	<0.0002	<0.0002	0.00098[6]	0.00022
Total Suspended Solids (TSS)	496	88	65	362	178	43	276	82.7
pH (no units)	6.70	7.63	7.40	7.12	6.69	7.79	6.59	7.76
Specific Conductance (umhos/cm)[7]	725	359	452	205	432	556	306[g]	711

1 All values in milligrams per liter (mg/L) unless otherwise noted. All analyses were performed off-site by contract laboratory (BC Labs in Bakersfield, CA).
2 Value above Method Detection Limit (MDL) but below Practical Quantitation Limit (PQL).
3 "<"symbol precedes a reporting limit; that is, the analyte was non-detect.
4 Aroclor 1254 and Aroclor 1260 were the only polychlorinated biphenyls (PCBs) detected.
5 NS = Not Sampled for this parameter.
6 Surrogate recovery below established limit.
7 Umhos/cm = micromhos per centimeter.

Table 3-3 Stormwater Data for 2000-2001 Storm Season

Date	Main Gate		North Adit		IR-6		IR-8	
	October 26 2000	November 29 2000	October 26 2000	November 29 2000	October 26 2000	November 29 2000	October 26 2000	November 29 2000
Parameter[1]	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event
Metals								
Aluminum	0.62	1.6	0.87	0.51	0.50	0.44	3.7	1.6
Cadmium	<0.0010[2]	<0.0010	<0.0010	<0.0010	=0.0010[3]	<0.0010	0.0041	0.0013
Chromium	0.0029	0.0042	0.0035	0.0031	0.0040	0.0031	0.015	0.0064
Copper	0.011	0.018	0.014	0.0092	0.087	0.020	0.120	0.097
Lead	0.012	0.045	0.0091	0.0054	0.015	0.012	0.046	0.013
Manganese	0.13	0.59	0.12	0.10	0.06	0.032	0.37	0.11
Molybdenum	<0.01	<0.010	<0.01	<0.010	<0.010	=0.010	<0.010	=0.010
Nickel	0.009	0.015	0.017	0.014	0.0067	<0.0050	0.081	0.014
Zinc	0.061	0.22	0.11	0.085	0.43	0.47	0.93	0.32
Non-Metals								
Total Organic Carbon	16	23	17	14	31	14	20	11
Total Petroleum Hydrocarbons	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
PCBs (total)	NS[4]	NS	NS	NS	0.00092[5]	<0.0002	<0.0002	<0.0002
pH (no units)	7.22	7.29	7.51	7.78	7.43	7.80	7.31	6.96
Total Suspended Solids	<5.0	520	<5.0	91	37	48	510	220
Total Dissolved Solids	180	250	160	860	220	650	350	75
Specific Conductance (umhos/cm)[6]	210	310	220	1100	280	780	450	96

1 All values in milligrams per liter (mg/L) unless otherwise noted. All analyses were performed off-site by contract laboratory (CLS in Rancho Cordova, CA).
2 "<"symbol precedes a reporting limit; that is, the analyte was non-detect.
3 "=" symbol denotes an analyte detected at it's reporting limit.
4 NS = Not Sampled for this parameter.
5 Aroclor 1260 was the only Polychlorinated Biphenyl (PCB) compound detected.
6 Umhos/cm = micromhos per centimeter.

3.3.5 Industrial and Sanitary Wastewater

SLAC operated under three separate Mandatory Wastewater Discharge Permits in 2000. These permits set discharge limits for the sanitary sewer and were in effect April 1, 1997. The permits will expire on March 31, 2002.

The three SLAC wastewater discharge permits were:

1. WB 970401-F, which regulated SLAC as a whole, including industrial and sanitary wastewaters.
2. WB 970401-P, which regulated operations at the Rinse Water Treatment Plant (RWTP).
3. WB 970401-HX, which regulated operations at the Batch Treatment Plant (BTP).

Permit requirements for SLAC included:

1. Semi-annual sampling for seven heavy metals, Total Toxic Organics (TTO), and pH at the RWTP.
2. Semi-annual sampling for cyanide at the final rinse tank for the Plating Shop cyanide treatment tank.
3. Semi-annual sampling for seven heavy metals, Total Toxic Organics (TTO), and pH at the BTP.
4. Signs posted throughout the site advising personnel not to discharge non-permitted material to the sanitary sewer and providing emergency response numbers should there be an accidental release.
5. Quarterly sampling for seven heavy metals and pH at the Sand Hill Road Flow Meter Station.

SLAC discharged a total of 17,407,757 gallons of wastewater to the sanitary sewer system in 2000, an average of 47,562 gallons per day. The total volume represents a 23% increase relative to the 1999 volume. This increase largely was due to the number of unauthorized non-stormwater connections re-plumbed from the storm drain system to the sanitary sewer. For more information, see section 3.3.2 on page 43. In 2000, the SLAC Sanitary Wastewater Monitoring Program consisted of the following three permits:

3.3.5.1 Total Facility Discharge Permit

The Total Facility Discharge Permit (Permit No. WB 970401-F) covered the SLAC total[1] contribution to the sanitary sewer, including the combined flow from the RWTP and all other on-site wastewater discharges.

SBSA monitored the discharge quarterly to ensure compliance with the permit. SLAC split samples with SBSA during these monitoring events and analyzed them to compare results for quality assurance purposes. All analytical results from samples collected in 2000 are presented in Table 3-4 on page 51 and Table 3-5 on page 52.

[1] A small portion of the SLAC domestic wastewater was carried off-site via the sanitary sewer on the south side of the facility. Historically, the volume of this wastewater was considered by the sewage authorities to be trivial, and was not routinely monitored. However, flow meters will be installed near the southern facility boundary in 2001 to quantify the southern discharge.

Table 3-4 2000 Flow Meter Station Sampling Data (First Half)

Parameter	Discharge Limit[1] (lb/day)	January 13, 2000				May 16, 2000			
		SLAC Monitoring Results (mg/L)	SBSA Monitoring Results (mg/L)	SLAC Calculated Results [2] (lb/day)	SBSA Calculated Results (lb/day)	SLAC Monitoring Results (mg/L)	SBSA Monitoring Results (mg/L)	SLAC Calculated Results (lb/day)	SBSA Calculated Results (lb/day)
Metals (mg/L)									
Cadmium	0.036	<0.00005	<0.0100[3]	0.0000	<0.0021	0.002	<0.0100	0.0010	<0.0050
Chromium	0.48	0.008	<0.0300	0.0017	<0.0064	<0.005	<0.0300	<0.0025	<0.0150
Copper	0.35	0.068	0.0900	0.0145	0.0192	0.067	0.0700	0.0335	0.0350
Lead	0.33	0.005	<0.1000	0.0011	<0.0124	0.007	<0.1000	0.0035	<0.0500
Nickel	0.064	0.020	<0.0300	0.0043	<0.0064	0.009	<0.0300	0.0045	<0.0150
Silver	0.076	<0.003	<0.0100	<0.0004	<0.0021	<0.003	<0.0100	<0.0015	<0.0050
Zinc	0.7	0.450	0.4150	0.0961	0.0887	0.12	0.1130	0.0600	0.0566
Non-Metals									
pH	6.0-12.5[4]	NS[5]	8.40	7.89	8.40	7.70	8.30	7.70	8.30
Flow (gpd)	62,175	25,618				59,988			

1 Discharge Limit = SBSA Annual Average Limit (determined by comparison of limit with the average of all samples collected during each one-year term of this permit)
2 Calculated Results in lb/day = (gal/day)(mg/l pollutant)(8.34 lb/gal)(10^{-6} l/mg)
3 "<"symbol indicates Method Detection Limit (MDL), which is the value used in calculations.
4 = Daily Maximum, rather than Annual Average Limit
5 NS = Not Sampled

Table 3-5 2000 Flow Meter Station Sampling Data (Second Half)

Parameter	Discharge Limit[1] (lb/day)	July 28, 2000				November 14, 2000			
		SLAC Monitoring Results (mg/L)	SBSA Monitoring Results (mg/L)	SLAC Calculated Results [2] (lb/day)	SBSA Calculated Results (lb/day)	SLAC Monitoring Results (mg/L)	SBSA Monitoring Results (mg/L)	SLAC Calculated Results (lb/day)	SBSA Calculated Results (lb/day)
Metals (mg/L)									
Cadmium	0.036	<0.002[3]	<0.01	<0.0004	<0.0046	0.0016	<0.0100	0.0002[4]	<0.00138
Chromium	0.48	0.012	<0.03	0.0055	<0.0137	0.0017	<0.0300	0.0002	<0.00413
Copper	0.35	0.21	0.20	0.0960	0.0914	0.066	0.0900	0.0091	0.0124
Lead	0.33	0.028	<0.10	0.0128	<0.0457	0.0200	<0.1000	0.0028	<0.0138
Nickel	0.064	0.015	0.04	0.0069	0.0183	0.011	<0.0300	0.0015	<0.00413
Silver	0.076	0.004	<0.01	0.0018	<0.0046	<0.001	0.0100	<0.0001	0.00138
Zinc	0.7	0.36	0.351	0.1646	0.1605	0.16	0.1790	0.0220	0.0247
Non-Metals									
pH (no units)	6.0-12.5[5]	8.00	8.20	7.93	8.30	8.04	7.80	8.04	7.80
Flow (gpd)	62,175	54,813				16,507			

1 Discharge Limit = SBSA Annual Average Limit (determined by comparison of limit with the average of all samples collected during each one-year term of this permit)
2 Calculated Results in lb/day + (gal/day)(mg/l pollutant)(8.34 lb/gal)(10^{-6} l/mg)
3 "<"symbol indicates Method Detection Limit (MDL), which is the value used in calculations.
4 Value used in calculation is between the Practical Quantitation Limit (PQL) and the Method Detection Limit (MDL).
5 = Daily Maximum, rather than Annual Average Limit

3.3.5.2 Rinse Water Treatment Plant (Permit No. WB 970401-P)

SLAC conducted metal finishing operations in an on-site electro plating shop during 2000. Rinsewater baths from the Plating Shop were processed through the RWTP prior to being discharged to the sanitary sewer. The RWTP discharged 697,093 gallons of effluent to the sanitary sewer in 2000. Effluent from the RWTP consistently met required federal metal finishing pre-treatment standards, which were specified in the permit.

As required by federal standards, SBSA periodically monitored the metal finishing discharges, as well as the rinsewater from a cyanide treatment process in the Plating Shop. Again, SLAC and SBSA split samples from the RWTP and cyanide tank for quality assurance purposes. SBSA and SLAC analytical results for 2000 are presented in Table 3-6 on page 54. The results indicated that SLAC continued to operate in compliance with applicable regulations.

3.3.5.3 Batch Treatment Plant (Permit No. WB 970401-HX)

The BTP was permitted to treat effluent from the heat-exchanger descaling operation prior to discharge to the sanitary sewer. It accumulated batches of up to 4,000 gallons, which were then treated to remove metals and adjust pH. The BTP was not operated in 2000.

3.3.5.4 Sanitary Sewer Assessment

The sanitary sewer assessment conducted by EPR in 1999 included several recommended corrective actions. The actions completed in 2000 included two reported breaks in a sanitary sewer line north of Sector 29, near the east end of the linac. Video inspection indicated discontinuity in the line in both areas and both areas were excavated. Although neither area was an actual break or leak, fittings that made the line seem discontinuous (through the lens of a video camera) were upgraded.

Table 3-6 2000 Rinse Water Treatment Plant Sampling Data

Constituent	Federal Daily Maximum (mg/L)	Federal Monthly Average (mg/L)	SBSA-Initiated Annual Sampling		SBSA-Initiated Annual Sampling		SLAC-Initiated Semi-Annual Sampling		SBSA-Initiated Semi-Annual Sampling		SLAC-Initiated Semi-Annual Sampling	
			January 19		April 5		May 26		October 12		October 30	
			SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA
Metals (mg/L[1])												
Cadmium	0.69	0.26	<0002.[2]	<0.01[3]	NS[4]	NS	<0.001	NS	NS	NS	<0.001	NS
Chromium	2.77	1.71	0.005[2]	0.0300	NS	NS	0.045	NS	NS	NS	0.016	NS
Copper	3.38	2.07	0.240	0.0240	NS	NS	0.11	NS	NS	NS	0.71	NS
Lead	0.69	0.43	0.0006[2]	<0.100	NS	NS	<0.003	NS	NS	NS	<0.002	NS
Nickel	3.98	2.38	0.0055	0.0400	NS	NS	0.027	NS	NS	NS	0.27	NS
Silver	0.43	0.24	0.010	0.0100	NS	NS	0.007	NS	NS	NS	0.042	NS
Zinc	2.61	1.48	0.027[2]	0.0190	NS	NS	<0.02	NS	NS	NS	0.14	NS
Non-Metals												
Cyanide	1.20	0.65	<0.0063	0.0050	NS	NS	<0.003	NS	NS	NS	<0.010	NS
pH (no units)	6.0--12.5	NA[5]	9.73	10.30	NS	NS	8.2	NS	NS	NS	6.63	NS
TTO[6]	2.13	NA	0.0130	NS	0.0014	0.0021	0.004	NS	0.0023	0.0019	0.045	NS

1 mg/L = milligrams per liter (= parts per million). All values except those for pH are expressed in milligrams per liter (mg/l is equivalent to parts per million).
2 Value reported is between the Practical Quantitation Limit (PQL) and the Method Detection Limit (MDL).
3 < = Precedes reporting limits for individual parameters; that is, not detected.
4 NS = Not Sampled.
5 NA = Not Applicable
6 TTO = Total Toxic Organics (analyzed by EPA Method 601/602). Chloroform was the primary TTO compound present.

3.3.6 Endangered Species Act

Based on information provided by the California Department of Fish and Game (DFG) and the US Department of Fish and Wildlife, 14 animal species and 13 plant species occurring in San Mateo County were listed as endangered, threatened, proposed, or of concern. Of these, three of the animal species may occur on or immediately adjacent to the SLAC leaseholding: the California red-legged frog (*Rana aurora*, subspecies *draytonii*), the San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), and the steelhead trout (*Oncorhynchus mykiss*). All three are aquatic or semi-aquatic species associated with San Francisquito Creek, which is located south of and roughly parallel to the linac. The creek receives run-off from SLAC via three natural drainages, although no part of the creek is on the SLAC leaseholding. SLAC and San Francisquito Creek are shown in Figure 3-3 on page 56.

The red-legged frog, which was granted threatened status at the federal level in August 1997, is common in and around San Francisquito Creek. However, this frog is truly amphibious and can be found as far as one mile from the nearest water body. Accordingly, it may occur at SLAC, and has figured prominently in the permitting process for erosion-control and sediment-control projects in the on-site natural drainages. However, no verified sightings of red-legged frogs have been recorded to date on the SLAC leaseholding. Stanford University's Center for Conservation Biology routinely performs biological surveys on Stanford lands; the first such surveys were done at SLAC in 1999, and a report was completed in the summer of 2000.

Historically, the San Francisco garter snake has occurred on and around the SLAC facility. However, this common name encompasses several subspecies, and the subspecies designated as endangered by the federal government (*T. s. tetrataenia*) intergrades with a similar subspecies (*T. s. infernalis*) in southeastern San Mateo County and northwestern Santa Clara County. In other words, the SLAC facility lies near the northeastern edge of the endangered subspecies' distribution, rather than near its center. This distributional limit, coupled with specific habitat requirements, makes the endangered subspecies unlikely to occur at SLAC.

Steelhead populations are increasing in the creek, due in large part to the efforts of the local watershed consortium established under the Coordinated Resource Management and Planning process, of which Stanford University and SLAC are founding members. However, this species is highly unlikely to occur on the SLAC leaseholding, due to the seasonal water flow patterns, the small sizes of the on-site drainages, and downstream drainage modifications by other Stanford University leaseholders.

3.3.7 Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act regulates pesticide use in the United States. The term "pesticide" refers to insecticides, rodenticides, and herbicides. In 2000, SLAC used licensed subcontractors to apply "registered use" pesticides and SLAC personnel applied "general use" pesticides only. In 2000, SLAC used pesticide and herbicide handling and storage procedures that were developed in 1994. These procedures were incorporated into the subcontracts for landscape maintenance and pest control, and have been implemented by the subcontractors.

As of the publication date of this report, SLAC personnel (in SEM) have been trained to take over the day-to-day pesticide application on the site. SLAC maintained the contract with licensed sub-contractors to maintain the option of occasionally using those licensed subcontractors for pesticide application.

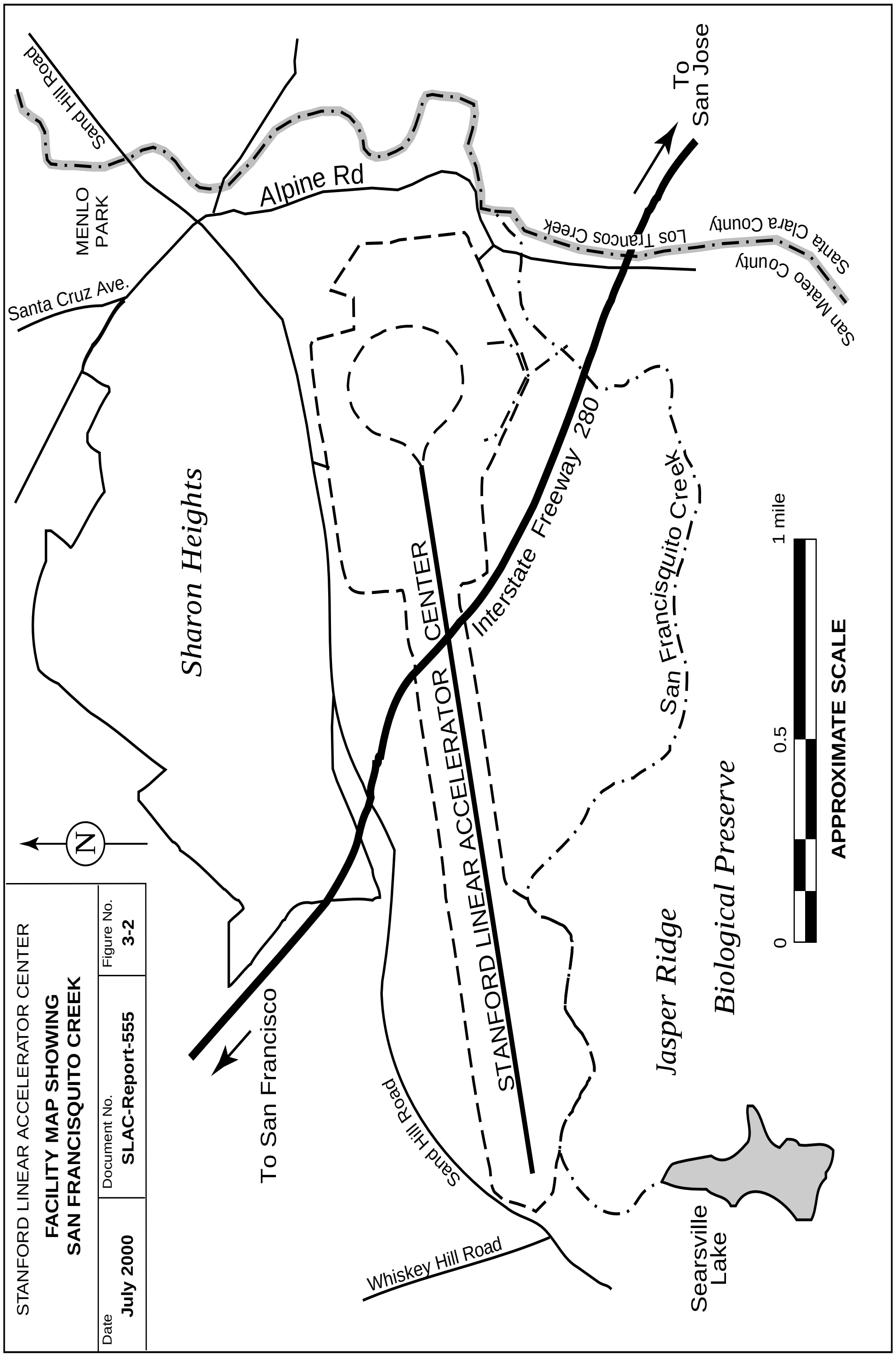


Figure 3-3 Facility Map Showing San Francisquito Creek

3.3.8 Executive Order 11990, Protection of Wetlands

As part of an environmental assessment conducted in 1991, SLAC had a subcontractor perform a survey to determine whether any area(s) within or next to the SLAC facility should be formally designated as wetlands, which are specifically protected under Section 404 of the CWA. The field survey and evaluation were performed using established federal guidance.

According to the survey, the IR-8 drainage ditch showed characteristics of wetlands, but a definitive evaluation was not possible because of continuing drought conditions and because the study was performed in the fall, when reproductive structures on aquatic vegetation were generally absent.

The portion of the IR-8 drainage channel that represents the majority of the potential wetlands at and around SLAC is approximately 4,000 square feet, less than one-tenth of an acre. By comparison, in practice the US Army Corps of Engineers (COE) uses ten acres as their functional cutoff for "significant" wetlands.

Representatives from the COE, the RWQCB, and the DFG have been on-site to observe erosion-related problems at Sectors 14 and 18. The COE stated that the Sector 18 area appeared to be a wetland, and that the Corps would treat it as such for permitting purposes. Nevertheless, a follow-up to the 1991 survey would be required for a definitive determination. In the meantime, SLAC has operated proactively under the assumption that wetlands do exist within and adjacent to the facility boundaries. That is, SLAC applies for various permits to perform erosion control work and characterizes the facility as being associated with wetlands.

3.4 Waste Minimization

3.4.1 Site-Wide Program Planning and Development

SLAC has been implementing its waste minimization program in accordance with established waste minimization plans. The plans address the reduction of specific hazardous waste streams in accordance with regulations and provide strategies to increase employee awareness on waste reduction measures for non-hazardous and low-level radioactive wastes as well as hazardous wastes.

Implementation of waste minimization and pollution prevention is a SLAC line responsibility. Some of the highlights of SLAC implementation of waste minimization and pollution prevention measures are discussed in Section 3.4.2, below.

SLAC has an Environmental Safety Citizens Committee (formerly the Waste Minimization and Pollution Prevention Citizens Committee). The committee is composed of a representative from each division, an ES&H Coordinator from the Research Division, and the ES&H Waste Minimization and Pollution Prevention Coordinator. The committee reviews waste streams, identifies pollution prevention opportunities, and reviews new projects.

3.4.2 Waste Minimization and Pollution Prevention Activities/Implementation

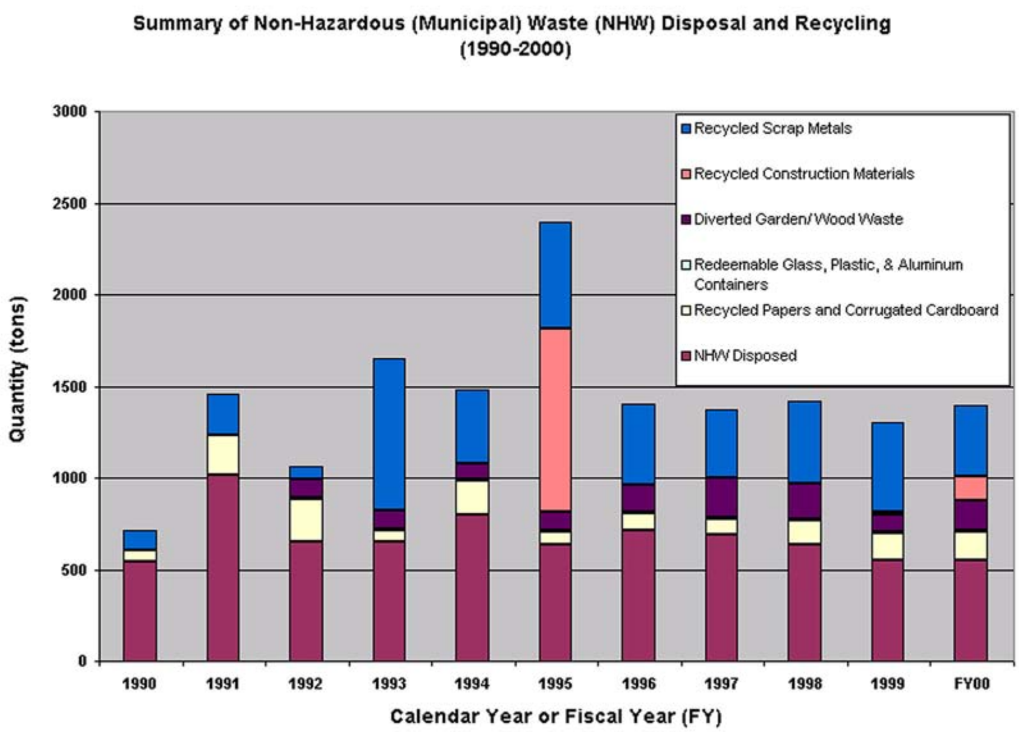
In 2000, SLAC continued to make progress in implementing waste reduction measures for non-hazardous (municipal) waste, hazardous waste, and low-level radioactive waste. An overview of the program activities and implemented waste reduction measures follows.

3.4.2.1 Site-wide Recycling

SLAC implemented a site-wide program for recycling of various papers, corrugated cardboard, and beverage cans and bottles based on its 1998 pilot recycling project. The site-wide program is now fully operational.

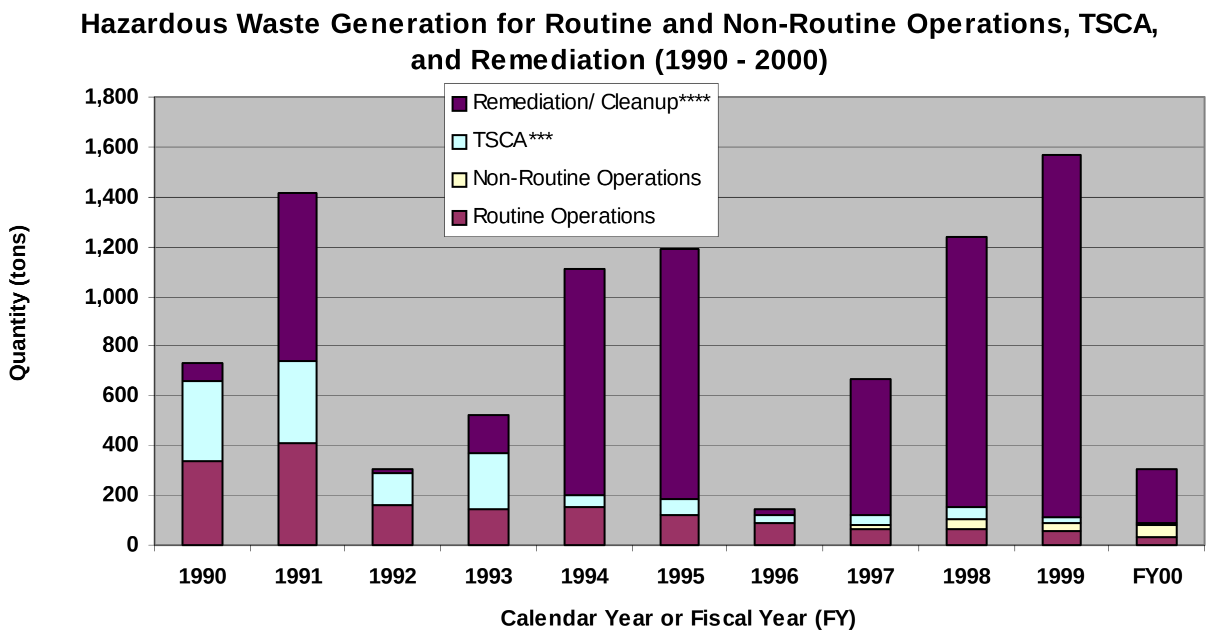
3.4.2.2 Non-hazardous Waste Reduction

The quantities of non-hazardous waste and the materials recycled or diverted from landfills from 1990 to 2000 are summarized in Figure 3-3. Material recycled or diverted is shown with and without scrap metal recycling to show the contribution of scrap metals. In fiscal year 2000 (FY00), SLAC achieved 45 percent diversion without scrap metal and 60 percent diversion with scrap metal.



* Fiscal Year was October 1, 1999 to September 30, 2000

Figure 3-4 Non-Hazardous Waste Summary



**** Remediation wastes were from site restoration, usually removal of soils contaiminated with PCBs, oils, solvents or metals.
*** TSCA wastes include PCBs from electric equipment replacement and asbestos wastes from building renovations.
** Hazardous waste generated from routine or non-routine operations associated with research projects, supporting operations, and facility maintenance activities. Routine operational hazardous wastes are those from repeated activities.
* Includes hazardous wastes from routine and non-routine operations, TSCA, and remediation.

Non-routine operational hazardous wastes were those from major one-time projects or activities.

Figure 3-5 Hazardous Waste Summary

3.4.2.3 Hazardous Waste

Hazardous waste has been reduced through a combination of techniques, including:

- Converting empty metal containers and drums to scrap metal.
- Exchanging chemicals with other users (both on and off-site).
- Reusing chemicals.
- Returning unused material back to the vendor or manufacturer.
- Sending electrical equipment off site for re-use by other organizations.
- Treating acid and alkaline wastes in accordance with the California Tiered Permit Program.

Due to the above listed activities, hazardous waste was reduced or reused by more than 8 tons during FY00.

3.4.2.4 Hazardous Waste Reduction

Figure 3-4 shows the trends in the generation of hazardous waste for three major categories: operational, Toxic Substances Control Act (TSCA), and remediation-related hazardous waste.

Some of the operational hazardous wastes were classified as non-routine due to their one-time or highly infrequent generation. As of FY00, SLAC had reduced its hazardous waste by 77% relative to 1993 and by 90% relative to 1990.

TSCA wastes result from removal of old electrical equipment (PCB-containing equipment) and construction practices (asbestos-containing materials). These wastes result from the phasing out of these materials from use in SLAC operations. Remediation wastes were the result of past practices or accidental spills.

TSCA and remediation wastes were expected to decrease over time due to elimination of the sources of PCB and asbestos wastes and by cleanup of wastes from past practices and spills.

3.4.2.5 Low-Level Radioactive Waste Reduction

Although little of the low-level radioactive materials or waste generated at SLAC were routine, SLAC reduced these materials and waste through measures such as segregation and reuse.

The quantities of low-level radioactive wastes were from the accumulation of waste generated over years of operation and various construction and decommissioning activities. Some low-level radioactive waste was generated from maintenance operations. Generation of this type tends to be sporadic.

3.5 Waste Management

3.5.1 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) of 1976 provided “cradle-to-grave” authority to regulate hazardous wastes from their generation to their ultimate disposal. This was accomplished through a system of record-keeping, permitting, monitoring, and reporting.

The primary objective of RCRA was to protect human health and the environment. A secondary objective of RCRA, however, was to conserve valuable material and energy resources by promoting beneficial solid waste management, resource recovery, and resource conservation systems.

To meet the second objective, Congress required that the Federal government employ its purchasing power to help create and sustain markets for recycled materials. Under Section 6002 of RCRA, the Federal Government established a program that required Federal purchasing of specified recycled content products. Aspects of this portion of RCRA are discussed in Section 3.5.2, which covers waste prevention, recycling, and federal acquisition.

The different aspects of RCRA as it relates to hazardous waste management activities at SLAC are discussed in Sections 3.5.1.1 through 3.5.1.4.

3.5.1.1 Hazardous Waste Management

Management of hazardous waste at SLAC was performed by the Hazardous Waste Management Group of the WM Department. SLAC was a generator of hazardous waste and was not permitted to treat hazardous waste or to store it for longer than 90 days. The SMC/DHS was the agency responsible for inspecting SLAC as a generator of hazardous waste for compliance with federal, state, and local hazardous waste laws and regulations.

3.5.1.2 Hazardous Waste Generation and Tracking

SLAC utilized a self-developed, site-specific computerized hazardous waste tracking system (WTS). Hazardous waste containers were tracked from the time they are issued to the generator to eventual disposal off-site. The WTS included electronic information fields which generated information for the Biennial, Superfund Amendments and Reauthorization Act (SARA) Title III, and TSCA PCB annual reports.

The majority of hazardous waste generated from operations throughout the site was accumulated in Waste Accumulation Areas (WAAs). Each WAA was managed by a Hazardous Waste and Materials Coordinator, who was trained and provided with written guidelines on proper management of WAAs. Training included spill response preparedness, waste minimization, the SLAC waste-tracking system, and required “refresher” generator training.

SLAC had the potential to generate radioactive hazardous waste. The type of waste generated at SLAC was sometimes referred to as “combined waste” by the state of California, indicating that the waste contained both accelerator-induced radioactivity and a state or federal hazardous component.

3.5.1.3 Hazardous Waste Treatment

SLAC performed hazardous waste treatment under the State of California Tiered Permit Program (program) using both Permit-by-Rule and Conditional Authorization tier permits. Under this program, SLAC was authorized to treat listed or characteristic hazardous wastes, and performed hazardous waste treatment at the BTP and the Rinsewater Treatment Plant (RTP).

Two fixed units had Permit-By-Rule tier permits, and one fixed unit that had a Conditional Authorization permit. Hazardous wastes in these units were the result of waste generated during treatment of:

- Non-hazardous rinse or wastewaters.
- Hazardous wastes specifically authorized by the State of California.

Non-hazardous rinse and wastewaters were treated in these units to ensure the water discharged to the sanitary sewer would meet industrial and sanitary wastewater discharge requirements.

Some wastes (typically acid and alkaline) generated from metal finishing operations were also authorized for treatment. The filtered solids generated in these treatment units were hazardous and were further treated in a sludge dryer to remove water and reduce waste volume. The SLAC Permit-by-Rule (PBR) was last inspected by the San Mateo County DHS in December, 1999. The PBR was found to be in compliance with “No violations noted.”

3.5.1.4 Hazardous Waste Generator Inspection

The SMC/DHS last conducted a Hazardous Waste Generator Inspection during April 2000. The inspection was thorough, with more than 80 locations inspected over three consecutive days. The inspections resulted in no notices of violation and SLAC was commended for implementing significant improvements in its waste management practices.

3.5.2 Waste Prevention, Recycling, and Federal Acquisition

In earlier years, most of the RCRA Subtitle C Program effort was focused on regulating the management of hazardous waste. The emphasis was shifted on September 14, 1998, when the President signed Executive Order 13101, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, which required Federal facilities to increase their attention to the purchase of designated products which meet EPA recovered material content requirements.

In 1999, SLAC received a compliance assistance inspection from the EPA Region 9 as part of a pilot program conducted by the agency to evaluate Federal facility compliance with Section 6002. The inspection indicated that SLAC was procuring some of the designated vehicular products that did not meet the EPA recovered materials content requirements. EPA encouraged SLAC to review the Comprehensive Procurement Guidelines (CPG) for all designated items and incorporate them in SLAC purchasing procedures.

SLAC reviewed the procurement of designated products in the CPG with the key departments involved with these products. An affirmative procurement program was under development through the purchasing department in association with key departments to determine roles and responsibilities and how the departments will implement the program by the end of 2000.

3.6 Hazardous Material Management

The Superfund Amendments and Reauthorization Act (SARA) Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), was primarily directed toward developing an inventory of information needed to compile various reports required by EPCRA. These reports also addressed the implementation requirements for statutes in the State of California (the La Follette and Waters Bills).

On March 1, 2001 (for 2000), SLAC submitted a Hazardous Material Business Plan (HMBP) which details the response in the event of a release of hazardous material. This plan designated an emergency coordinator, described the first response and several levels of escalation, delineated the means by which all mandated notification will be made to the local authority (LA) and local fire department, and described the facility’s evacuation, containment, and cleanup capability. The site maps did not change significantly since the last submittal in 1997.

Under Section 312 of EPCRA, SLAC must provide to the LA and the local fire department an annual inventory of hazardous substances that were present in quantities greater than 55 gallons, 500 pounds, or 200 cubic feet. The LA required a report to be filed for each individual hazardous substance.

Compliance for 2000 was achieved by sending out chemical inventories to the Chemical Inventory Coordinators (CICs). This information was then checked against the chemical inventory database and any discrepancies were checked for verification with the appropriate CIC.

For a discussion of the TRI reporting requirements under Section 313 of the EPCRA, see Section 3.2.3 on pages 25 and 26. The SARA Title III report, and the State equivalent, HMBP report, were submitted to SMC/DHS for 2000. See Table 3-7 for report information.

Table 3-7 EPCRA Compliance Information

Article	Title	Report Required	Report Submitted
302-303	Planning Notification	YES	YES
304	EHS Release Notification	YES	YES
311-312	MSDS/Chemical Inventory	YES	YES

3.7 PCB and Tank Management

3.7.1 Toxic Substances Control Act

TSCA regulates equipment that is filled with oil or other dielectric fluids containing PCBs. SLAC has some equipment that falls into this category. PCBs, their use, and their disposal are regulated by TSCA. TSCA regulations include provisions for phasing out PCBs and other chemicals that pose a risk to health or the environment. The EPA is responsible for ensuring that facilities are in compliance with TSCA. The State of California further regulates PCBs as a non-RCRA hazardous waste. No EPA inspections regarding TSCA were conducted at SLAC during 2000.

The site inventory of oil-filled equipment was updated for the Spill Prevention Control and Countermeasure (SPCC) plan. The SPCC plan was prepared by SLAC to prevent, control, and mitigate the discharge of any oil or oil products, as defined in 40CFR112.2.

A project to reclassify transformer #140 to non-PCB status was completed and the request to reclassify had been sent to the USEPA. Transformer #140 had previously been retroflushed (PCB oil replaced by non-PCB oil), but was still registered as a “PCB transformer,” and had not been operated for ninety days at 60°C, because it was in storage. The final concentration of the oil was 24 parts per million (ppm).

3.7.2 Tank Management

Several measures to improve spill prevention were incorporated during the year. Monthly visual inspections of all above-ground storage tanks have been incorporated into the SEM preventive maintenance program. Any necessary repairs were routed through the SEM Request System. This computer-based system automatically logged, tracked, and documented repairs performed in addition to automatically triggering monthly inspections.

SLAC was in the process of installing an on-site fueling operation to replace the weekly mobile fueling service in 2000. The new stationary tank would contain 500 gallons of diesel and 1,500 gallons of gasoline. The tank would be double-walled and a gutter with blind sumps would be installed to collect any spilled fuel.

3.8 Environmental Quality Acts

3.8.1 National Environmental Policy Act

SLAC formalized a National Environmental Policy Act (NEPA) program in 1992, administered by the Business Services Division (BSD) with EPR providing input and document review. Under this program, proposed project and action descriptions were reviewed to determine if NEPA documentation was required. If so, the proper paperwork would be prepared and submitted. The project or action was entered in a database and tracked. The resulting draft NEPA document was reviewed by specified SLAC staff for concurrence, and was forwarded to the DOE/SSO for review and approval.

NEPA provided a three-level mechanism to ensure that all environmental impacts of and alternatives to performing a proposed project were considered before each project was carried out. The three types of NEPA documentation, in order of increasing complexity, were Categorical Exclusions (CXs), Environmental Assessments, and Environmental Impact Statements.

The aspects that must be considered when scoping and preparing documentation for a proposed project included archaeological sites, wetlands, floodplains, sensitive species, and critical habitats. If any extraordinary circumstances were identified during project scoping, a range of options for the project had to be developed and the impacts of those options had to be evaluated.

3.8.2 California Environmental Quality Act

NEPA compliance was considered to be the functional equivalent of compliance with the California Environmental Quality Act (CEQA). In support of this approach, the SMC Planning and Building Division (PBD) sent a letter dated November 4, 1999 to SLAC. The letter stated that PBD had elected not to exercise its CEQA permitting authority for SLAC projects involving (for example) erosion control.

In 2000, SLAC submitted eight CXs, including a User Lodging Facility, to be constructed northeast of the existing Panofsky Auditorium. All eight CXs were approved by DOE/OAK.

4

Environmental Radiological Program

4.1 Airborne Monitoring

Airborne radionuclides were produced in the air volume surrounding major electron beam absorbers such as beam dumps, collimators, and targets. The degree of activation depended on the beam power absorbed and the composition of the parent elements. The composition of air was well known, consisting of nitrogen, oxygen, and trace quantities of carbon dioxide and argon.

Induced radioactivity produced at high energies was composed of short-lived radionuclides, such as oxygen-15 (^{15}O) and carbon-11 (^{11}C), with half-lives of 2 minutes and 20 minutes, respectively. Nitrogen-13 (^{13}N), with a half-life of 10 minutes, is also produced, but in much lower concentrations. As a consequence of water cooling and concrete shielding, both containing large quantities of hydrogen, the thermal neutron reaction with stable argon produced argon-41 (^{41}Ar), which has a half-life of 1.8 hours.

The year 2000 was an active year for the research program at the Stanford Linear Accelerator Center (SLAC). Many of the facilities at SLAC were powered up at least once during the year. Although each facility was running at dramatically different energies and durations, each had the potential to produce activated airborne radionuclides. Most facilities at SLAC had no uncontrolled venting of the accelerator housing during time of beam acceleration in 2000. Two facilities at SLAC were not totally enclosed, so emissions due to diffusion could occur. Estimated releases from all facilities are located in Appendix B "NESHAPs Report" of this document.

For most of the facilities at SLAC, activated air was not released to the environment until the facility was opened for personnel entry. For the purpose of maintaining radiation doses to personnel as low as reasonably achievable, entries were administratively controlled to allow time for short-half-life radionuclides to decay prior to entry. Cool-down periods were facility- and energy-dependent, varying from 30 to 60 minutes in 2000, with the norm being 60 minutes.

Of all the SLAC facilities, only End Station A (ESA) and the *B* Factory (PEP-II) had the potential to allow diffuse emissions of activated airborne products. Diffusion from ESA and PEP-II activities were via Beam Dump East (BDE) and Interaction Region 10 (IR-10), respectively.

The majority of experimental facilities at SLAC are designed to transport the high-energy beams produced by the SLAC linac without high-energy losses, and thus without significant activation of the air within the facility. The accelerator, PEP-II, the Stanford Linear Collider (SLC), the Stanford Synchrotron Radiation Laboratory (SSRL), and their experimental areas were designed to transport and condition (not absorb) high-energy electrons and positrons. In these structures the concentration of activated gases remaining after the “cool down” period were not measurable.

Those facilities that, by design or operation, involve losing or “dumping” high energy have the potential for producing activated airborne radionuclides. Beam-on time created both energy loss and activation of the air surrounding the energy-loss area itself. In 2000, the following areas all experienced beam-on time:

- Beam Switchyard (BSY)
- Positron Source (PS)
- BDE at ESA
- Final Focus Test Beam

Energy-loss and beam-dump areas were sealed from access or venting, unless an emergency arises during operations or during beam-off until the required “cool-down” period had passed. The exceptions were BDE and IR-10 as noted earlier. Activation products were very short-lived (half-lives of only 2 minutes to 2 hours, inclusive), with decay during the cool down period resulting in non-measurable concentrations. To establish concentrations without measurable quantities, calculations were made using facility specifics. These calculations were made using conservative (protective of the public) assumptions.

As a government-owned contractor-operated facility, SLAC must (at a minimum) meet requirements set by the Department of Energy (DOE). DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, mandates that no individual in the general population be exposed to greater than 100 mrem (1.0 mSv) in one year from all pathways due to DOE-funded activity. This Order prescribes calculations to be made to ensure that off-site releases to the public are below 100 mrem. The results of these calculations are called Derived Concentration Guides (DCGs).

A number of assumptions must be made in order to make the DCG calculations; SLAC chose the most conservative assumptions to err on the side of public safety. As an example of conservatism, SLAC has assumed that a member of the public would be wholly immersed in these activated gases while being off-site. Although it is obvious that this scenario is unrealistic, it allows the calculations to be made without the need to define the real scenario, and provides a wide margin of protection to the public. The DCGs, as calculated for the SLAC potential release of radioactive gases (^{15}O, ^{11}C, ^{13}N, and ^{41}Ar) are presented in Table 4-1.

Table 4-1 Radioactive Gases Released to Atmosphere

Radionuclide	Half-Life	DCG μCi/cm^3 [a,b]
^{15}O	2.1 minutes	1.7×10^{-9}
^{13}N	9.9 minutes	1.7×10^{-9}
^{11}C	20.5 minutes	1.7×10^{-9}
^{41}Ar	1.8 hours	1.7×10^{-9}

[a] μCi = 3.7×10^4 Bq

[b] Calculated from DOE Order 5400.5, assuming total submersion by dividing the averaged DCG by 10. See Appendix A.

This same Order requires that DOE-funded activities comply with US EPA requirements. Under EPA National Emission Standards for Hazardous Air Pollutants (NESHAP) *Title 40, Code of Federal Regulations*, Part 61 (40CFR61), SLAC must meet the requirements of the relevant subparts by calculation of potential doses to both the maximally exposed individual (MEI) and the public as a whole due to the emissions of airborne radionuclides. Continuous monitoring was not required because all of the SLAC emissions points were defined by EPA as "minor sources" of air pollution.

NESHAP emissions were derived using calculations based, again, on conservative assumptions. It was assumed that each time a beam-off situation occurred at any facility that the containment was breached by entry. If there was never a venting or breach, then the activated gases would decay to background and no emissions would result. In 20 hours time after beam-off, all activated gases would have decayed to less than 1% of their saturation values.

These emissions were derived by calculating the saturation activity for the radionuclides listed in Table 4-1, and then hypothetically releasing them instantaneously after the cool-down period. For both the IR-10 and BDE release points (which were not totally contained) a diffusion mechanism was conservatively estimated to determine releases that occurred continuously during beam-on periods.

SLAC demonstrated its fulfillment of NESHAP requirements of off-site dose to the public of less than 10 mrem. Fulfillment of this requirement was evident in the results of running the DOE-approved modeling program CAP88PC[1], Version 1.0 (refer to Table 4-2 and Appendix B of this report).

Table 4-2 Summary of Annual Effective Dose Equivalents due to 2000 Laboratory Operations

	Maximum Dose to General Public[a, b] (direct radiation only)	Maximum Dose to General Public[a, b] (airborne radiation)	Maximum Dose to General Public[a, b] (airborne + direct radiation)	Collective Dose to Population within 80 km of SLAC[b]
Dose	5.63 mrem	0.03 mrem	5.66 mrem	14.72 person-rem
DOE Radiation Protection Standard	100 mrem	10 mrem	100 mrem	—
Percentage of Radiation Protection Standard	5.63%	0.3%	5.66%	—
Background	100 mrem	200 mrem	300 mrem	1.47×10^6 person-rem
Percentage of Background	5.63%	<1%	1.9%	Negligible

[a] This is the dose to the maximally exposed member of the general public. It assumes that the hypothetical individual is at the closest location to the facility continuously, 24 hours/day, 365 days/year.
[b] 100 mrem = 1mSv and 1 person-rem = 0.01 person-Sv.

[1] CAP88PC is a personal computer software system used for calculating both dose and risk from radionuclide emissions to air.

The results of this modeling show that the maximum off-site dose, with all the conservative assumptions applied, from potential airborne emissions from SLAC is only 3 x 10^{-2} mrem (3 x 10^{-4} mSv) annual effective dose equivalent (EDE). Thus, the public dose due to SLAC research operations was approximately 100 times lower than EPAs level of concern (10 mrem EDE).

4.2 Wastewater Monitoring

During 2000, wastewater containing small quantities of radioactivity within regulatory limits was periodically discharged from the site to the sanitary sewers. The only possible sources of liquid radioactive effluents were from low conductivity water (LCW) cooling systems in the BSY and other areas in the accelerator housing. Periodic system maintenance or leaks necessitated the disposal of LCW. In the case of leaking cooling systems, water was collected in sumps of sufficient size to hold the entire volume of LCW in the system. Along the Klystron Gallery, a series of polyethylene tanks were used to hold LCW from the LINAC sumps and alcoves of the gallery prior to disposal.

The greatest sources of induced radioactivity occurred where the electron/positron beam was absorbed. The only significant radionuclides produced in water were the short-lived oxygen-15 (^{15}O) and carbon-11 (^{11}C); beryllium-7 (^{7}Be), with a half-life of 54 days; and longer-lived tritium (^{3}H), with a half-life of 12.3 years. Other radionuclides, which could potentially be in the water systems, would come from the activation of corrosion products in the water.

The activated corrosion products were typically gamma emitters. Oxygen-15 and ^{11}C are too short-lived to present an environmental problem in water. Beryllium-7 and corrosion products were removed from the LCW by the resin beds required to maintain the electrical conductivity of the water at a low level. Therefore, tritium was the only radioactive element present in the water that was of environmental significance in 2000. Tritium emits a weak beta particle which was detected primarily though liquid scintillation analysis.

As in previous years, SLAC discharged many batches of LCW to the sanitary sewer. All water potentially containing radioactivity was sampled and analyzed. All batches, as well as the cumulative total for the year, had contaminant levels within applicable radiological regulatory limits.

A summary of radioanalysis records of the wastewater discharged for each quarter of 2000 is given in Table 4-3. A total of 1,211,000 gallons of LCW was discharged to the sanitary sewer during 2000. The total amount of tritium discharged was 2.40 millicuries.

Table 4-3 Radioanalysis Results for Wastewater Discharged During 2000

Period Released	Quantity [gal[a]]	Radioactivity [mCi[b]]
First Quarter	352,000	1.2
Second Quarter	372,000	0.2
Third Quarter	264,000	0.4
Fourth Quarter	223,000	0.6
Total:	1,211,000	2.40

[a] 1 gal = 3.8 liter
[b] 1 mCi = 3.7 x 10^{7} Bq

SLAC was also bound by the provisions in a contract for service with the West Bay Sanitary District, Permit No. WB970401-F and 10CFR20.2003. These provisions limited SLAC to a maximum of 5,000 mCi (that is 5 Ci, or 1.85×10^{11} Bq) of all radionuclides to be discharged to the sanitary sewer each calendar year.

The concentration of radioactivity released was, in all cases, less than the DCG specified by DOE Order 5400.5. The total tritium activity released in 2000 was less than 1% of the annual limit. The history of radioactivity discharged from the SLAC site is shown in Table 4-4.

Table 4-4 History of Radioactivity Discharged

Year	Quantity [gal[a]]	Radioactivity [mCi[b]]
1992	123,000	40.6
1993	193,618	2.51
1994	219,875	1.71
1995	307,887	10.8
1996	313,427	338.8
1997	298,977	22.3
1998	1,502,000	71.8
1999	1,486,000	7.11
2000	1,211,000	2.40

[a] 1 gal = 3.8 liter
[b] 1 mCi = 3.7×10^7 Bq

4.3 Stormwater Monitoring

Samples of stormwater, as described in Section 3.3.4, were analyzed for radioactivity. The results of these analyses showed no detectable levels of tritium or other radioactivity.

4.4 Groundwater

Tritium analyses were conducted on groundwater from Existing Well 4 (EXW-4), Monitoring Well 30 (MW-30), and all other SLAC monitoring wells sampled in 2000. These wells are described in Section 5 of this document. As in past years, tritium was detected at low levels in EXW-4 and MW-30. The concentrations of tritium in samples from EXW-4 taken in January and August 2000 were 8,000 picocuries per liter (pCi/liter) and 12,000 pCi/liter, respectively. The concentration of tritium in a sample taken from MW-30 in August was 670 pCi/liter.

These concentrations were well below the maximum allowable concentration of tritium in drinking water of 20,000 pCi/l set by the EPA and adopted by the State of California. However, the groundwater at SLAC was not usable as drinking water due to a very high total dissolved solids (TDS) content, and the groundwater was not used for any other purpose.

Note: *Tritium was not detected in any monitoring wells other than those listed above.*

4.5 Radiological Media Sampling Program

Media sampling was limited to industrial wastewater (the major pathway for radionuclide release to the environment) and stormwater. Future media samples were to be defined by the SLAC Radiological Environmental Monitoring Program which is under development in 2000. The low source terms proportionate to the DOE DCGs have identified only industrial wastewater as a likely pathway for any potential off-site population exposure.

4.6 Soil Sampling

Soil sampling in the past has been performed when activities in the accelerator area suggested that it would be prudent, such as construction inside the accelerator enclosure. The soil samples were analyzed for gamma-emitting radionuclides with a high-purity germanium detector.

To more thoroughly characterize background radioactivity at SLAC, and for environmental surveillance, the Operational Health Physics (OHP) Department has adopted the policy of performing gamma energy analysis on soil samples taken from most excavation projects on site.

In 1999, soil was sampled from the area north of linac Sector 13, an area formerly used to store radioactive accelerator components. The analysis revealed the presence of the radionuclides ^{137}Cs, ^{60}Co, and ^{133}Ba in concentrations of 0.2 pCi/gram, 0.2 pCi/gram and 0.3 pCi/gram, respectively. Also present were the naturally occurring radionuclides ^{40}K, in concentrations ranging from 3 to 16 pCi/gram, and those of the uranium and thorium chains.

The concentration of ^{137}Cs was consistent with average concentrations of fallout from weapons testing during the 1950s and 1960s. The low concentrations of ^{60}Co, found only in localized sites of the area, suggested that its presence was the result of corroding metal articles stored in each localized area. Further surveys in 2000 supported the assumption that the radioactivity detected was due to corrosion of material stored in the area. Further studies will be done in 2001 to determine a course of action for this area.

4.7 Passive Thermoluminescent Dosimeter Monitoring Program

SLAC has a site boundary environmental thermoluminescent dosimeter (TLD) monitoring program. Landauer, a National Voluntary Laboratory Accreditation Program certified dosimetry service, was contracted to provide SLAC with quarterly TLDs. The LDR-X9 aluminum oxide TLD was designed to measure low-level photon radiation with a minimum detection level of 0.02 mrem (0.0002 mSv). The LDR-I9 TLD was used for monitoring neutron radiation with a minimum detection level of 10 mrem (0.1 mSv). Both of these TLD systems were in use throughout 2000.

The environmental measurements using TLDs are summarized in Appendix D. Figures D-1 through D-3 in Appendix D depict the locations of these TLDs. TLD results indicated that the site boundary location with the highest accumulated dose-equivalent in CY00 reported 22.9 mrem (0.229 mSv) above background.

The TLD data for 2000 were used to evaluate the radiation dose from direct radiation to the maximally exposed member of the general public and the collective dose to the general public within 80 km of SLAC. See Table 4-2 for a summary of the results and Appendix D for the data.

4.8 Low-Level Radioactive Waste Reduction

The quantities of low-level radioactive wastes on site were the accumulation of waste generated over years of SLAC operations. A significant portion of SLAC low-level radioactive waste was in the form of scrap metals.

Depending on their condition and the radiological characteristics, some of the metals could be recycled because radioactive levels were very low and were candidates for regulatory exemption. This waste reduction approach is called Return-on-Investment (ROI). ROI is a DOE-sponsored pollution prevention activity that assists sites in recycling or reuse of materials or waste that contain residual radioactive material. No ROI activities were conducted in 2000 due to the moratorium in the DOE complex.

SLAC has found that simple things had a marked effect on day-to-day production of radioactive waste. In 2000, better housekeeping of accelerator areas reduced the amount of material (parts, equipment, tools, and supplies) that must be considered potentially activated when removed from high-radiation and beam-loss areas.

Here again, a concern for reduction of radioactive waste led to a more comprehensive approach in both characterization and management of activated material that could become waste. It was found that simple disassembly of parts and equipment (where only certain material was activated) resulted in a significant reduction of waste needing to be managed as being radioactive. This process is known as volume reduction. See Section 2 for performance measures for waste reduction goals.

4.9 Biota Dose Issues

Pathway analysis for radiation exposure to biota surrounding SLAC identified three potential paths: liquid emissions, airborne emissions, and direct radiation exposure to biota. DOE issued a draft technical standard in June 2000 entitled “A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota” to assist in demonstrating compliance with the dose limits of 1 rad/day to aquatic organisms, 1 rad/day to terrestrial plants, and 0.1 rad/day to terrestrial animals.

Results of preliminary source term assessment indicated that no possibility exists of approaching or exceeding the dose limits for plants or animals from the SLAC liquid effluent and airborne radioactive emissions. Section 3.3 of the Standard explains “the Standard is not intended to be applied to the exposure of biota to ionizing radiation without releasing materials to the environment.” This implies radiation dose from effluents only and not from penetrating radiation, so direct radiation exposure to biota was not considered here. The proposed screening tool in the Standard will be used in the future, as necessary, to determine compliance with biota dose limits as required by DOE.

5

Groundwater Protection and Restoration

SLAC performs groundwater protection through a network of monitoring wells. The wells are located so that they serve as environmental surveillance and for investigation of soil and groundwater that may be impacted by chemicals of concern (which are potentially radiological and non-radiological). This groundwater monitoring ensures the protection of human health and the environment. Documents such as *Standard Operating Procedures for Environmental Protection and Restoration,* a *Quality Assurance Project Plan,* and the *Health and Safety Plan* support the monitoring and investigation activities.

The *Annual Well Inspection and Maintenance Manual* guides inspection of wells to protect the integrity of the monitoring wells. In 2000, groundwater monitoring data were collected on a semi-annual schedule from existing wells and from new wells as they were installed for investigative work. All reports and documents referred to in this section were available at the SLAC library, or could be obtained from the Environmental Protection and Restoration (EPR) Department at SLAC. To support this work, SLAC provided documentation of the groundwater regime with respect to quantity and quality.

5.1 Documentation

The groundwater regime at the SLAC facility and nearby off-site areas has been comprehensively documented in the SLAC *Hydrogeologic Review* completed in 1994. This report compiled data and summarized results of the numerous geologic, hydrogeologic, and hydrogeochemical investigations that had taken place at or near SLAC for various reasons:

- Water resources studies
- Research
- Geotechnical studies (used to site the structures being built at SLAC)
- Environmental monitoring purposes

The report developed a conceptual model of the groundwater regime at SLAC. Based on many tests in exploratory borings and wells, the hydraulic conductivity of this bedrock was much less than the range of hydraulic conductivity generally accepted as representing natural aquifer material.

In 2000, information was gathered to formally exempt groundwater at SLAC as a potential municipal or domestic supply source based on criteria specified in state and Regional Water Quality Control Board (RWQCB) Resolutions, Numbers 88-63 and 89-39, respectively. The report was to be submitted to the California RWQCB in 2001.

5.2 Identification and Summary of Areas with Potential Chemical Impact

The SLAC 1992 report entitled *Identification and Summary of Potentially Contaminated Sites* provided a summary of areas that might be chemically impacted by hazardous substances. Information for the report was collected from a variety of sources including spill reports, aerial photographs, operations records, reports on previous investigations, and interviews with SLAC personnel throughout the facility. As other potentially chemically impacted areas were identified, they were incorporated into a master list. As funds were available and as the areas became accessible, they were put in a workplan for evaluation. Several areas were evaluated in 2000. Reports were generated for this work in 2000.

5.3 Strategies for Controlling Potential Sources of Chemical Impact

Strategies for contaminant source control involved measures to control known soil or groundwater contamination, and procedures to address practices that could contribute to soil and groundwater contamination. In addition, the Stormwater Pollution Prevention Plan (SWPPP) and the Spill Prevention, Control, and Countermeasure Plan (SPCC) discuss best management practices for preventing contamination at the SLAC facility. *Environment, Safety, and Health Manual* chapters on "Secondary Containment" and "PCB and Oil-filled Equipment" address practices for preventing contamination from reaching soil or groundwater.

To reduce the threat of groundwater contamination further, SLAC has established Waste Minimization and Pollution Prevention Awareness programs. These programs have promoted source control through the reduction of hazardous material usage and hazardous waste generation. This was accomplished by encouraging environmentally conscious engineering and by increasing employee awareness.

5.4 Restoration Activities

SLAC first began to develop a comprehensive Environmental Restoration Program (ERP) in 1991. The program addressed environmental contamination problems from discovery and characterization through remediation and long-term monitoring or maintenance, if required. The restoration approach at SLAC was as follows:

1. Identify sites with actual or potential contamination (involving soil, groundwater, surface water, and / or air)
2. Prioritize chemically impacted sites based on site complexity, nature of chemical impact, associated risks, remaining data needs, and projected remedy
3. Perform investigations and identify remedies protective of human health and the environment, beginning with the highest-priority sites

In 2000, SLAC was generally at step 3 (of the steps listed above). Investigative work proceeded this year for chemically impacted groundwater sites that are discussed in this section.

SLAC followed the general Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) technical guidance in investigating and remediating soil and groundwater contamination. SLAC was not, however, listed in the National Priorities List as a Superfund site and was not required to follow formal CERCLA procedures. The RWQCB provided oversight and approval of restoration activities that impacted surface or groundwater at SLAC. The San Mateo Department of Health Services (SMC / DHS) conducted oversight of environmental restoration activities involving remediation of chemically impacted soil.

In 2000, SLAC ERP personnel continued investigations for site characterization and evaluation of remedial alternatives. Four groundwater sites were identified and monitored (see Figure 5-2 on page 77 and Figure 5-3 on page 78). One of these sites is monitored on a semi-annual basis under RWQCB Waste Discharge Order No. 85-88.

Investigation and remediation of sites impacted with polychlorinated biphenyls (PCBs) continued in 2000. Removal actions took place at a number of former transformer sites and at the active Master Substation. The field work for the removal action at the former 1.0 / 1.5 Megawatt Substation was completed in 2000. A report documenting the removal was to be completed in 2001 and submitted to the EPA, the RWQCB, and the SMC / DHS.

A community relations plan was completed and distributed to the surrounding community in 1993. SLAC community relations activities in 2000 centered on the monthly meetings of the Steering Committee for the Coordinated Resource Management and Planning (CRMP) process for the San Francisquito Creek watershed.

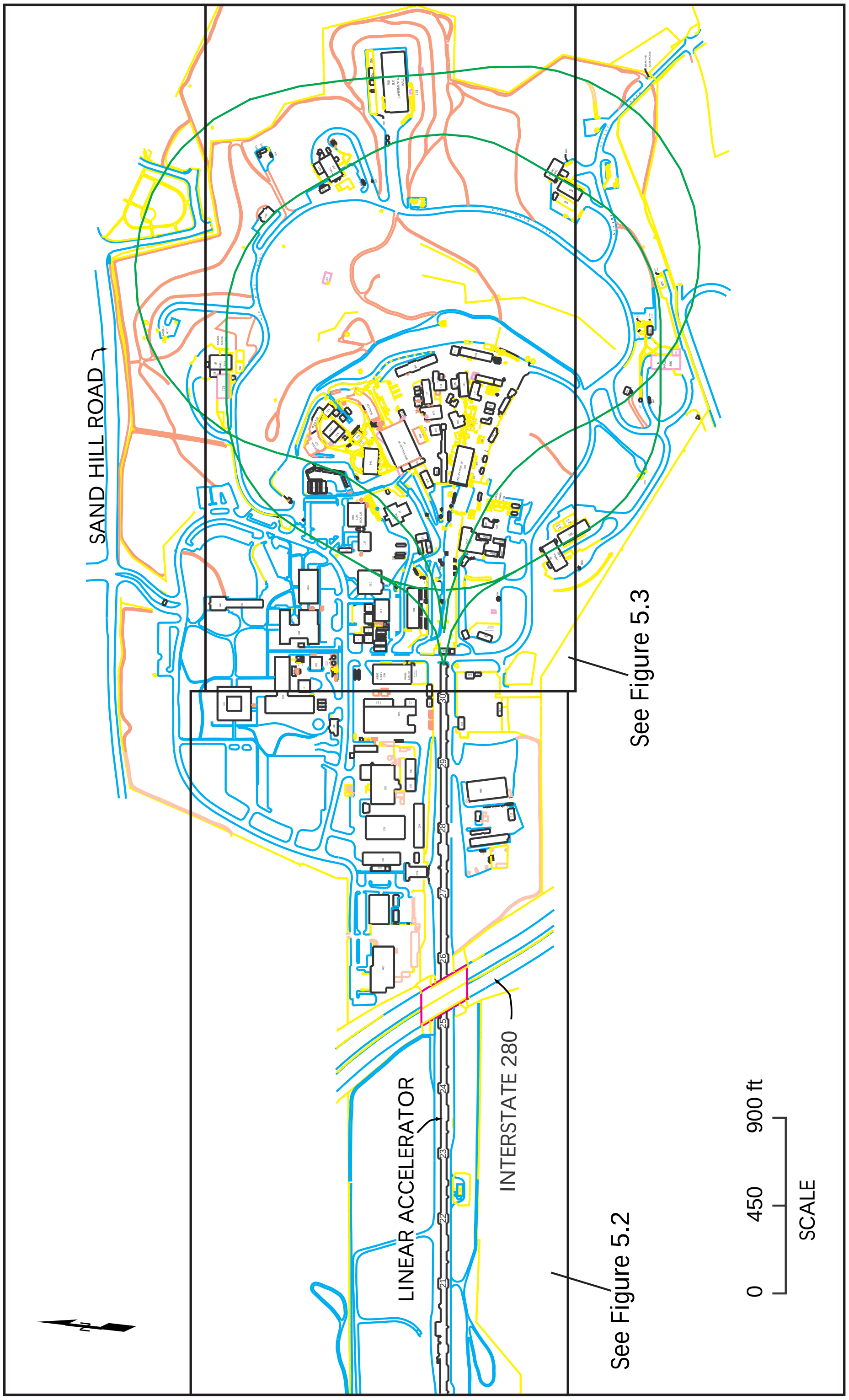


Figure 5-1 Site Map

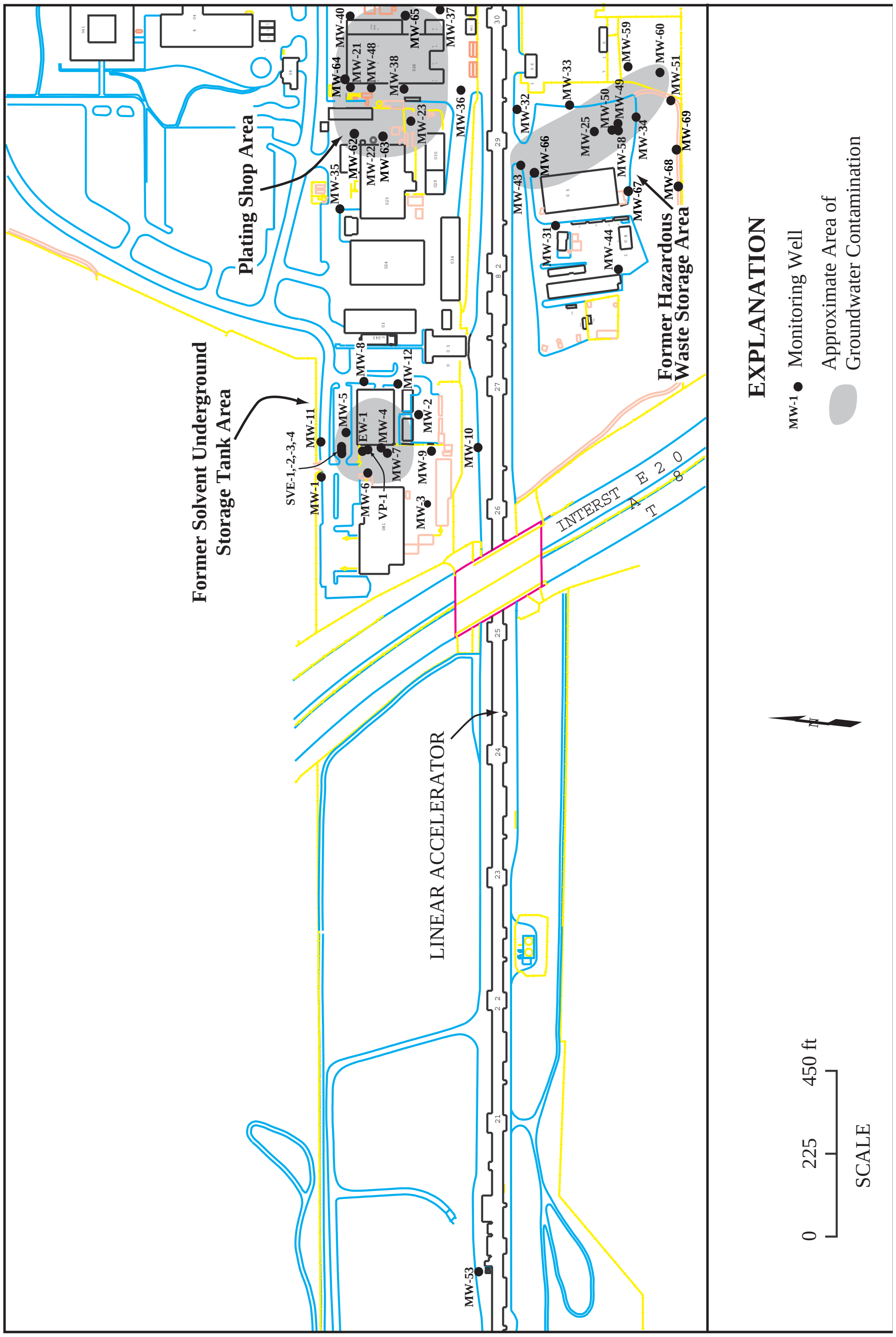


Figure 5-2 Location of Western Groundwater Monitoring Well Network and Areas with Groundwater Contamination

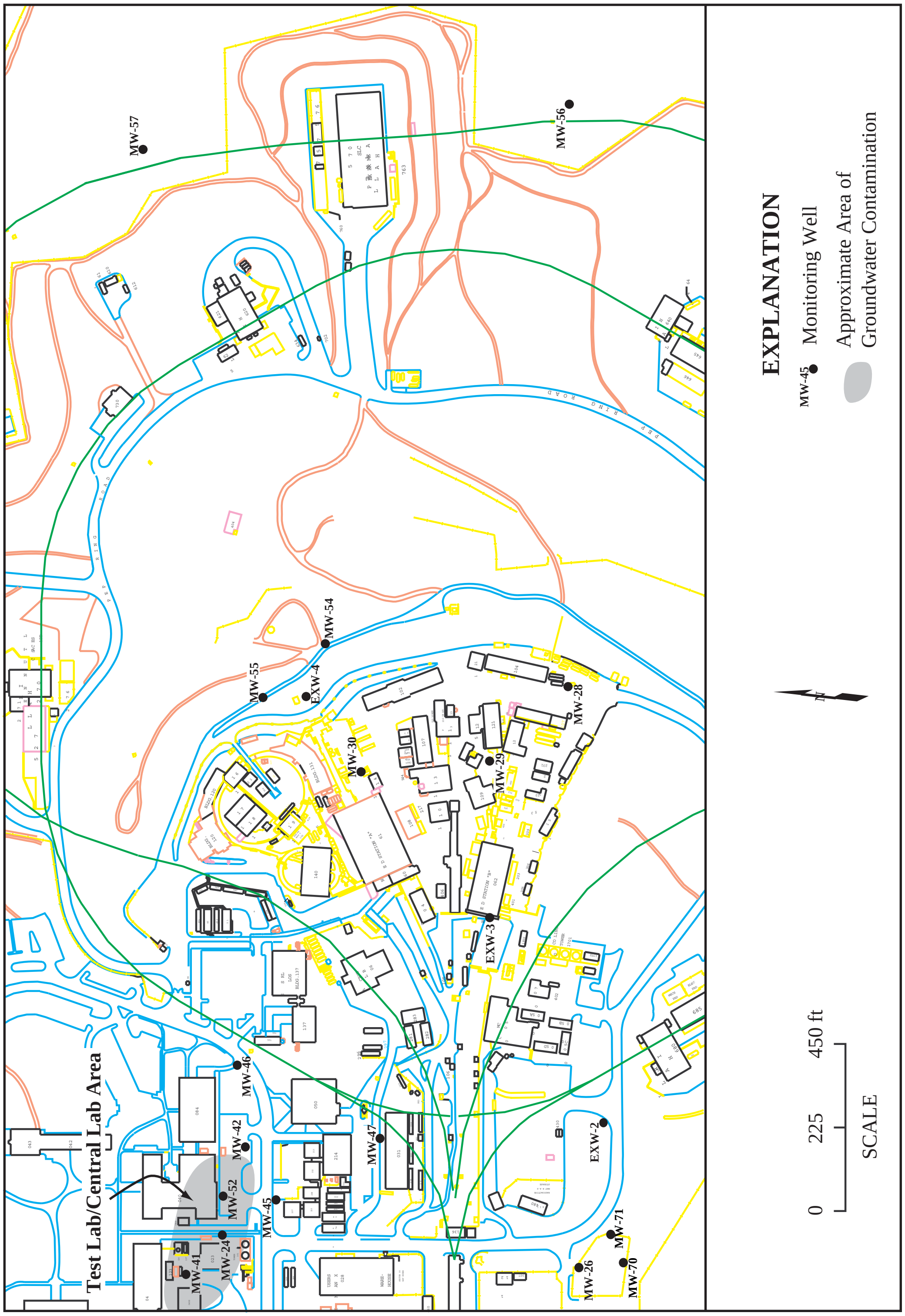


Figure 5-3 Location of Eastern Groundwater Monitoring Well Network and Areas with Groundwater Contamination

5.5 Groundwater Characterization Monitoring Network

5.5.1 2000 Summary of Results and Issues

Work continued in 2000 on putting in more wells around the areas of known contamination to define the lateral and vertical extent of potential contamination. The draft report of the site characterization for the Test Lab / Central Lab was completed in 1999 and submitted to the State of California RWQCB for review and comment. Comments were received and planned for incorporation in 2000.

Groundwater samples were collected at least once from 62 wells in 2000 and analyzed for a variety of constituents including volatile organic compounds (VOCs). Figure 5-1 on page 76 shows the portion of the site that contains the monitoring network. Figure 5-2 on page 77 and Figure 5-3 on page 78 show the specific well locations. The groundwater analytical results were generally within each well's historic range of concentrations.

5.5.2 Background

SLAC characterized groundwater at the site to determine and document the effects that the facility operations had on groundwater quality. The groundwater monitoring network included 15 wells that provided environmental surveillance of groundwater conditions. They were used to monitor general groundwater quality in the major areas of the facility that historically or presently store, handle, or use chemicals that could pose a threat to groundwater quality. In addition, the groundwater monitoring network at SLAC included 55 wells that checked groundwater at four distinct sites with known groundwater contamination.

During ongoing remedial investigations, selected wells at areas with known groundwater contamination were sampled and analyzed on a semi-annual basis. Samples could have been analyzed for one or more of the following:

- Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds
- Total Petroleum Hydrocarbons (TPHs)
- Metals
- Polychlorinated Biphenyls (PCBs)
- Total Dissolved Solids (TDS)
- General minerals
- Tritium

VOCs were detected at levels of concern at SLAC. The results of semi-annual sampling and analysis of wells were reported to the RWQCB in semi-annual monitoring reports.

Table 5-1 on page 80 summarizes the wells at SLAC by the number of wells, area of the facility, and the purpose of the well. The purpose of each well could be either monitoring chemicals of concern or environmental surveillance, including general background monitoring. Ten wells were installed at SLAC in 2000. As noted in Table 5-1 on page 80, the four areas with groundwater contamination are:

- The Former Hazardous Waste Storage Area (FHWSA)
- The Former Solvent Underground Storage Tank (FSUST)
- The Test Lab and Central Lab areas
- The area of the Plating Shop

In addition, a grab groundwater sample taken at the Lower Salvage Yard in 1999 during excavation of soil impacted with PCBs detected PCBs in a groundwater sample. Two wells were installed in this area in 2000.

Table 5-1 Purpose and Location of Monitoring Wells

	Number of Active Wells	
Area of Site	**Monitoring Plumes with Chemicals of Concern**	**Environmental Surveillance**
FSUST[a]	18 wells	
FHWSA[b]	16 wells	
Test Lab / Central Lab	7 wells	
Plating Shop	13 wells	
Research Yard		3 wells
Beam Dump East		3 wells
Master Substation; Lower Salvage Yard		3 wells
CWMA[c]		1 well
End Station B		1 well
Vacuum Assembly Building		1 well
Other (remote area)		5 wells

[a] Former Solvent Underground Storage Tank
[b] Former Hazardous Waste Storage Area
[c] Centralized Waste Management Area

The locations with chemicals of concern in groundwater are shown in Figure 5-2 on page 77 and in Figure 5-3 on page 78.

The organic chemicals most commonly found in groundwater at SLAC were trichloroethene (TCE) and its breakdown products. TCE was historically used at SLAC as a cleaning solvent. TCE was no longer in general use at SLAC, although it was used in very small quantities in a few research laboratories. The four groundwater sites impacted with chemicals of concern were discussed in detail in the next section. This was followed by a discussion of PCB impacted soil sites.

5.6 Groundwater Site Descriptions and Results

5.6.1 Former Solvent Underground Storage Tank

5.6.1.1 Background

A groundwater monitoring network was located in proximity to the SLAC Plant Maintenance building in the northwestern portion of the facility (see Figure 5-2 on page 77). This network consisted of eighteen wells which were being used to monitor the migration of chemical constituents associated with the FSUST. The tank was used to store organic solvents during the period of 1967 to 1978. A pressure test performed on the FSUST in 1983 indicated a leak. The tank and accessible chemically impacted soil were removed in December 1983.

The RWQCB required that SLAC monitor selected wells at the FSUST site on a semi-annual basis (RWQCB Waste Discharge Order 85-88). Since 1987, the samples have been analyzed for VOCs (Environmental Protection Agency Methods 8010/8020) by an analytical laboratory certified by the California Department of Health Services.

5.6.1.2 2000 Results and Issues

The results of investigations performed at the FSUST were provided in two draft reports, the *Site Characterization for the Former Solvent Underground Storage Tank Area*, and the *Evaluation of Remedial Alternatives for the Former Solvent Underground Storage Tank Area*.

The *Site Characterization* report described the nature and extent of chemicals in the soil and groundwater at this site and evaluated the risks posed by these chemicals. The evaluation of the risks was used to identify remedial goals.

The *Evaluation of Remedial Alternatives* report established remedial action objectives and then evaluated 42 alternatives to determine which would meet best the objectives. Comments were received from the California RWQCB. The final reports were expected to be completed in 2001.

The proposed remedial plan includes installing a pump and treat system with the goal of containing the entire groundwater plume. Groundwater modeling and a preliminary design report were completed in 2000 for installation of a groundwater extraction and treatment pilot system.

Groundwater extraction wells and a temporary treatment system were to be installed for the completion of the pilot test in 2001. The final system was to be designed and installed following completion of the pilot test.

5.6.2 Former Hazardous Waste Storage Area

5.6.2.1 Background

The FHWSA was in use from approximately 1965 to 1982. During closure of the yard, PCBs were found in shallow soils. As a result, several inches of topsoil were removed. Monitoring well 25 (MW-25) was installed in this area in 1990, and VOCs were detected in the groundwater.

Four wells were installed and 25 soil borings were taken in 2000, in addition to the 12 wells and 29 soil borings previously installed at this site. Figure 5-2 on page 77 defines the extent of VOCs in the groundwater.

5.6.2.2 2000 Results and Issues

Results of the 2000 drilling and testing program delineated the extent of soil impacted with chemicals of concern at the site and groundwater impacted with chemicals of concern at the south end of the site.

Information acquired from the 2000 work had shown that most of the impacted groundwater appeared to be confined to the Santa Clara Formation which comprised about the upper 20 feet of bedrock.

Two additional wells were to be installed in 2001 to delineate the extent of groundwater impacted with the chemicals of concern at the east and north ends of the site. In addition, a fate and transport study and a risk assessment were to be performed during 2001 for the chemicals of concern that were present in groundwater and soil at the site.

5.6.3 Plating Shop

5.6.3.1 Background

In 1990, three monitoring wells, MW-21, MW-22, and MW-23, were installed downgradient of the Plating Shop. Constituents of concern were detected in all three wells and an investigation began as described below.

A concrete steam cleaning pad was located adjacent to the Plating Shop and work performed in 1997 identified the soil beneath it as a potential source of VOCs in the groundwater. Consequently, an Interim Removal Action was performed in CY98, which included removing the pad, and excavating approximately 200 cubic yards of chemically impacted soil for off-site disposal. A new steam cleaning pad was built to replace it at a location to the south of the original pad. In order to construct it at the new location, well MW-22 had to be destroyed.

5.6.3.2 2000 Results and Issues

Four new wells were installed in 2000, and additional soil samples were collected as part of the source investigation. Based on the findings to date, a risk assessment was to be performed in 2001 to evaluate potential risks to human health and the environment.

5.6.4 Test Lab and Central Lab

5.6.4.1 Background

Monitoring Well 24 was installed between the Test Lab and Central Lab in 1990 at the site of a former leaking diesel pump. Chemically impacted soil was removed and the well was installed to monitor for the possible presence of diesel fuel, which has never been detected in this well. Chlorinated solvents have been detected.

A soil gas survey and soil borings were drilled over the entire Test Lab and Central Lab area to delineate the sources of contamination. Results of the investigation indicated three possible source areas for VOCs, including one adjacent to the Test Laboratory and two adjacent to the Central Laboratory.

5.6.4.2 2000 Results and Issues

Results of the investigative work at the Test Lab / Central Lab area were detailed in the site characterization report for the Test Lab / Central Lab area. The report was submitted to the RWQCB for review and comment in late 1999. Comments from the regulators were received in 2000. The report was revised in 2000 and was scheduled for further revision in 2001.

Based on the characterization studies and risk assessments indicating minimal potential risks to human health and the environment, the revised report was to propose long term monitoring of the plume. The final report was expected to be completed in 2001.

5.7 Soil Sites Description and Results

5.7.1 Lower Salvage Yard

5.7.1.1 Background

The Lower Salvage Yard historically has been used for storage of salvaged equipment, including oil-filled equipment and other materials, such as scrap metal including lead. Prior to its use as a salvage yard, the first SLAC substation occupied the area.

Site characterization data indicated several chemicals of concern including PCBs and petroleum hydrocarbons. Thus a removal action was initiated in 1999.

A total of 3,114 tons of material were excavated from the Lower Salvage Yard to achieve the cleanup goal of 1 part per million PCBs. However, PCBs above the cleanup goal remained in the side walls of the excavation. Thus, additional excavation will be required in the future. In addition, PCBs were detected in a groundwater sample from a deep part of the excavation.

5.7.1.2 2000 Results and Issues

Two downgradient groundwater monitoring wells were installed in 2000 to identify whether chemicals had migrated in groundwater. No PCBs have been detected in these wells, but groundwater from one well has been found to contain a low level of 1,1-dichlorethane. Two additional wells were to be installed at the site in 2001 to better define the extent of VOCs and PCBs in groundwater.

5.7.2 IR-6 and IR-8 Drainage Channels

5.7.2.1 Background

Surface water runoff from the Research Yard drains into the man-made IR-6 drainage channel, and ultimately off site into San Francisquito Creek.

IR-8 is a natural ephemeral drainage that was engineered during SLAC construction to accept groundwater from the linac subdrainage system and surface water runoff from the campus area at SLAC.

In 1992, soil and sediment samples were taken along a 2.5 mile length of San Francisquito Creek. The samples analyzed for a variety of constituents and analysis results showed no detectable PCBs. Lead analysis showed only background levels.

Additional study of the drainage system, the removal and off-site disposal of chemically impacted sediments from the IR-6 off site drainage channel, and its upstream catch basins occurred in 1995. The RWQCB was the lead agency.

In 1997, it was found that sediments with PCBs were still entering the IR-6 drainage channel. Video taping of the storm drain lines indicated sediment was trapped in the lines. This sediment in the storm drain lines was the presumed main source of residual PCB. In 1997, all removable solids were flushed out of the Research Yard drain lines.

5.7.2.2 2000 Results and Issues

In 2000, samples were collected at 50-foot interval down the length of the off-site IR-6 and IR-8 drainage channels. The concentrations were consistent with last year's monitoring results, which indicated that PCBs were present only in the upper reaches of the channel and have not migrated. Where present, PCBs are at or below last year's concentrations. Lead concentration in channel sediments were generally within background levels for this area.

In 2000, SLAC completed a draft human health and screening ecological risk assessment, as well as an initial feasibility study of clean-up options for the IR-6 and IR-8 drainage channels. The draft assessment identified data gaps that led to implementing a field program in 2000 and 2001 to collect additional data that was to be incorporated into the final report in 2001. The chemicals of potential concern were PCBs and lead.

The human and ecological risk assessment evaluated potential risks to receptors under current and hypothetical future scenarios based on unrestricted use. The screening feasibility study of potential cleanup options determined that source control and sediment removal were the preferred options. Once the sources are controlled, sediment in the IR-6 and IR-8 drainage channels would undergo a final remediation planned for 2002.

5.7.3 Research Yard Investigation and Remediation

5.7.3.1 Background

Previously, a number of former substations had been remediated for PCBs in the Research Yard. In addition, an extensive further evaluation of the Research Yard indicated several potential sources that could have introduced PCBs to the IR-6 drainage channel. These former transformer sites were investigated during 2000.

5.7.3.2 2000 Results and Issues

Seven sites were evaluated for the presence of PCBs during 2000. Surface and subsurface soil conditions were evaluated at each of these sites. Based on the results, additional work was required at three sites: former Substation 512, 1.0 / 1.5 Megawatt Power Supply (MWPS), and 5.8 MWPS.

At one of these sites, the former 1.0 / 1.5 MWPS Substation, a Removal Action Plan was written and a total of 134 tons of material was removed. The fieldwork was completed in 2000 with involvement from the EPA and the SMC / DHS.

During these and previous studies, lead and PCBs were found in sediment that had accumulated on the asphalt near buildings and equipment in the Research Yard. Cleaning of this accumulated sediment, for approximately 75% of the Research Yard, occurred in 2000. The cleaning consisted of vacuuming up accumulated sediment and debris and then pressure washing the asphalt.

5.8 Quality Assurance

As described in the *Quality Assurance Project Plan* and the *Standard Operating Procedures*, SLAC conducted a data validation review for all data collected in 2000.

A Model for Potential Dose Assessment

According to Department of Energy (DOE) Orders, an assessment of whole-body dose equivalent (in person-rem) to the general population near SLAC was required where appropriate. For this report, the term dose equivalent was called dose. The SLAC dose to the maximally exposed member of the general public due to accelerator operations in 2000 was conservatively estimated to be 5.66 mrem (0.057 mSv) from penetrating radiation. The 5.66 mrem (0.057 mSv) value was approximately 1.9% of the total natural background dose and was 5.66% of the dose limit for members of the general population, that is, 100 mrem (1 mSv) per year (DOE Order 5400.5).

Three major pathways lead to human exposure from human-made ionizing radiation:

- Airborne Radioactivity.
- Food Chain Radioactivity.
- Direct Exposure to Penetrating Radiation.

Of these pathways, only direct exposure to penetrating radiation was of measurable significance from SLAC operations. The sources of this exposure were neutrons resulting from the absorption of high-energy electrons, from photons from klystron operations, and / or from the experimental areas where energetic particles are created, some of which could have escaped from heavily shielded enclosures.

To make an accurate and realistic assessment of radiation exposure to the public at low doses, we needed to know the exposure from the natural radiological environment (background radiation). The instruments respond to natural radiation sources as well as human-made sources, and the portion due to natural radiation was subtracted from the total measurement. The population exposure assessments in this report are overstatements, due to the conservative modeling assumptions used compared to the likely actual impact. The resulting values represent an upper limit of the possible range.

While the annual radiation dose from accelerator operations at the site boundary has generally been measurable, it has always amounted to less than 10% of the total annual individual dose from natural background radiation. According to a US Environmental Protection Agency (EPA) report, the average dose from cosmic, terrestrial, and internal radiation (not including radon) in California is 125 mrem (1.25 mSv). For purposes of comparison, we have rounded this number down to 100 mrem (1 mSv).

Another quantity of interest was the population dose in units of person-rem (person-cSv). This was the product of average individual dose and the total population exposed. For example, if 1,000 people were exposed to an average annual background dose of 0.1 rem (1 mSv), then the population dose would be 0.1 x 1,000 or 100 person-rem (1 person-Sievert) from natural background radiation. The annual variation of exposure to natural background radiation could be $\pm$ 20%, largely caused by differences in naturally occurring uranium, thorium, and potassium present in the ground and in building material where people live and work.

Most high energy accelerator laboratories have made measurements to determine the characteristic attenuation of radiation fields from their facilities. These measurements are unique to each facility because of design differences, types of machines, and surrounding topography. We have chosen a conservative formula for calculating the dose at distances other than the point of measurement. Lindenbaum gave a method for evaluating skyshine which was later verified by Ladu using Monte Carlo techniques.

Lindenbaum approximated the falloff by $(e^{-R/\lambda})(R^{-1})$ where R is distance in meters from the source and $\lambda = 250$ m. This equation fits the SLAC data fairly well for neutron doses and was the one used to predict skyshine doses beyond our measuring stations (see Figure A-1). It is likely that the methods used and reported in this document could overestimate the true population dose by at least an additional factor of two. This model was used for photon skyshine and as a conservative model for neutron skyshine.

In 2000, the doses to the public were dominated by photon radiation from either the klystrons or the accelerator with neutron doses being insignificant. The model used for evaluating the dose to the general public was as follows:

A. Maximally Exposed Member of the General Public:

1. Determined the closest locations of the general public to the facility.
2. Evaluated the thermoluminescent dosimeter (TLD) data closest to these locations.
3. Determined the source of the radiation as seen by the TLD station.
4. Extrapolated the photon dose from the source to the general public using a conservative line source geometry (1/R relationship), if the source was klystron radiation. In locations where the line source geometry may not have been accurate, it was conservative.
5. Extrapolated the neutron dose or photon dose from accelerator radiation using the Lindenbaum approximation.
6. Evaluated TLD data to determine the highest dose locations.
7. Determined the location of the general public closest to these TLD locations.
8. Extrapolated the photon dose from the source to the general public using a conservative line source geometry (1/R relationship), if the source was klystron radiation. In locations where the line source geometry may not have been accurate, it was conservative.
9. Extrapolated the neutron dose or photon dose from accelerator radiation using the Lindenbaum approximation.
10. Reported the highest dose to any member of the general public as the maximally exposed individual.

B. Collective Dose to the General Public:

1. Established a population grid out to 80 km from the facility.
2. Determined the highest site boundary TLD dose.
3. Applied this dose conservatively to the whole facility.
4. Applied this dose to the population grid using a line source geometry (1/R relationship) out to 500 meters of the facility and a point source geometry ($1/R^2$ relationship) from 501 meters to 80,000 meters.
5. Extrapolated the neutron dose using the Lindenbaum approximation.
6. Summed all the population doses from the grid.

The population demographics in the vicinity of SLAC, that is, within an 80 km radius, included a mixture of commercial and residential dwellings. Based on the data from the 1990 census, the population estimate in this area is about 4,917,443 residents. Based on the TLD results, the maximum dose at the SLAC site boundary was about 22.9 mrem in 2000. Using this maximum dose value, it was estimated that the collective dose to the population within 80 km of SLAC was about 17.72 person-rem (0.1772 person-Sv).

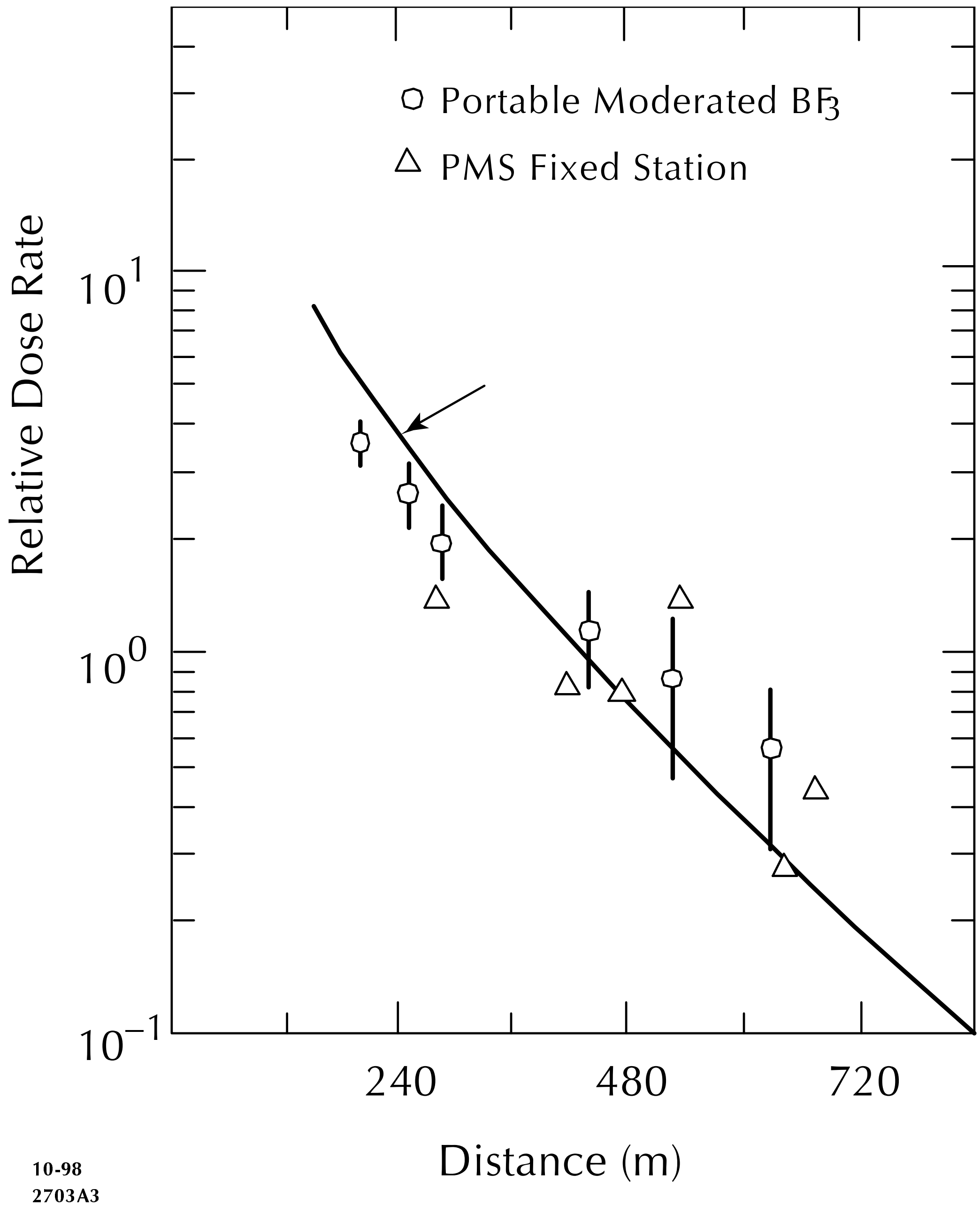


Figure A-1 Neutron Measurements Made Along a Line Between End Station A and the Site Boundary

Note: *The relative dose rate is normalized with respect to beam power.*

B

NESHAPs Report

Original report published separately.
Table and section formats reflect those of the original.

1 Facility Information

Stanford Linear Accelerator Center (SLAC) was in full compliance in calendar year 2000 (CY00) with the requirements set forth in 40 CFR Part 61 Subpart H.

1.1 Site Description

SLAC is a national facility operated by Stanford University under contract with the U.S. Department of Energy (DOE). It is located on the San Francisco peninsula, about halfway between San Francisco and San Jose, California. The site area is a belt of low, rolling foothills, lying between the alluvial plain bordering the San Francisco Bay on the east and the Santa Cruz Mountains on the west.

The whole accelerator site varies in elevation from 53 to 114 meters (175 to 375 feet) above sea level, whereas the alluvial plain to the east around the Bay lies less than 46 meters (150 feet) above sea level. The mountains to the west rise abruptly to 610 meters (2,000 feet). The SLAC site occupies 170 hectares (420 acres) of land. The site is located in an unincorporated portion of San Mateo County. It is bordered on the north by Sand Hill Road and on the south by San Francisquito Creek.

The SLAC staff is roughly 1,400 employees, temporary staff, and visiting scientists. The climate in the SLAC area is Mediterranean. Winters are cool, with intermittent rains, and summers are mostly warm and dry.

The populated area around SLAC is a mix of office, school, university, condominiums, apartments, single-family housing, and pasture. SLAC is mainly surrounded by 5 communities: Atherton town, West Menlo Park, Woodside town, Portola Valley town, and Stanford. Population distribution and housing data from the 1990 census for these five communities are shown in Table 1 below:

Table 1 Demographic Data

Geographic Area	Population [persons]	Pop. Density [persons/sq. mile]	Housing [units]	Land Area [sq. mile]
Atherton town	7,163	1,463.32	2,518	4.895
West Menlo Park	3,959	7,086.19	1,701	0.559
Portola Valley town	4,194	458.02	1,675	9.157
Woodside town	5,035	428.88	1,892	11.740
Stanford	18,097	6,569.14	4,770	2.755
Total:	38,448	NA	12,556	29.106

SLAC is a component of the U.S. high-energy physics program. The laboratory uses a 3.2 km (2 mile) long electron accelerator to produce and accelerate both electrons and positrons for basic particle physics research.

SLAC also operates the Stanford Synchrotron Radiation Laboratory (SSRL), a synchrotron research facility. This laboratory uses 3 GeV stored electrons to generate synchrotron radiation for basic energy research.

The facilities at SLAC are used to maintain the accelerator, to design and construct new detector systems, and to support research in accelerator technology. There are a variety of facilities at SLAC that may be used at any given time. Experimental needs and schedules dictate facility use. Therefore, not every facility is significantly utilized each year. Facilities that are utilized are included in Section 1.2.

1.2 Source Description

Radioactive material is inevitably produced by the operation of the accelerator. During the acceleration process some electrons strike accelerator components and induce radioactivity in the material. In addition, some high-energy particles interact with air molecules producing relatively short-lived radionuclides such as ^{15}O, ^{13}N, ^{11}C, and ^{41}Ar. These radioactive gases are normally produced in areas where the beam strikes beam line components (beam loss).

In a January 1998 letter to the Environmental Protection Agency (EPA), SLAC discussed three separate issues, one being what constituted an air pollution “source”. The other two issues are discussed in subsequent sections. The LINear ACcelerator (linac), damping rings, positron source (PS), and the beam switchyard (BSY) can be expected to be operational on a near-constant basis. This results in potentially high accumulations of activated radionuclide gases within these specific areas. This is not true for the other facilities here, as their usage will rise and fall as experiments begin and end.

The commissioning of the Positron-Electron Project (PEP) rings, the minimal use of End Station A (ESA), and the Next Linear Collider Test Accelerator (NLCTA) at End Station B (ESB), are all examples of the changing use of these major research facilities. New experiments are continually being developed at SLAC to test newer theory. The letter to EPA stressed that SLAC has only the potential to emit radionuclides from areas of high-energy beam-loss, and that other possible sources simply did not have the potential to cause impact to the public.

There were nine potential beam loss areas identified at SLAC for CY00 where the saturation air radioactivity was produced. The SLC Beam Dumps were inactive during CY00. The nine current SLAC research facilities are as follows:

- Accelerator Housing (LINAC).
- Positron Source.
- Beam Switchyard (BSY).
- SLC Damping Rings.
- Stanford Synchrotron Radiation Laboratory (SSRL) Booster Injector.
- Final Focus Test Beam (FFTB).
- End Station A (ESA).
- Asymmetric B-Factory (PEP-II).
- Next Linear Collider Test Accelerator (NLCTA).

The saturation radioactivity is defined to be the equilibrium air radioactivity level inside these areas when the accelerator is running. Calculations of saturation activity in each of these nine beam loss areas are conservatively based on the specific beam power loss and the area geometry (that is, air path length, air volume, and other factors).

Potential release points from these areas are either from the access openings (that is, entrance doors, access ways) or from the forced air ventilation ducts. All the access openings are closed and administratively secured during beam operation. With the exception of PEP II and the infrequently used ESA, accelerator areas are not vented to the atmosphere. Therefore, most potential releases occur only after turning off the beam. Ventilation of PEP II and ESA is discussed further in their respective sections below.

SLAC operational practices use the As Low As Reasonably Achievable (ALARA) concept to minimize exposures of personnel to radiological hazards. ALARA takes precedence over research concerns at SLAC. With respect to release of activated gases due to beam loss, the gases are so short lived (a half-life of only 2 minutes for the main O-15 constituent), that simply allowing an hour to pass before unsealing an area diminishes exposures dramatically.

With ALARA as standard policy at SLAC, it is normal for a sealed area to remain closed (for example, no breach by venting or entry) until an appropriate cool-down period passes. The cool-down period allows for decay of expected activated gases and results in the ability to work without other hazards present. Electrical transients and high thermal regimes (much of the equipment runs at temperatures over 100 degrees F) pose far greater immediate risks to SLAC personnel than do radionuclides.

For the SLAC seven sealed experimental facilities, cool-down periods run from 30 to 120 minutes after the beam is shut off (refer to Tables 2 through 10). The other two facilities, PEP-II and ESA, have continuous diffusion to the atmosphere via Beam Dump East (BDE) and Interaction Region 10 (IR 10), respectively. It should be noted here that, in some cases, if not most, the estimated diffusion to the atmosphere of activated gases is a gross over-statement of what can reasonably be expected to have been released. Even with these conservative calculations, SLAC emissions are still below EPA's accepted limits.

In CY00, NLCTA was operated at low power allowing a 30-minute decay time to adequately reduce the gases produced there. Conversely, the Positron Vault (PV) has very high energy beam losses due to interception of the linac's electron beam to produce positrons. Most of the experiments at SLAC have beam-loss energies between that of NLCTA and the PV, resulting in the ALARA practice of a 60-minute cool down period before venting or entry.

The calculated source terms in each area include the assumptions that the total value of air in the area is at saturation levels, and is instantaneously released whenever that area was shut down for repair or maintenance. These calculated source terms are presented in Tables 2 through 11. In addition, the "number of releases / year" was conservatively estimated for areas where the exact number was not known.

The decay time for the produced radioactive gases prior to release varied for the different beam loss areas. Detailed descriptions of the beam loss areas and their associated radionuclide concentrations are discussed in the following sections.

1.2.1 Accelerator Housing

The accelerator, or LINear ACcelerator (LINAC), is enclosed in a 3.2 km (2-mile) long housing. The housing is located 7.6 meters (25 feet) below ground. Access to the housing is through 76.2-cm (30-inch) diameter shafts every 100.5 meters (330 feet). These shafts (release points) are also used as intake and exhaust shafts for the accelerator housing.

Before machine operation, the housing is searched and locked. There is a solid cover across each access way shaft, which is interlocked with the accelerator. The cover must be in place for machine operation; consequently, the housing is not vented when the accelerator is in operation. There are no releases from these points when the machine is on. After the machine is turned off (no beams are being produced) the housing can be vented. Venting is usually delayed for an appropriate decay time.

The radioactive gas concentration is very low in the accelerator housing because there is very little beam loss, as evidenced by the level of activation in the accelerator structure. It is conservatively assumed that the saturation activities in this area are similar to those in one of the SLC Beam Dump areas.

Table 2 Accelerator Housing Activity

Radionuclide	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.0E-01	6	60	7.63E-10	0.00%
N-13	2.0E-02	6	60	1.85E-03	5.91%
C-11	3.0E-02	6	60	2.32E-02	74.35%
Ar-41	1.5E-03	6	60	6.16E-03	19.74%
Total:	1.5E-01			3.12E-02	100.00%

* 1 Ci = 3.7×10^{10} Bq

After the electron beam leaves the accelerator, it is guided to an area where it may interact with a stationary target or be directed to collide with a beam of positrons. The distance from this facility to the nearest receptor (receptor defined as a member of the general public) is about 305 meters (1,000 feet).

1.2.2 Positron Vault

The positron vault is located in an area separated from the accelerator housing by a thick concrete shield. The beam is deflected out of the accelerator into the positron target. The electron beam produces electron / positron pairs in the target. The positrons are separated and transported back to the beginning of the accelerator. The air activation associated with the operation of the positron target has been evaluated with respect to the saturation activities. The saturation activities of potential radioactive gases in this area are listed in Table 3.

Table 3 Positron Vault Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.4E+00	8	60	1.42E-08	0.00%
N-13	3.0E-01	8	60	3.69E-02	8.10%
C-11	3.0E-01	8	60	3.09E-01	67.88%
Ar-41	2.0E-02	8	60	1.10E-01	24.03%
Total:	2.0E+00			4.56E-01	100.00%

* 1 Ci = 3.7 x 10^{10} Bq

The positron source has a separate exhaust fan (release point). The positron source is not vented during machine operation. The distance to the nearest receptor is about 640 meters (2,100 feet).

1.2.3 Beam Switchyard

There are four vents (release points) at BSY. The vents at BSY and Beam Dump East (BDE) have covers. The covers are closed during beam operation. Use of the saturation activity produced in the accelerator housing, as the release from these four vents will give a conservative estimate of the effective dose equivalent. The distance from this facility to the nearest receptor is about 457 meters (1,500 feet). The 120 minute decay time listed for the beam switchyard more accurately reflects the actual decay time for this area than 60 minutes.

Table 4 Beam Switchyard Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/Y)*	Percent of Contribution
O-15	1.0E-01	7	120	1.13E-180	0
N-13	2.0E-02	7	120	03.31E-05	0.39%
C-11	3.0E-02	7	120	03.49E-03	41.33%
Ar-41	1.5E-03	7	120	04.92E-03	58.27%
Total:	1.5E-01			08.45E-03	100%

* 1 Ci = 3.7 x 10^{10} Bq

1.2.4 Damping Rings

There are two damping rings associated with the SLC. The rings are located on the north and south sides of the accelerator at the end of Sector 1. The distance from these two rings to the nearest receptor is about 274 meters (900 feet). Each ring has a forced air ventilation system (release point). No ventilation is carried out during beam operation. The saturation activity produced in each ring has been calculated. The radionuclides produced and the saturation activities are listed in Table 5.

Table 5 Damping Rings Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.8E-02	13	60	2.98E-10	0.00%
N-13	3.2E-03	13	60	6.40E-04	17.84%
C-11	6.0E-04	13	60	1.01E-03	28.05%
Ar-41	2.2E-04	13	60	1.94E-03	54.11%
Total:	2.2E-02			3.59E-03	100.00%

* 1 Ci = 3.7 x 10^{10} Bq

1.2.5 SSRL Booster Injector

SSRL has a 3 GeV booster ring and linac (injector) that produce very low concentrations of radioactive gases. The Stanford Positron Electron Asymmetric Ring (SPEAR) ring of SSRL produces negligible radioactive gases because there is little to no beam loss; therefore, the SPEAR ring is not considered to be a source. The radionuclides and their saturation activities are listed in Table 6.

Table 6 SSRL Booster/Injector Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	3.7E-04	68	60	3.20E-11	0.00%
N-13	7.0E-04	68	60	7.32E-04	37.18%
C-11	8.0E-05	68	60	7.02E-04	35.63%
Ar-41	1.2E-05	68	60	5.35E-04	27.19%
Total:	1.2E-03			1.97E-03	100.00%

* 1 Ci = 3.7 x 10^{10} Bq

The booster ring does not have forced air ventilation; thus the entrance door is the only potential release point. The distance from this facility to the nearest receptor is about 427 meters (1,400 feet).

1.2.6 Final Focus Test Beam

The FFTB is an extension of the old C-line from the BSY and extends out into the research yard. This facility tests technology that is used to reduce electron beam pulse sizes and increase collision probabilities for the next generation linear accelerators. The radionuclides produced and their saturation activities are listed in Table 7.

Table 7 Final Focus Test Beam Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	6.8E-05	11	60	9.51E-13	0.00%
N-13	1.2E-04	11	60	2.03E-05	9.68%
C-11	1.3E-04	11	60	1.84E-04	87.88%
Ar-41	6.8E-07	11	60	5.12E-06	2.44%
Total:	3.2E-04			2.10E-04	100.00%

The FFTB does not have forced air ventilation; thus the entrance door is the only potential release point. The distance from this facility to the nearest receptor is about 487 meters (1,550 feet).

1.2.7 End Station A

The End Station A (ESA) facility is used for fixed target experiments utilizing up to 50 GeV electrons from the A-line of the BSY. The majority of the beam loss occurs at BDE, which is a 400-gallon water dump at the end of the line from ESA. The radionuclides produced and the saturation activities are listed in Table 8.

Table 8 End Station A Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	6.3E-06	2	0	1.26E-05	4.34%
N-13	5.9E-05	2	0	1.18E-04	40.61%
C-11	3.2E-05	2	0	6.40E-05	22.02%
Ar-41	4.8E-05	2	0	9.60E-05	33.04%
Total:	1.5E-04			2.91E-04	100.00%

The ESA beam loss area is located at BDE. The distance from this facility to the nearest receptor is about 457 meters (1,500 feet). BDE does not have forced air ventilation; thus the entrance door to BDE is the only potential release point. This entrance door is a gate and does not constitute an area isolated from the environs. Continuous air diffusion to the environs is assumed at a rate of one tunnel volume per week. For this reason, the typical decay time of 0 minutes is used.

1.2.8 NLCTA

The Next Linear Collider Test Accelerator (NLCTA) facility is designed to test certain key operating principles of a large scale accelerator, the Next Linear Collider (NLC). The

NLCTA is a 42 meter beamline housed in End Station B (ESB) and powered by three 50 MW klystrons. The radionuclides produced and their saturation activities are listed in Table 9.

Table 9 NLCTA Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	2.5E-04	10	30	8.81E-08	34.45%
N-13	3.8E-04	10	30	1.36E-07	53.00%
C-11	1.9E-05	10	30	6.78E-09	2.65%
Ar-41	7.1E-05	10	30	2.53E-08	9.90%
Total:	7.2E-04			2.56E-07	100.00%

The NLCTA beam loss area is located at ESB. The distance from this facility to the nearest receptor is about 580 meters (1,900 feet) to the north. The NLCTA does not have forced ventilators; thus the entrance door is the only potential release point.

1.2.9 PEP-II

The PEP-II Asymmetric B-Factory (PEP-II) facility consists of two independent storage rings, which store 9 GeV electrons and 3.1 GeV positrons, respectively. This facility is designed to collide electrons and positrons with different energies; thus studying the physics behind CP violations. The radionuclides produced and the saturation activities are listed in Table 10.

Table 10 PEP-II Activity

Isotope	Saturation Activity (Ci)	Estimated Number of Releases	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	2.46E-03	3020	0	7.43E+00	27.98%
N-13	4.63E-03	3020	0	1.40E+01	52.66%
C-11	4.92E-04	3020	0	1.49E+00	5.60%
Ar-41	1.21E-03	3020	0	3.65E+00	13.76%
Total:	8.8E-03			2.66E+01	100.00%

The PEP-II beam loss areas are located at IR-8 and IR-10. A conservative assumption is made that all activated air for the PEP-II facility will be released from the IR-10 facility, which is located closer to the site boundary. The closest member of the general public is located NNE or IR 10 at 427 meters (1,400 feet). The IR-8 facility does not constitute an area isolated from the environs.

Continuous air diffusion to the environs is assumed at a rate of one facility volume every 2 hours. For this reason, the typical decay time of 0 minutes is used. The radionuclide activities used for assessing compliance are listed in Table 12. These activities were calculated using internal reports and memorandum to file.

Table 11 Summary Activity by Location for CY00

Isotope	Accelerator Housing [Ci]	Positron Source [Ci*]	SLC Beam Dump [Ci]	Beam Switchyard [Ci]	SLC Damping Rings [Ci[1]]	SSRL Booster/ Injector [Ci]	FFTB [Ci]	ESA [Ci]	NLCTA [Ci]	PEP-II [Ci]	All Site Total (Ci[1])	Percent of Contribution
O-15	7.6E-10	1.4E-08	0.0E+00	1.1E-18	3.0E-10	3.2E-11	9.5E-13	1.3E-05	8.8E-08	7.4E+00	7.4E+00	27.46%
N-13	1.8E-03	3.7E-02	0.0E+00	3.3E-05	6.4E-04	7.3E-04	2.0E-05	1.2E-04	1.4E-07	1.4E+01	1.4E+01	51.83%
C-11	2.3E-02	3.1E-01	0.0E+00	3.5E-03	1.0E-03	7.0E-04	1.8E-04	6.4E-05	6.8E-09	1.5E+00	1.5E+00	6.74%
Ar-41	6.2E-03	1.1E-01	0.0E+00	4.9E-03	1.9E-03	5.4E-04	5.1E-06	9.6E-05	2.5E-08	3.7E+00	3.7E+00	13.96%
Total:	3.1E-02	4.6E-01	0.0E+00	8.4E-03	3.6E-03	2.0E-03	2.1E-04	2.9E-04	2.6E-07	2.7E+01	2.7E+01	
Percent of Contribution	0.12%	1.69%	0.00%	0.03%	0.01%	0.01%	0.00%	0.00%	0.00%	98.15%		100.00%

1 Ci = 3.7 x 10^{10} Bq

2 Air Emissions Data

Nearest Point Source	Type Control [a]	Efficiency [3]	Distance to Receptor
Positron Source	Not vented during beam operation	100%	640 m (NNE)
Damping Ring	Not vented during beam operation	100%	274 m (WNW)
Accelerator Housing	Not vented during beam operation	100%	305 m (N)
Beam Switchyard	Not vented during beam operation	100%	457 m (NNW)
SSRL Booster / Injector	Not vented during beam operation	100%	427 m (N)
FFTB	Not vented during beam operation	100%	487 m (N)
End Station A	Not vented during beam operation; however since this is not a closed facility, emission occurs by diffusion.	100%	457 m (N)
NLCTA	Not vented during beam operation.	100%	580 m (N)
PEP-II	Not vented during beam operation; however since this is not a closed facility, emission occurs by diffusion.	100%	427 m (NNE)

[a] There are no controls during venting, so efficiency is not applicable.

Non-Point Source	Annual Quantity (Ci)
None Identified	0.0

Table 12 Total Radioactive Gases Potentially Released in CY00 (Decay/Venting Delay Corrected)

Isotope	All Site Total (Ci[a])	Percent of Contribution
O-15	7.4E+00	27.46%
N-13	1.4E+01	51.83%
C-11	1.8E+00	6.74%
Ar-41	3.8E+00	13.96%
Total (Ci):	2.7E+01	100.00%

[a] 1 Ci = 3.7 x 10^{10} Bq

3 Dose Assessments

3.1 Description of the Dose Model

The EPA atmospheric dispersion / radiation dose calculation computer code, CAP88-PC Version 2.0, was used to calculate the average radiation dose to individuals at specified distances and directions from the facility and to individuals within each population segment around the facility. Collective population dose is calculated as the average radiation dose to an individual in a specified area, multiplied by the number of individuals in that area.

The CY00 radioactivity air emissions were conservatively derived and are shown in Table 11 in Section 2. The “number of releases / year” was estimated for each release point. This parameter was purely based on the number of times that the machine was shut down for repair or maintenance in CY00, and was independent of whether or not venting was carried out. The typical period of time after the accelerator was shut down till the opening of the housing for entries in CY00 was about one hour for each of the beam loss areas. These beam loss area-specific decay times were used to calculate the remaining inventory of radioactive gases prior to release.

As noted in the previous discussion in sections 1.2.7 and 1.2.9, potential releases from ESA and PEP-II are atypical of SLAC release points. Through BDE, ESA is not isolated from the environs and has been calculated to diffuse through the BDE entrance door at the rate of one tunnel volume per week. Similarly PEP-II operations at IR 8 and IR 10 allow diffusion to the atmosphere, as each of these areas is unisolated from the environs. A conservative assumption is made that all diffusion takes place from IR 10, which is more proximal to the general public; and at a rate of one facility volume every two hours.

Each release point was conservatively modeled as a single point source with a stack height of 0.0 meter and a diameter of 0.0 meter. The distances in meters (feet) from each single release point to the respective nearest receptors were specifically noted. The dose assessment model consisted of two parts:

1 Individual source term releases, which took into account the closest receptor and contributions from all other sources to that receptor in order to find the appropriate or “real” Maximally Exposed Individual (MEI).

2 A collective source term release, which was used to determine a collective Effective Dose Equivalent (EDE) to the surrounding population, out to 80 km.

Part 1 of the assessment model included determining where the closest and highest exposed individual resides for each source term and adding the dose contributions from all the other source terms to that individual. This calculation was carried out for each of the ten source terms separately since a point source model of release from the collective sources at SLAC was inappropriate for the nearest receptors. The MEI from each source term (with the appropriate contributions from the other source terms) was compared and the highest of these was considered the MEI for SLAC.

Determination of the MEI resulted in locating that individual near Sand Hill Road on the North / Northeast side of the SLAC facility. Details of this evaluation can be found in Table 13.

Part 2 of the assessment model utilized the radial population grid (shown in Table 14) to calculate the collective dose in person-rem to the surrounding population out to 80 km. In this case, the source term was modeled as the ten sources taken as a point source to the population. The point source model was appropriate for the collective EDE calculations at distances out to 80 km.

An estimate of the population residing within 80 km of SLAC was made using 1990 census data. An area defined by a circle of 80 km radius around the center of SLAC (Sector 30) was further divided into 16 equal sectors, with segments formed by the intersection of the sectors and a total of 13 radial distances of 0.1, 0.3, 0.5, 1.0, 2.0, 4.0, 6.0, 8.0, 10.0, 30.0, 40.0, 60.0, and 80.0 km. The population within each segment was derived by multiplying the segment area by the population density of the appropriate city / cities. Unpopulated areas, that is, mountains and pastures were also taken into account in this population study.

Since SLAC does not have a qualified weather station, meteorological input data for CY00 was based on the averaged data provided for San Francisco Airport (SFO) which most closely represented the local conditions at SLAC. The January 1998 EPA letter references the SFO data as the most valid and representative data set that applies to SLAC. In addition, previous parametric studies have shown that meteorological data did not significantly affect the final results and the use of SFO meteorological data in CAP88-PC yielded reasonably conservative results for both the MEI and the collective EDE.

Table 13 Determination of Maximally Exposed Individuals

Run Name		Source	Contributors	Location		EDE (mrem/yr)	Total (mrem/yr)
SLC00	1	SLC Beam Dumps		274m	NE	0.00E+00	
			SSRL	792m	ENE	1.10E-06	
			BSY	1,097m	NE	2.60E-06	
			LINAC	1,372m	ENE	5.44E-06	
			Positron Vault	2,195m	E	6.70E-06	
			Damping Rings	3,962m	E	2.30E-07	
			FFTB	852m	ENE	9.40E-08	
			ESA	822m	ENE	1.70E-07	
			NLCTA	730m	NE	7.00E-11	
			PEP-II	915m	ENE	7.04E-03	
							7.06E-03
SSRL00	2	SSRL		427m	N	7.40E-06	
			Dumps	731m	NW	0.00E+00	
			BSY	640m	NNE	7.90E-06	
			LINAC	792m	NE	1.30E-05	
			Positron Vault	1,554m	NE	4.80E-05	
			Damping Rings	3,353m	ENE	1.60E-07	
			FFTB	487m	N	5.80E-07	
			ESA	457m	N	9.50E-07	
			NLCTA	580m	N	4.90E-10	
			PEP-II	427m	N	3.150E-02	
							3.16E-02
BSY00	3	BSY		457m	NNW	1.80E-05	
			SSRL	640m	NW	1.40E-06	
			Dumps	1,280m	WNW	0.00E+00	
			LINAC	366m	NNW	8.00E-05	
			Positron Vault	640m	NE	3.20E-04	
			Damping Rings	2,743m	ENE	2.40E-07	
			FFTB	700m	NW	1.30E-07	
			ESA	670m	NW	2.10E-07	
			NLCTA	820m	WNW	4.00E-11	
			PEP-II	610m	W	5.78E-03	
							6.20E-03
Linac00	4	Linac		305m	N	2.40E-04	
			BSY	457m	NW	1.60E-05	
			SSRL	640m	WNW	8.50E-07	
			Dumps	1,280m	WNW	0.00E+0	
			Positron Vault	792m	NE	2.00E-04	
			Damping Rings	2,438m	ENE	3.00E-07	
			FFTB	700m	WNW	7.80E-08	
			ESA	670m	WNW	2.10E-07	
			NLCTA	820m	WNW	4.00E-11	
			PEP-II	610m	W	5.78E-03	
							6.24E-03
PV00	5	Positron Vault		640m	NNE	3.20E-04	
			LINAC	731m	NNW	1.80E-05	
			BSY	914m	NW	7.90E-06	
			SSRL	1,097m	NW	4.40E-07	
			Dumps	1,676m	NW	0.00E+00	
			Damping Rings	2,195m	NE	2.70E-07	
			FFTB	1,157m	NW	3.60E-08	
			ESA	1,127m	NW	6.70E-08	
			NLCTA	820m	WNW	4.00E-11	
			PEP-II	610m	W	5.78E-03	
							6.13E-03

Table 13(continued) Determination of Maximally Exposed Individuals

Run Name		Source	Contributors	Location		EDE (mrem/yr)	Total (mrem/yr)
DR00	6	Damping Rings		274m	WNW	1.00E-05	
			Positron Vault	2,195m	W	1.10E-05	
			LINAC	2,743m	W	4.40E-07	
			BSY	3,048m	W	1.60E-07	
			SSRL	3,353m	W	1.90E-08	
			Dumps	3,962m	W	0.00E+00	
			FFTB	3,353m	W	1.30E-09	
			ESA	3,353m	W	3.00E-09	
			NLCTA	3,600m	WSW	8.80E-13	
			PEP-II	3,440m	WSW	1.20E-04	
							1.42E-04
FFTB00	7	FFTB		487m	N	5.80E-07	
			Damping Rings	3,353m	ENE	1.60E-07	
			Positron Vault	1,554m	NE	4.80E-05	
			LINAC	792m	NE	1.30E-05	
			BSY	640m	NNE	7.90E-06	
			SSRL	427m	N	7.40E-06	
			Dumps	731m	NW	0.00E+00	
			ESA	457m	N	1.70E-06	
			NLCTA	580m	N	4.90E-10	
			PEP-II	427m	N	3.20E-02	
							3.21E-02
ESA00	8	ESA		457m	N	1.70E-06	
			Damping Rings	3,353m	ENE	1.60E-07	
			Positron Vault	1,554m	NE	4.80E-05	
			LINAC	792m	NE	1.30E-05	
			BSY	640m	NNE	7.90E-06	
			SSRL	427m	N	7.40E-06	
			Dumps	731m	NW	0.00E+00	
			FFTB	487m	N	5.80E-07	
			NLCTA	580m	N	4.90E-10	
			PEP-II	427m	NNE	3.20E-02	
							3.21E-02
NLCTA00	9	NLCTA		580m	NNW	2.40E-10	
			Damping Rings	3,353m	ENE	1.60E-07	
			Positron Vault	1,554m	NE	4.80E-05	
			LINAC	792m	NE	1.30E-05	
			BSY	640m	NNE	7.90E-06	
			SSRL	427m	N	7.40E-06	
			Dumps	731m	NW	0.00E+00	
			ESA	457m	N	1.70E-06	
			FFTB	487m	N	5.80E-07	
			PEP-II	427m	NNE	3.20E-02	
							3.21E-02
PEP-II00	10	PEP-II		427m	NNE	3.20E-02	
			Damping Rings	3,353m	ENE	1.60E-07	
			Positron Vault	1,554m	NE	4.80E-05	
			LINAC	792m	NE	1.30E-05	
			BSY	640m	NNE	7.90E-06	
			SSRL	427m	N	7.40E-06	
			Dumps	731m	NW	0.00E+00	
			FFTB	487m	N	5.80E-07	
			ESA	457m	N	1.70E-06	
			NLCTA	580m	NNW	2.40E-10	
							3.21E-02

3.2 Population Data

Table 13 Table 14 Radial Population Data for CAP88-PC

Direction	0.1 km	0.3 km	0.5 km	1.0 km	2.0 km	4.0 km	6.0 km	8.0 km	10.0 km	30.0 km	40.0 km	60.0 km	80.0 km	Total
N	0	0	125	403	1100	1331	4103	23994	18447	28176	0	330284	321492	729455
NNW	0	0	126	403	1292	1696	4956	21485	19690	127166	96225	816270	184076	1273385
NW	0	0	127	403	1292	1231	1803	2671	2617	25645	18835	0	0	54624
WNW	0	0	127	403	1289	910	650	503	503	13312	3002	0	0	20699
W	0	0	125	379	149	793	650	0	0	100	0	0	0	2196
WSW	0	0	12	0	0	715	520	503	0	120	0	0	0	1870
SW	0	0	12	0	0	242	668	210	0	420	0	0	0	1552
SSW	0	0	12	0	0	417	690	0	420	0	0	0	0	1539
S	0	0	12	0	1195	1529	913	1118	5590	0	6725	37754	24520	79356
SSE	0	0	12	0	1195	1529	3579	1878	3006	28061	27357	24520	58692	149829
SE	0	0	12	0	896	1195	2020	1878	10521	100380	270722	10171	25641	423436
ESE	0	0	12	0	896	598	4855	17926	25498	130550	391124	234674	0	806133
E	0	0	125	0	1195	5976	4855	22360	11180	50686	156449	0	0	252826
ENE	0	0	125	40	1322	5976	5174	15870	4690	107196	69336	78923	28370	317022
NE	0	0	125	391	869	4944	3773	8669	5608	53762	22300	23229	0	123670
NNE	0	0	125	403	1416	2597	3623	12564	6607	0	170278	160746	321492	679851
TOTAL:	0	0	1214	2825	14106	31679	42832	131629	114377	665574	1232353	1716571	964283	4917443

• SEE ATTACHMENTS FOR OTHER INPUT PARAMETERS

3.3 Compliance Assessment

During EPA's December 1997 meeting with SLAC representatives, the question of confirmatory monitoring was raised. The question was subsequently answered in detail in a January 9 letter from Roger Sit to Mr. Rosenblum. In that letter, SLAC defended the practice of demonstrating that a large degree of conservatism was used in the selection of inputs to the NESHAP-mandated CAP88PC modeling, and the use of grab samples to confirm the conservatism of the saturation activities.

This intentional "double conservatism" in the SLAC selection of input parameters and calculations-based data, coupled with confirmatory grab samples, offers reasonable assurance that the results of our CAP88PC modeling portray an overstatement of the potential emissions from SLAC. SLAC believes that it has met the intention of the 40CFR61 H requirements, and has adequately addressed the request for detailed rationale requested by the regulators in this matter.

This assessment of the potential radioactivity released is based on calculations of the activity produced and other conservative assumptions as stated in Section 3.1, Description of the Dose Model. This compliance assessment used the computer code CAP88-PC Version 2.0 to calculate the dose for CY00.

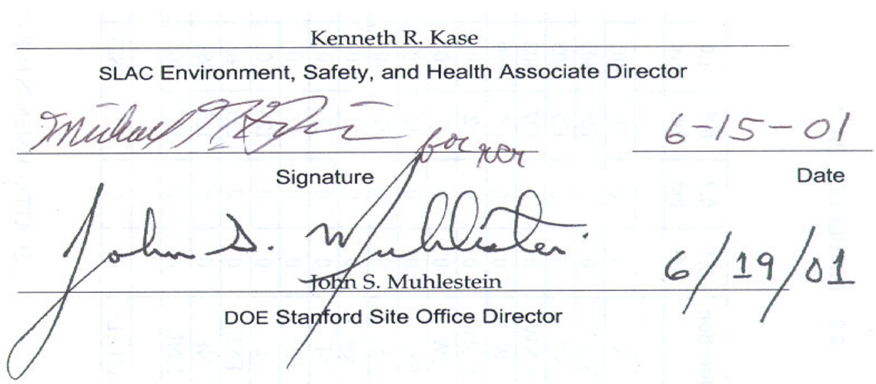
Maximally Exposed Individual

Effective Dose Equivalent: 3.21×10^{-2} mrem / year (3.19×10^{-4} mSv / year)

Location of Maximally Exposed Individual: 427 meters North / Northeast (Sand Hill Road)

3.4 Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See 18 U.S.C. 1001.)


Kenneth R. Kase
SLAC Environment, Safety, and Health Associate Director
6-15-01
Signature Date
John S. Muhlestein
DOE Stanford Site Office Director
6/19/01

4 Additional Information

As mentioned earlier in this report, all nine active SLAC research facilities had beam-on activities in calendar year 2000 (CY00). As is shown in section 3.3 of this report, even with all nine facilities powered-up, the SLAC potential emission of activated gases is extremely minor. At a calculated dose due to emissions of about three one-hundreths (0.0321) of a mrem per year, SLAC is below the ten mrem (0.1 mSv) NESHAP annual threshold limit. In addition, there were no unplanned (emergency) releases of potentially activated radionuclides to contribute to the minute amounts that were calculated to have been emitted at SLAC.

5 Supplemental Information

- During CY00, the collective effective dose equivalent for the population within 80 km from SLAC 's site boundary (4,917,443 persons) was estimated to be 1.9 x 10^{-1} person-rem (1.9 x 10^{-3} person-Sv).
- The reported source terms in the NESHAP report for CY00 included all unmonitored sources that were identified at SLAC.
- Compliance with Subparts Q and T of 40 CFR Part 61 was not applicable at SLAC.
- Information on Rn-220 emissions from sources containing U-232 and Th-232 where emissions potentially could exceed 0.1 mrem in one year to the public or 10% of the non-radon dose to the public was not applicable at SLAC.
- Information on non-disposal/non-storage sources of Rn-222 emissions where emissions potentially could exceed 0.1 mrem in one year to the public or 10% of the non-radon dose to the public was not applicable at SLAC.
- SLAC did not have any emission points that contributed to more than 1% of the 10 mrem in one year (0.1 mSv in one year) NESHAP's limit. Thus, continuous monitoring of these emission points was not required.

C Calibration and Quality Assurance Procedures

The recording of natural background radiation provides continuous verification that the monitoring equipment at SLAC is connected and functioning properly. Also, backgrounds collected during accelerator downtimes and any interrupted operations provide additional information for establishing the calibration baseline.

Direct Radiation Monitoring Equipment

A regular calibration procedure was performed on the Peripheral Monitoring Stations in CY99. Radiation sources were placed at a measured distance from the detector to produce a known dose equivalent rate, for example, 1 mrem/h (0.01 mSv/h).

The equipment is kept in normal operation during these checks. The data printout is marked so that the calibration data is not confused with actual measurements of machine-produced radiation. This procedure will be carried out at least once each year, and following any equipment repair or maintenance actions.

An appropriate response to natural background radiation provides evidence that the instruments are operating properly. An improved calibration program is under development.

Liquid Radiological Effluents

Water samples are analyzed in-house with a liquid scintillation counter and a high purity germanium detector as necessary. Both pieces of equipment are calibrated with appropriate National Institute of Standards and Technology traceable sources.

D Environmental TLD Measurements for 2000

This appendix contains data on environmental thermoluminescent dosimeter (TLD) measurements for 2000, including:

- Summary of net photon and neutron doses for 2000.
- Environmental TLD Monitoring Stations (Table D-1).

TLD Type	Nominal Minimum Detectable Levels	Type of Radiation Detected
Al_2O_3:C (LDR-X9 Landauer Company)	0.02 mrem	Gamma
NeutrakER (LDR-I9 Landauer Company)	10 mrem	Neutron

D-1 Net Annual Doses for 2000

TLD Location	TLD #	Net Photon Dose (mrem)	Net Neutron Dose (mrem)
Transport Control	—	NA	M[a]
Deployment Control	—	NA	M[a]
SB at Region 6	1	2.1 +/- 5.8	M[a]
SB at Injector	2	7.6 +/- 5.8	M[a]
Computer Center SE Corner	3	1.3 +/- 6.1	M[a]
SB at Region 4	4	4.9 +/- 6.1	M[a]
SB at North Damping Ring	5	15.4 +/- 6.6	M[a]
I-280 Overpass South	6	5.2 +/- 6.8	M[a]
SB at Sector 10 south	7	2.0 +/- 6.0	M[a]
SB across from B of A	8	9.0 +/- 6.0	M[a]
Alpine Gatehouse	9	1.2 +/- 5.9	M[a]
Meteorological Tower	10	2.7 +/- 5.8	M[a]
SB at SLD	11	10.0 +/- 5.7	M[a]
SB at Region 12	12	7.3 +/- 6.2	M[a]
SB at Region 2	13	3.2 +/- 5.8	M[a]
SLAC Entrance Gatehouse	14	7.1 +/- 6.1	M[a]
SLAC Cafeteria	15	8.2 +/- 5.2	M[a]
SB at Region 8	16	-1.1 +/- 6.7	M[a]
SB at Addison Wesley Building	17	4.3 +/- 7.5	M[a]
SB at Positron Vault	18	6.9 +/- 5.8	M[a]
Control	19	3.7 +/- 5.9	M[a]
SB at Sector 20 south	20	9.8 +/- 6.3	M[a]
SB at South Damping Ring	21	3.7 +/- 6.2	M[a]
I-280 Overpass North	22	6.8 +/- 5.9	M[a]
SB at Sector 21 south	23	7.7 +/- 5.8	M[a]
SB at building 81	24	7.5 +/- 5.8	M[a]
RAMSY	25	-11.3 +/- 6.1	M[a]
PMS 1	26	11.4 +/- 6.2	M[a]
PMS 2	27	8.0 +/- 6.0	M[a]
PMS 3	28	15.0 +/- 6.6	M[a]
PMS 4	29	3.5 +/- 6.1	M[a]
PMS 5	30	11.4 +/- 6.1	M[a]
PMS 6	31	12.1 +/- 7.5	M[a]
PMS 7	32	3.2 +/- 5.8	M[a]
SB at Sector 24 north	33	-7.0 +/- 7.2	M[a]
SB at Sector 17 north	34	12.0 +/- 6.3	M[a]
SB at Sector 5 north	35	22.9 +/- 5.8	M[a]

[a] Below the minimum detection limit.

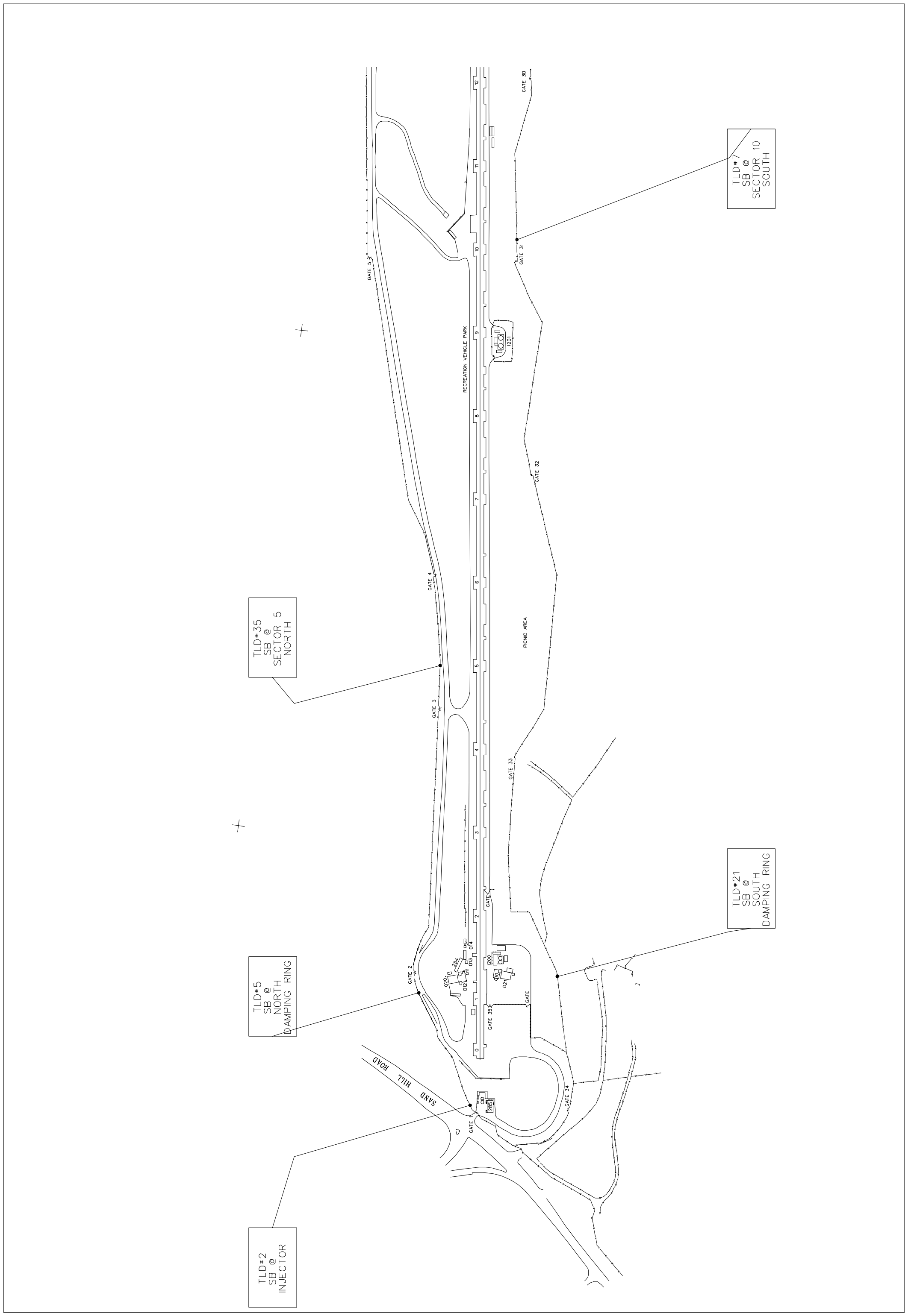


Figure D-1 Environmental TLD Monitoring Stations, Sectors 0 through 12

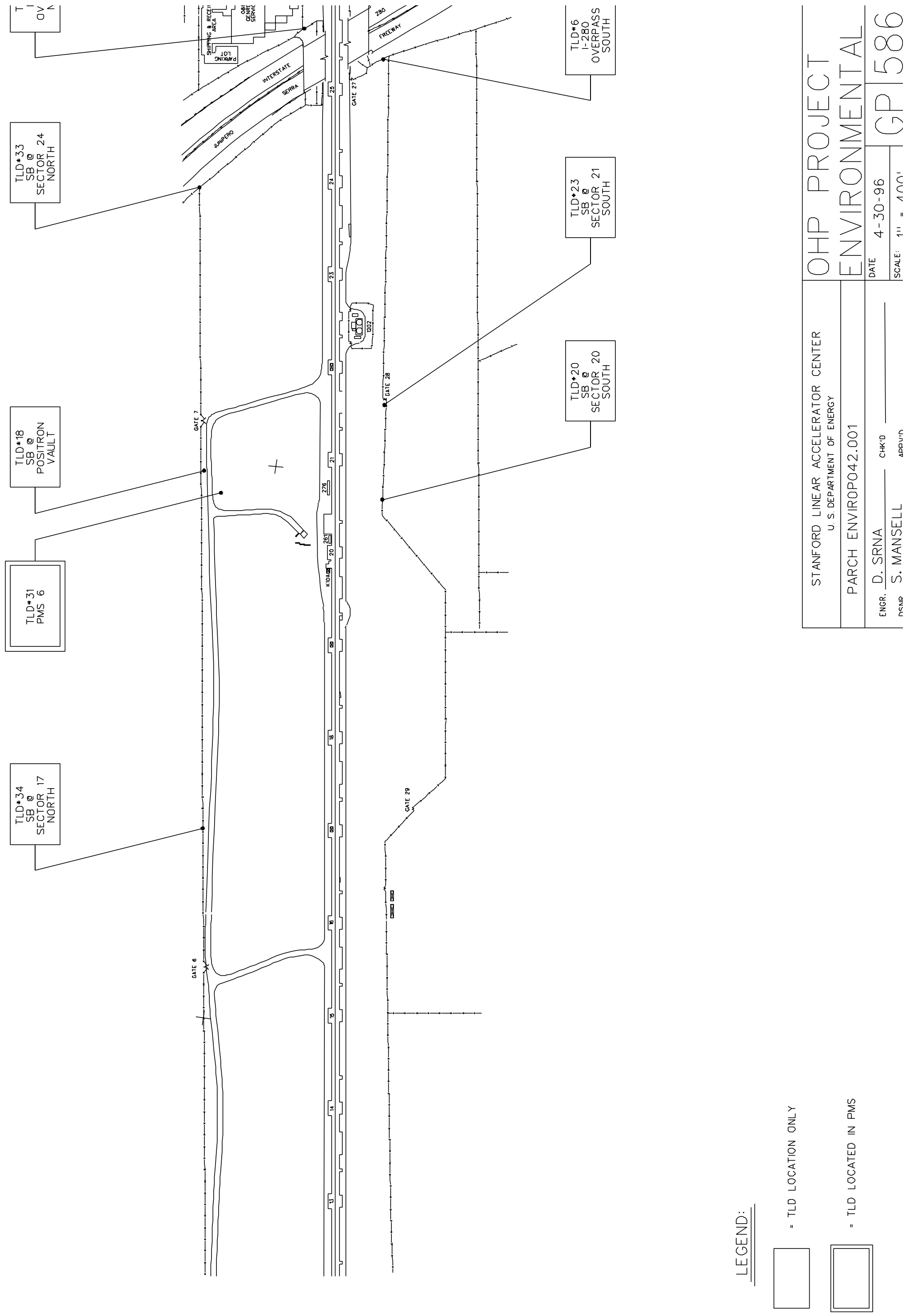


Figure D-2 Environmental TLD Monitoring Stations, Sectors 12 through 27

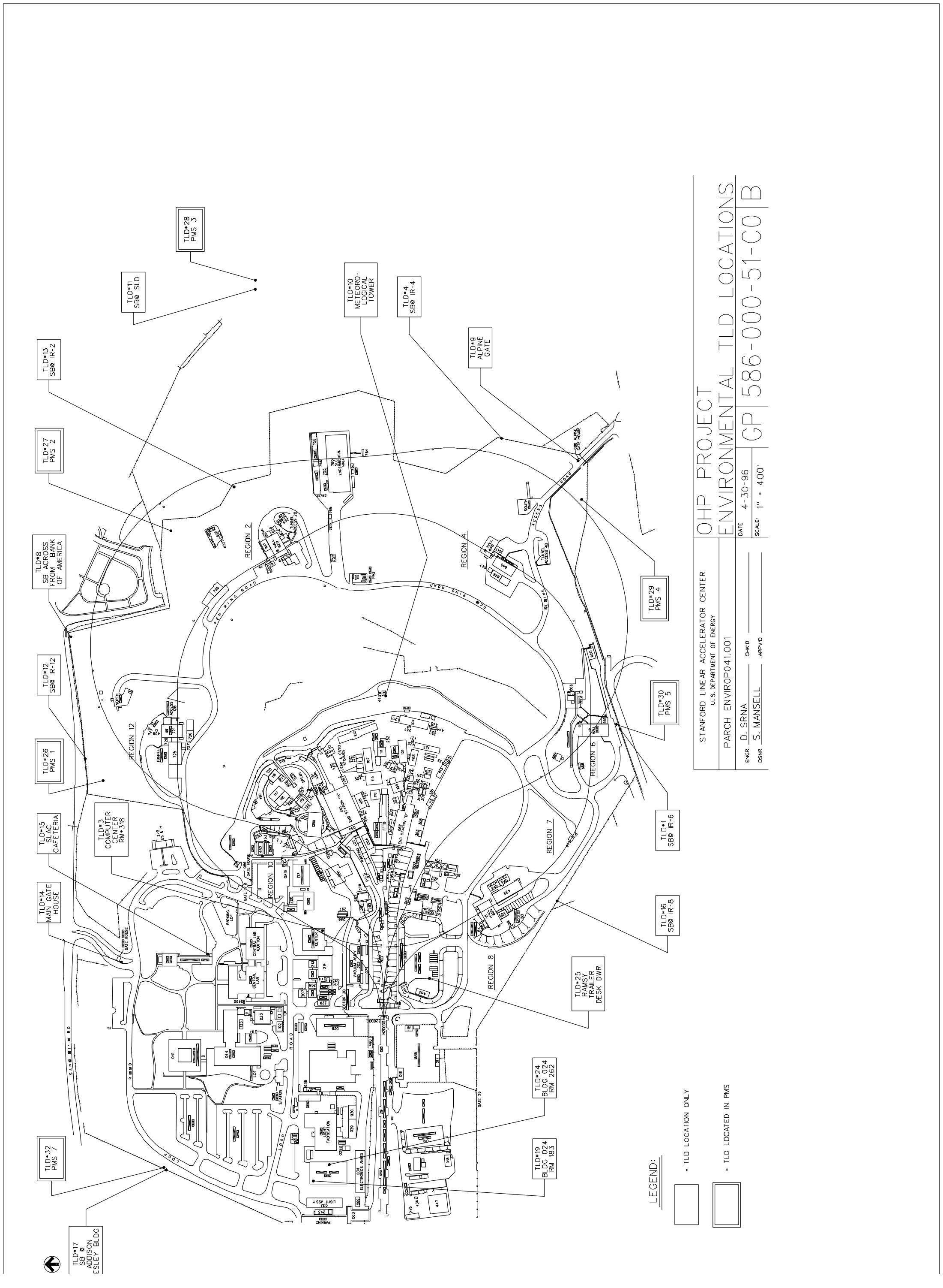


Figure D-3 Environmental TLD Monitoring Stations, Sector 27 through SLC

E Acronyms and Abbreviations

A

ALARA	As Low As Reasonably Achievable

B

BAAQMD	Bay Area Air Quality Management District
BDE	Beam Dump East
BMP	Best Management Practice
BPO	Basin Plan Objective
BSY	Beam Switchyard
BTP	Batch Treatment Plant

C

CAA	Clean Air Act
CalARP	California Accidental Release Prevention Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQA	California Environmental Quality Act
CWMA	Centralized Waste Management Area
COE	(Army) Corp of Engineers
CPM	Counts Per Minute
CRMP	Coordinated Resource Management and Planning (program)
CWA	Clean Water Act
CX	Categorical Exclusion

D

DCE	Dichloroethene
DCG	Derived Concentration Guide
DEAR	DOE Acquisition Regulations
DFG	Department of Fish and Game
DOE	Department of Energy
DOE/OAK	DOE Oakland Operations Office
DOE/SSO	DOE Stanford Site Office

E

EA	Environmental Assessment
EC	Electrical Conductivity
EDE	Effective Dose Equivalent

EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EML	Environmental Measurements Laboratory
EMSL-LV	Environmental Monitoring Systems Laboratory- Las Vegas
EPR	Environmental Protection and Restoration (Department)
ERP	Environmental Restoration Program
ES&H	Environment, Safety, and Health (Division)
ESA_2	End Station A
ESA_1	Endangered Species Act
ES&HCC	Environment, Safety, and Health Coordinating Council

F

FEMA	Federal Emergency Management Agency
FFS	Final Focus System
FFTB	Final Focus Test Beam
FHWSA	Former Hazardous Waste Storage Area
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FMS	Flow Meter Station
FSUST	Former Solvent Underground Storage Tank
FUST	Former Underground Storage Tank
FY	Fiscal Year (October 1 - September 30)

G

GPMP	Groundwater Protection Management Program
GPP	General Plant Project

H

HMBP	Hazardous Materials Business Plan
HPGe	Hyper-pure Germanium
HWMC	Hazardous Waste and Material Coordinator
HWMG	Hazardous Waste Management Group

I

IR	Interaction Region
IRA	Interim Removal Action

K

kWh	kilowatt-hour

L

LA	Local Authority
LCW	Low Conductivity Water
linac	Linear Accelerator
LSC	Liquid Scintillation Counter

M

MCC Main Control Center
MCL Maximum Concentration Level
MEI Maximally Exposed Individual
MFD Mechanical Fabrication Department
MPMWD Menlo Park Municipal Water Department
MW mega-watt

N

NCP National (Oil and Hazardous Substances Pollution) Contingency Plan
NEPA National Environmental Policy Act
NESHAP National Emission Standards for Hazardous Air Pollutants
NHPA National Historic Preservation Act
NIST National Institute of Standards and Technology
NLC Next Linear Collider
NLCTA Next Linear Collider Test Accelerator
NOI Notice of Intent
NO_X Nitrogen Oxides
NPDES National Pollutant Discharge Elimination System
NPL National Priorities List
NVLAP National Voluntary Laboratory Accreditation Program

O

ODS Ozone-Depleting Substance
OHP Operational Health Physics (Department)

P

PCB Polychlorinated Biphenyl
pCi/l Pico-curies per Liter
PED Plant Engineering Department
PEL Physical Electronics Laboratory
PEP Positron-Electron Project
PEP-II Asymmetric *B* Factory
PMS Peripheral Monitoring Station
ppb parts per billion
ppm parts per million
POTW Publicly Owned Treatment Works
PPO Program Planning Office
PS Positron Source

Q

QA	Quality Assurance
QAP	Quality Assessment Program
QC	Quality Control

R

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RMP	Risk Management Plan
ROI	Return-on-Investment
RP	Radiation Physics (Department)
RQ	Reportable Quantity
RWQCB	Regional Water Quality Control Board
RWTP	Rinse Water Treatment Plant

S

S&E	Safety and Environmental
SARA	Superfund Amendments and Reauthorization Act
SBSA	South Bayside System Authority
SDWA	Safe Drinking Water Act
SER	Site Environmental Report
SHA	Safety, Health, and Assurance (Department)
SLAC	Stanford Linear Accelerator Center
SLC	Stanford Linear Collider
SLD	SLAC Large Detector
SMC/DHS	San Mateo County Department of Health Services
SMS	Safety Management System
SPCC	Spill Prevention, Control, and Countermeasures Plan
SPEAR	Stanford Positron-Electron Asymmetric Ring
SSRL	Stanford Synchrotron Radiation Laboratory
Sv	Sievert
SWPPP	Storm Water Pollution Prevention Plan

T

TCA	Trichloroethane
TCE	Trichloroethene (or Trichloroethylene)
TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimeter
TPH	Total Petroleum Hydrocarbons
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TSS	Total Suspended Solids
TTO	Total Toxic Organics

V

VOC Volatile Organic Compound

W

WAA Waste Accumulation Area
WBSD West Bay Sanitary District
WSS Work Smart Standards
WM Waste Management (Department)
WTS Waste Tracking System

F ASER Distribution

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Annual Site Environmental Report
Reader Survey

To Our Readers:

Each Annual Site Environmental Report publishes the results of environmental monitoring at SLAC and documents our compliance with federal, state, and local environmental regulations. In providing this information, our goal is to give our readers (regulators, scientists, and the public) a clear accounting of our environmental activities, the methods we use, our results, the status of our program, and issues that affect SLAC environmental programs.

We want the information in this report to be of interest to you, easy to understand, and to communicate SLAC efforts to protect human health and provide environmental stewardship. We want to know from you if we succeeded. We appreciate and will use your comments to improve our next report.

1. Is the writing ☐ too concise? ☐ too verbose? ☐ uneven? ☐ just right?

2. Is the technical content ☐ too high? ☐ too low? ☐ uneven? ☐ just right?

	YES	NO
3. Is the report comprehensive?	☐	☐
4. Do the illustrations help you understand the text better?	☐	☐
Did you understand the figures?	☐	☐
Are there enough figures?	☐	☐
Are there too few figures?	☐	☐
Are there too many figures?	☐	☐
5. Are the data tables of interest?	☐	☐
Would you prefer short summaries of data trends instead of data tables?	☐	☐
6. Is the background information sufficient?	☐	☐
7. Did you understand the methods described?	☐	☐
8. Is the acronym list useful?	☐	☐
9. Are the appendices useful?	☐	☐

Other comments:

Please fold, staple, stamp, and mail this survey to SLAC.
Laboratory staff may return this survey via interoffice mail to Hillary Russak, Mailstop 84.

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Mailstop 84
Stanford Linear Accelerator Center
2575 Sand Hill Road
Menlo Park, CA 94025

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