SLAC-R-525

1997 Site Environmental Report
January—December 1997

ENVIRONMENT, SAFETY,
AND
HEALTH DIVISION

SLAC Report 525
September 1998

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

STANFORD LINEAR ACCELERATOR CENTER
Stanford University Stanford, California

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Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

SEP 2 9 1998

Dr. Burton Richter
Director, Stanford Linear
Accelerator Center
P.O. Box 4349, Bin 80
Stanford, California 94309

SUBJECT: Approval of the 1997 Site Environmental Report (SER) for the Stanford Linear Accelerator Center (SLAC)

Dear Dr. Richter:

This is to notify you that the 1997 SER for SLAC is approved for public release. My approval for release is based on Oakland Operations Office (OAK) staff review of the SER, and SLAC certification of the validity and accuracy of the monitoring data in the report.

The enclosed letter should be included in the final distribution copies of the report. This will fulfill the requirement in the Department of Energy (DOE) guidance for the preparation of 1997 SERs to include a statement in the report "ensuring DOE commitment to the validity and accuracy of the monitoring data." In addition to distribution of the report to relevant external regulatory agencies and other interested organizations or individuals, please provide ten copies of the final report to Hanley Lee of the Stanford Site Office for internal DOE distribution. Should you or your staff have any questions, please contact Steve Black of the Environment, Safety, and Health Division at (510) 637-1595.

Sincerely,

Original signed by:

John S. Muhlestein, Director
Stanford Site Office

Enclosure

cc: Mike Grissom, SLAC w/encl

Certification of Accuracy for:

1997 Site Environmental Report of the Stanford Linear Accelerator Center, CY97.

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.

Kenneth R. Kase
Associate Director
Environment, Safety, and Health Division

Contributors

Authors

Rich Cellamare
Judy Fulton
Jack Hahn
Michael Hug
Ken Kase
Walter LeClerc
Helen Nuckolls
Keith Reynolds
Michael Scharfenstein
Roger Sit
Kirk Stoddard
Valerie Stone

Contributing Authors

Michelle Decamara
Susan Witebsky

Coordinators

Mike Grissom
Ray Jensen

Editor

Gene Holden

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Executive Summary

This report provides information about environmental programs and compliance with environmental regulations in calendar year 1997 (CY97) at the Stanford Linear Accelerator Center (SLAC). SLAC is a national laboratory operated by Stanford University under contract with the US Department of Energy (DOE) and is devoted to experimental and theoretical research in elementary particle physics, in basic sciences using synchrotron radiation, and in accelerator physics and technology. The most significant information in this report is summarized briefly in the following sections.

Releases

In CY97, as in CY96, there were no known releases of radioactive material by SLAC to the environment in excess of DOE or regulatory limits. There were 19 non-radioactive releases in CY97, and regulatory notification was required in three of these cases. They were:

- Two releases from the sanitary sewer to the storm drain.
- One release of low conductivity water to the storm drain.

Environmental Restoration

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

Hazardous and Radioactive Waste

The Radioactive Waste Management Group of the Waste Management (WM) Department manages the low-level activated metals that are the primary source of radioactive waste at SLAC. The metal comes in the form of beam line components that are managed as radioactive material. In the early 1990's, SLAC changed the designation of some of the accumulated radioactive material that had been stored for potential re-use to radioactive waste. This radioactive waste will be disposed of as time and budget allow.

SLAC complied with all waste management requirements for the disposal of hazardous waste in CY97 as required under federal, state and local regulations. During CY97, all hazardous waste for off-site disposal was successfully shipped from SLAC within 90 days of generation.

Air Quality

SLAC did not exceed permit limits in CY97 for the 25 air pollution sources that are listed with the Bay Area Air Quality Management District (BAAQMD). SLAC was inspected by BAAQMD and issued a violation notice for exceeding solvent usage. The notice was cleared on January 23, 1997, (the day it was issued), by increasing the permitted usage volume.

Storm Water and Industrial Wastewater

SLAC is updating the Storm Water Pollution Prevention Plan (SWPPP) in accordance with the new permit, which became effective on July 1, 1997. There were no sanitary sewer permit violations in CY97. The identification of illicit storm water connections was completed in CY97, and SLAC is working to eliminate them.

Polychlorinated Biphenyls (PCBs)

SLAC has some equipment filled with oil or other dielectric fluids which contain PCBs. In CY97 SLAC continued to reduce its inventory of PCBs by retrofilling and reclassifying or disposing of nearly half of the remaining PCB-containing transformers on site, as well as other PCB-containing equipment. SLAC will continue to remove, or retrofill and reclassify, the remaining 14 PCB-contaminated transformers over the next few years.

Assessments

In CY97, SLAC operated under the "Work Smart Standards" (WSS), which are incorporated in SLAC's Management and Operating (M&O) contract. The WSS set includes all applicable statutory and regulatory requirements for public and worker safety and environmental protection. It also includes a number of industry standards that were found to be necessary to control specific hazards present at SLAC.

Progress continued toward completing the corrective actions developed in response to the 1991 Tiger Team assessment. All 51 of the environmental findings have been completed, and all 57 of the related tasks have also been completed. DOE has finished their validation of completed Tiger Team Tasks. SLAC's Tiger Team Corrective Action Plan (CAP) is closed. Any specific tasks which are relevant to the WSS set and have not yet been validated will be validated during Operational Awareness Activities.

A hazardous materials inspection was completed by San Mateo County in CY97. The inspection resulted in 41 corrective action tasks. Most of the tasks were addressed immediately. As of December 31, 1997, forty of the forty-one tasks have been completed.

SLAC's Quality Assurance and Compliance organization completed eight environmental self-assessments. The assessments in 1997 focused on stormwater and hazardous material management practices. No significant problems were identified in these areas. Of the 76 environmental findings 73 have been completed.

SLAC's held its second annual Safety and Environmental Discussion on February 28, 1997. The discussions provide employees the opportunity to raise safety and environmental concerns. Their issues are entered into a database and formally tracked. Of the 234 issues raised, 6 were environmental. There were no significant environmental problems identified. As of December 31, 1997, 5 of the 6 environmental issues have been addressed.

Environmental Radiological Program

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 CY97. In addition, there were no known instances of noncompliance for radionuclide air emissions in CY97.

Groundwater

SLAC's groundwater monitoring program is managed through EPR. Groundwater samples are collected from monitoring wells. These wells provide surveillance of SLAC's groundwater. No new wells were installed for surveillance in CY97. No new areas with constituents of concern in groundwater were found.

In addition, groundwater was collected from monitoring wells installed to investigate the extent of VOCs in groundwater. This work supports the site characterization and evaluation of remedial alternatives as described in Section 3.1.1 of this report, Environmental Restoration. Seven new wells were installed in CY97 to support the investigative effort.

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/.

1 Introduction

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). 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, whereas 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).

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 300 m-wide, 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 (see Figure 1-3).

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

1.2 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.

The main instrument of research is the 3.2-km linear accelerator (linac) that generates high intensity beams of electrons and positrons up to 50 GeV, which 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. The PEP program was completed several years ago. PEP is now being upgraded to serve as an Asymmetric B Factory (or PEP-II) that will study the B meson. PEP-II will make use of much of PEP's existing equipment and infrastructure, and is scheduled for completion in 1998.

A smaller storage ring, the Stanford Positron-Electron Asymmetric Ring (SPEAR) has its own smaller 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.

Scientists from all parts of the United States and from throughout the world participate in the experimental programs at SLAC.

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 as much as 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 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).

1.5 Site Water Usage

Use of water by SLAC is about equally divided between accelerator and equipment cooling, and domestic uses (such as landscape irrigation, sanitary sewer and drinking water). The average water consumption by SLAC for CY97 was 651,800 gallons per day. Since half of the water is necessary for machine cooling, 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 insensitive to 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 apparatuses.

Power-consuming devices are cooled directly 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 the heat is exchanged 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 portion of the tower water is ultimately evaporated into the atmosphere. Because of this constant evaporation during operation, the mineral content of the remaining water gradually increases and eventually must be discarded as "blowdown" water. SLAC discharged a total of 15,903,645 gallons of wastewater to the sanitary sewer system in 1997, an average of 43,572 gallons per day.

The 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 a separate 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.

1.6 Land Use

San Mateo County has the ultimate planning responsibility 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 will be 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. SLAC falls into the former category.

The purpose of the Stanford land endowment is to provide adequate land for facilities and space for the 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.

1.7 Demographics

The populated area around SLAC is a mix of office, school, university, condominiums, apartments, single family housing, and pasture. 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 most recent census (1990) 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

A population estimate 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

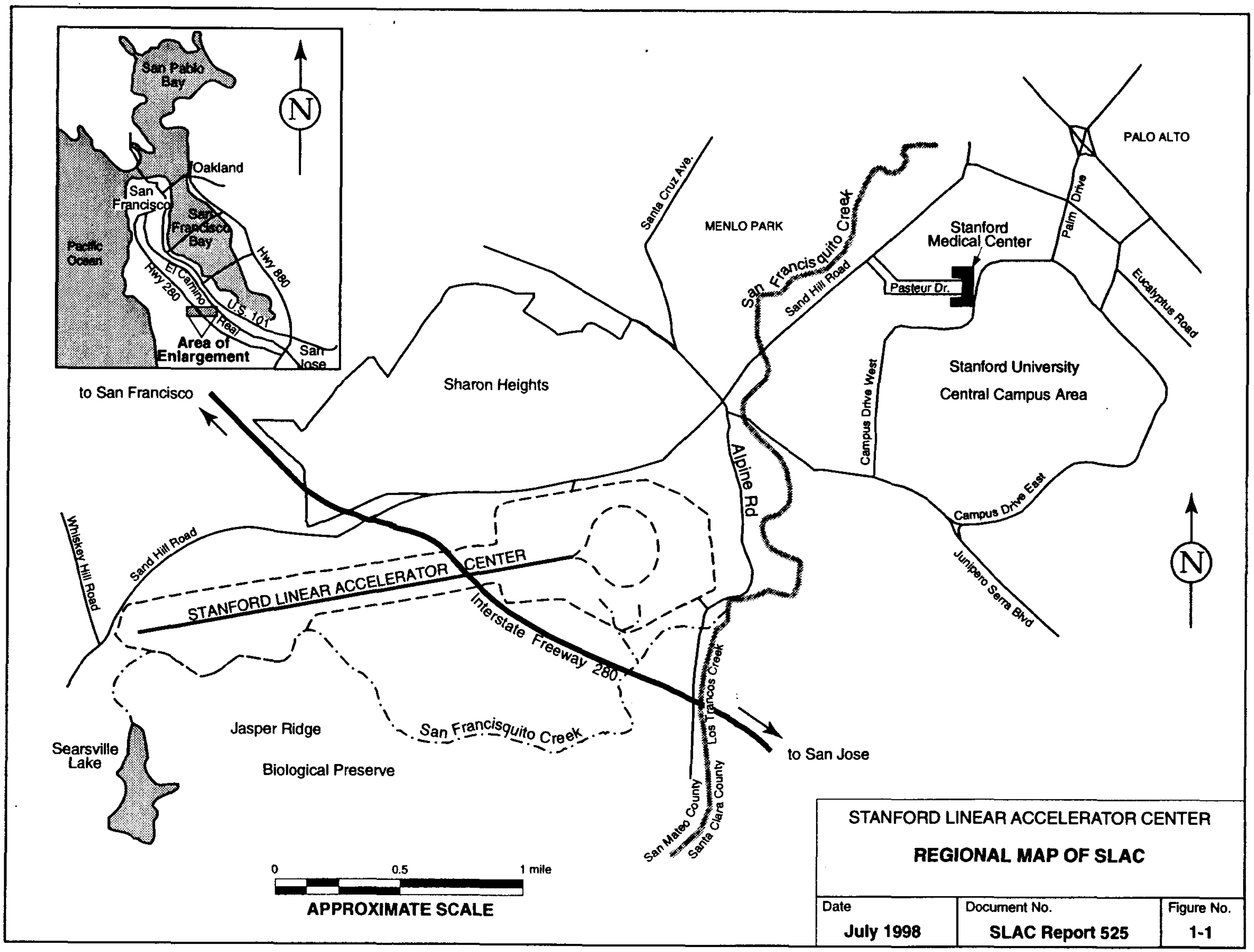

Figure 1-1. SLAC Site Location

Figure 1-2 Aerial View of SLAC Site

Figure 1-3 SLAC Research Yard and the Surrounding Community

2 Compliance Summary

This section of the *1997 Site Environmental Report* provides a summary of the Stanford Linear Accelerator Center's (SLAC's) compliance with environmental laws and regulations. Specific instances of noncompliance are discussed and descriptions of corrective actions are included. More detailed descriptions of environmental programs are presented in the environmental program information sections (see chapters 4, 5, and 6).

2.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

SLAC is not listed in the National Priorities List (NPL) as a Superfund site and is therefore not required to follow formal CERCLA procedures. SLAC does, however, follow general technical CERCLA guidance.

SLAC first began to develop a comprehensive Environmental Restoration Program (ERP) in CY91. The program delineates how SLAC will address environmental contamination problems from discovery and characterization through remediation and long-term monitoring or maintenance, if required. SLAC's restoration approach is as follows:

1. Identify sites with actual or potential contamination (involving soil, groundwater, surface water, and/or air).
2. Prioritize contaminated sites based on site complexity, nature of contamination, 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.

SLAC is currently at step 3 above. Investigative work this past year has proceeded for contaminated groundwater sites which are discussed in Section 7, Groundwater Protection.

SLAC personnel continued to be actively involved in various public participation activities throughout CY97. In particular, SLAC participated in the Comprehensive Resource Management and Planning (CRMP) process, a watershed management group for San Francisquito Creek.

SLAC personnel attended the monthly meetings of the Steering Committee and participated in various developing programs.

2.2 The Superfund Amendments and Reauthorization Act (SARA)

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

In CY97, SLAC submitted a Hazardous Materials 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 evaluation, containment, and cleanup capability. The site maps have not changed significantly since the last submittal in 1993.

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

Compliance for CY97 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.

Executive Order #12843 has committed SLAC to comply with the Toxic Release Inventory (TRI) reporting requirements under Section 313 of the EPCRA. SLAC, in accordance with DOE guidance, complied with EPCRA Section 313 in CY97.

2.3 Resource Conservation and Recovery Act (RCRA)

SLAC is a generator of hazardous waste, and as such is not permitted to treat hazardous waste or store it for longer than 90 days. The San Mateo County Department of Health Services (County) is the local agency responsible for inspecting generators of hazardous waste for compliance with Federal, state and local laws and regulations regarding hazardous waste.

The County conducted an annual site inspection in December 1996, with a follow-up inspection in March, 1997. The County inspection included hazardous materials, hazardous waste generation and accumulation areas and the site Hazardous Materials Business Plan (HMBP). In general, the inspection noted that routine waste management activities were performed well. Non-routine waste management activities, however, needed improvement.

A Hazardous Waste Generator Inspection was provided by the County to SLAC in March 1997, which required submittal of a certification of compliance by SLAC. The inspection report resulted in 41 corrective action tasks, such as the need to maintain adequate aisle space, and compliance with other container management requirements. SLAC prepared a response for areas inspected by the County and found to be non-compliant. Corrective actions were identified and implemented by SLAC, and the certificate of compliance was submitted to the County in April 1997.

SLAC successfully shipped all routinely generated hazardous waste for off-site disposal within 90 days of generation in CY97. As required under RCRA, all hazardous waste minimization certifications for disposal of hazardous waste were properly made. DOE/OAK performed semi-annual and monthly operational surveillances of the Centralized Waste Management Area and Radioactive Materials Storage Yard during CY97 and had no significant observations or findings.

In CY97, 198 employees completed four hours of on-site training covering general hazardous chemical and waste management, waste minimization and pollution prevention, stormwater protection, on-site transportation and spill emergency response. A one hour annual refresher training class based on ES&H Manual Chapter 16, "Spills", was provided for the Hazardous Waste and Material Coordinators (HWMCs) and Assistant Coordinators.

2.4 National Environmental Policy Act (NEPA)

SLAC formalized a NEPA program in CY92. Under this program, proposed project and action descriptions are reviewed to determine if NEPA documentation is required. If so, the proper paperwork is prepared and submitted. The project or action is entered in a database and tracked. In CY97, SLAC submitted 8 Categorical Exclusions (CXs) for General Plant Projects (GPPs), Accelerator Improvement Projects, and Capital Equipment Projects. All were approved by DOE/OAK.

2.5 Clean Air Act (CAA)

The Bay Area Air Quality Management District (BAAQMD) implements the CAA through a set of rules and regulations for operations or equipment that may cause air pollution. SLAC was inspected by BAAQMD and issued a violation notice for exceeding solvent usage. The notice was cleared the day it was issued (January 23, 1997) by increasing the permitted usage volume. The request to increase the permitted usage volume was approved by the BAAQMD on February 10,1997.

The National Emission Standards for Hazardous Air Pollutants (NESHAPS) program requires that facilities that release radionuclides into the air report those releases to the appropriate regional office of the Environmental Protection Agency (EPA). In accordance with this requirement, SLAC completed the Radionuclide Air Emissions Annual Report for CY97, which was provided to SLAC's DOE Operations Office in Oakland, CA (DOE/OAK) in June 1998. There were no instances of unplanned releases in 1997. In December of 1997, an informational meeting and tour was held between SLAC and Region IX of EPA regarding SLAC's NESHAPS Compliance Program.

2.6 Clean Water Act (CWA)

2.6.1 Groundwater Monitoring Program

In CY97, samples were collected from monitoring wells on a semi-annual basis and analyzed for a wide range of chemical constituents. As reported in previous Annual Site Environmental Reports (ASERs), results of the analyses indicated that water in several of the wells at four sites contained levels of chlorinated solvents at or above the State of California Maximum Contaminant Levels (MCL) for drinking water. The four sites identified are described in Section 6.1.

Tritium has historically been detected in two monitoring wells at SLAC. Although the tritium levels detected in water from EXW-4 have shown a decreasing trend since 1991. Tritium was also detected in groundwater from MW-30 in CY97. The tritium levels in both wells were less than one third the MCL, and are discussed in more detail in Section 5.4.

2.6.2 Surface Water

The Storm Water Pollution Prevention Plan (SWPPP), which includes the Best Management Practices (BMPs) and the Monitoring Plan, are being updated per the new permit effective July 1, 1997. The annual storm water report was submitted to the RWQCB on July 1, 1997.

2.6.3 Industrial Wastewater

SLAC received one new (WP 970401-HX) and two renewed Mandatory Wastewater Discharge Permits (WP 970401-F and WP 970401-P), effective April 1, 1997. These permits set discharge limits for the site's sanitary sewer until they expire on March 31, 2002. Data from CY97 indicated that SLAC's average discharge of wastewater to the sanitary sewer was 43,572 gallons per day.

As in previous years, SLAC discharged many batches of low conductivity water (LCW) to the sanitary sewer. All batches, as well as the cumulative total for the year, had contaminant levels that were within applicable radiological regulatory limits. The total number of gallons of LCW discharged to the sanitary sewer during CY97 was 298,977. The total amount of tritium discharged was 22.3 millicuries.

2.7 Safe Drinking Water Act (SDWA)

Drinking water and process water are supplied to SLAC by the City of Menlo Park from the Hetch Hetchy water system. There are no drinking-water wells at SLAC. The nearest drinking-water well to SLAC is 1,500 feet from the SLAC border.

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 Facilities Office.

2.8 Toxic Substances Control Act (TSCA)

The 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. In CY97 SLAC continued to reduce its inventory of PCBs by disposing of a significant portion of the remaining large and small PCB capacitors as well as other PCB-containing equipment. One transformer remains on inventory as a PCB transformer with greater than 500 parts per million (ppm) of PCB. This transformer is pending reclassification to non-PCB status. SLAC will continue to remove or retrofill and reclassify the remaining 14 PCB-contaminated transformers (containing 50 to 500 ppm of PCBs) over the next few years.

2.9 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA regulates pesticide use in the United States. The term "pesticide" refers to insecticides, rodenticides, and herbicides. SLAC uses licensed subcontractors to apply "registered use" pesticides. SLAC personnel apply "general use" pesticides only. In CY97, SLAC used pesticide and herbicide handling and storage procedures that were developed in CY94. These procedures were incorporated into the subcontracts for landscape maintenance and pest control, and have been implemented by the subcontractors.

2.10 Endangered Species Act (ESA)

Based on information provided by the California Department of Fish and Game and the U. S. Department of Fish and Wildlife, 14 animal species and 13 plant species occurring in San Mateo County are currently listed as endangered, threatened, proposed, or of concern. Of these, 3 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 runoff 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 2-1.

The red-legged frog was granted threatened status at the federal level in August 1997 and 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 sitings of red-legged frogs have been recorded on the SLAC leaseholding. Stanford University's Center for Conservation Biology routinely performs biological surveys on Stanford lands, but to date, no such surveys have been done at SLAC.

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 (CRMP) 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 leaseholders.

2.11 National Historic Preservation Act (NHPA)

There are no eligible NHPA sites at SLAC.

2.12 Executive Order 11988, "Floodplain Management"

According to the current Federal Emergency Management Agency (FEMA) floodplain maps for the area, a one-percent flood event, (known less accurately as a 100-year flood), would not reach the SLAC facility, but would be confined to the San Francisquito Creek channel south of the facility. The flooding of February 1998 qualified as a one-percent flood event, but SLAC was not impacted, thus corroborating this assertion.

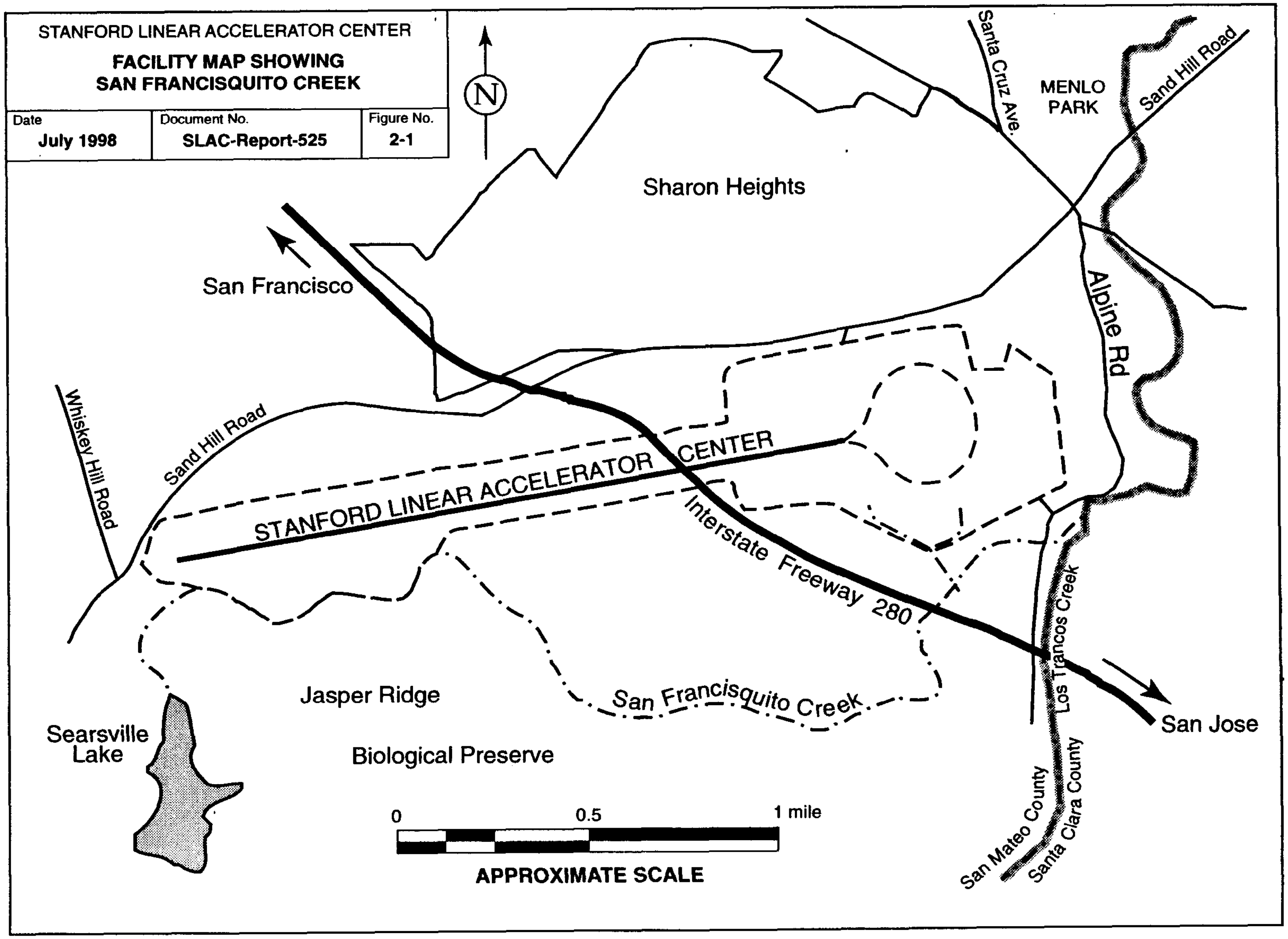

Figure 2-1 Facility Map Showing San Francisquito Creek

2.13 Executive Order 11990, "Protection of Wetlands"

As part of an environmental assessment conducted in CY91, 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 are generally absent.

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

Representatives from the COE, the RWQCB, and the Department of Fish and Game (DFG) were on site last year to observe the 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 in evaluating SLAC's Pre-Construction Notification. 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 on the site.

2.14 Tank Management

SLAC has no remaining underground storage tanks. Petroleum storage tanks with capacities over 1,000 gallons are regulated by the State Water Resources Control Board (SWRCB) under the Aboveground Petroleum Storage Act. SLAC currently has three diesel tanks and one mineral oil tank that are subject to this Act. The diesel tanks have capacities ranging from 2,000 to 10,000 gallons; the mineral oil tank has a 1,000 gallon capacity, for a site-wide total of 16,900 gallons, as reported in the biennial statement submitted to the SWRCB. The SPCC is available from EPR, and a copy has been transmitted to the RWQCB.

2.15 Releases to the Environment

2.15.1 Radiological

There were no reportable quantity (RQ) releases of radioactive material to the environment in CY97.

2.15.2 Non-Radiological

No wastewater discharge permit violations occurred during CY97. Nineteen accidental releases to the environment occurred in CY97. In four of these events, the released material entered a storm drain; these materials included untreated sewage (twice), activated water, and water containing mineral oil.

All four releases were determined to represent minimal or negligible risk. However, follow-up investigations into the two sewage releases indicated the need for corrective actions for the site-wide sanitary sewer system to prevent recurrence. These actions are now being developed for timely execution.

Notification to the RWQCB was required in three releases in CY97. Two releases were from the sanitary sewer to the storm drain, and 1 release was low conductivity water (LCW).

In the LCW release, potential radioactivity was the primary concern. However, radiological analysis indicated that the levels present in the water released were barely above background levels and two orders of magnitude below drinking water standards.

2.16 Assessments

- Quarterly conduct-of-operations audits of the Environmental Radiological Program were performed by the DOE.
- The California Department of Health Services, Radiation Health Branch conducts a site boundary radiation monitoring program. There were four Thermoluminescent Dosimeter (TLD) exchanges in 1997.

2.17 Summary of Permits

SLAC has a total of 31 permits:

- 1 California General Industrial Storm Water Permit.
- 1 Hazardous Waste Generator EPA ID No. CA8890016126.
- 2 Permit By Rule (PBR) permits.
- 3 Wastewater discharge permits.
- 25 Air pollution permits/listed sources.

The specific permits held by SLAC in CY97 were:

- West Bay Sanitary District and South Bayside System Authority
  Wastewater Discharge Permit No. WB970401-F
  Wastewater Discharge Permit No. WB970401-P
  Wastewater Discharge Permit No. WB970401-HX
  Expiration date: March 31, 2002
- Bay Area Air Quality Management District (BAAQMD)
  Plant No. 556, 24 listed sources (found in Table 4-1).
- Department of Toxic Substances Control
  Tiered Permit Fixed Treatment Units
  - Unit 1—Building 038, Treatment Facility (PBR)
  - Unit 2—Building 038, Sludge Dryer (PBR)
  - Unit 3—Building 460, Treatment Facility (Conditional Authorization)

SLAC has filed an Notice of Intent (NOI) to comply with the following permit:

- California Regional Water Quality Control Board
  San Francisco Bay Region
  SLAC Permit Identification Number: 2 41 S 002417
  California General Industrial Storm Water Permit
  Storm Water Permit No. WDR No. 97-03-DWQ

2.18 Other Major Environmental Issues

During CY97, SLAC's set of "Necessary and Sufficient ES&H Standards" had its name changed to "Work Smart Standards". This set of standards was incorporated into SLAC's Management and Operating (M&O) contract. The set includes all applicable statutory and regulatory requirements for public and worker safety and environmental protection. It also includes a number of industry standards that were found to be necessary to control specific hazards present at SLAC. One impact of this modification of SLAC's contract is that most DOE Orders that had previously been the basis for SLAC's ES&H program are no longer applicable.

Progress continued in CY97 toward completing the corrective actions developed in response to the 1991 Tiger Team assessment. All of the 51 environmental findings have been completed, as have all of the 57 related tasks. Seventeen of the 43 environmental findings have been validated, and 33 of the 53 related tasks have also been validated.

Other external appraisals resulted in the identification of 27 corrective action tasks, of which 24 have been completed. None of these corrective action tasks have been validated. Most of these tasks were primarily concerned with the adequacy of SLAC's documented plans and procedures. No significant threats to the environment were noted.

SLAC's Quality Assurance and Compliance organization completed seven environmental self-assessments. The assessments in 1997focused on water quality and hazardous waste management practices. No significant problems were identified in these areas. Of the 75 environmental findings made, 68 have been completed.

3 ES&H Organizational and Waste Minimization Information

This section of the *1997 Site Environmental Report* provides an overview of the Environment, Safety, and Health (ES&H) Division's organization, responsibilities, and waste minimization information. Further information about the ES&H Division is available on the world wide web (www) at:

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

3.1 ES&H Responsibilities

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

- Environmental Protection and Restoration (EPR)
- Operational Health Physics (OHP)
- Radiation Physics (RP)
- Safety, Health, and Assurance (SHA)
- Waste Management (WM)

The EPR Department oversees the majority of SLAC's environmental programs, including environmental restoration, waste minimization, air quality, storm water and industrial wastewater, polychlorinated biphenyls (PCBs), groundwater, and the National Environmental Policy Act (NEPA) reviews. The WM Department coordinates disposal of hazardous, radioactive, and mixed waste. The OHP Department oversees radiological monitoring and dosimetry at SLAC. The SHA Department oversees quality assurance for SLAC's environmental activities. The RP Department conducts beam checkouts of new experiments to ensure shielding adequacy for the protection of the workers and members of the general public.

3.2 Waste Minimization

3.2.1 Site-Wide Program Planning and Development

SLAC has been implementing its waste minimization program on schedule in accordance with established waste minimization plans. SLAC has two waste minimization plans, a waste reduction plan and a DOE plan. The waste reduction plan was prepared in October of 1995 to comply with California's Hazardous Waste Source Reduction and Management Review Act (Senate Bill 14) and is known as the SB-14 plan.

The SB-14 plan addresses the reduction of specific hazardous waste streams and was revised as of October 1995 in accordance with California regulations. The DOE plan is a site-wide plan to increase employee awareness on waste reduction measures for non-hazardous and low-level radioactive wastes as well as hazardous wastes. The DOE plan was prepared in May of 1997.

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 below.

In August 1997, SLAC initiated a Waste Minimization and Pollution Prevention Citizens Committee. The committee is composed of a representative from each division, including an ES&H Coordinator from the PEP II Division, and the ES&H Waste Minimization and Pollution Prevention Coordinator. The committee is currently reviewing waste streams and identifying pollution prevention opportunities.

3.2.2 Employee Awareness/Training Measures

Revised on-site training programs were developed in CY97 and presented to employees in CY97. Personnel were instructed 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.

The following specific training was accomplished during CY97:

1. For personnel who handled hazardous chemicals and waste and/or have responsibilities for potential discharges to the stormwater system as part of their job:
    - Provided, once a month, a four-hour class, "Introduction to Pollution Prevention and Hazardous Waste and Materials Management". In CY97, 198 SLAC employees completed this course.
    - Distributed the SLAC *Hazardous Materials Management Handbook*. to all personnel who completed the training. Revisions to the handbook began in CY97. Over 500 revised copies will be distributed in CY98.
2. Provided a one-hour refresher training on spills and spill response to SLAC Hazardous Waste Material Coordinators (HWMCs). The course was based on the ES&H Manual Chapter 16, *"Spills"*.

3.2.3 Waste Minimization and Pollution Prevention Activities/Implementation

A number of projects were in progress to promote waste minimization and pollution prevention, usually to focus on actual or potential generation of major waste streams.

3.2.3.1 Alternatives to Ozone Depleting Substances

To address the replacement of Ozone Depleting Substances (ODSs), SLAC had set up an inter-departmental committee to address the replacement of ODSs in vapor degreasing operations used for special cleaning needs in SLAC's high-energy physics equipment. Of particular concern is equipment used in ultrahigh vacuum service and in high-voltage, high-power applications. Three alternatives to ODSs were identified and are currently implemented or in the implementation stage.

One alternative is the replacement of an existing vapor-degreaser system that uses 1,1,1-trichloroethane with an advanced vapor degreaser system. The closed-system vapor degreaser may use an alternative solvent (non-ozone depleting) such as perchloroethlyene. The near-zero emissions vapor-degreaser system has been procured and is expected to be fully operational in CY98 after installation and parallel testing with the existing vapor degreasing system. Air emissions notification and operational procedures are being prepared to meet NESHAPS requirements.

While perchloroethylene has an increased health hazard over trichloroethane, the use of perchloroethylene in the advanced vapor degreaser is expected to be safe and not increase the threat of worker exposure. Because of the stringent and diverse cleaning needs for ultrahigh vacuum applications and the need for the high degree of reliability in the cleaning operations, the closed-system vapor degreaser was selected as an alternative over other cleaning options, such as aqueous-phase cleaning.

A second alternative that has been implemented is a petroleum-based combustible (low-vapor pressure) solvent. This solvent is used to meet high level cleaning requirements of vacuum system cold traps used by the Stanford Synchrotron Radiation Laboratory (SSRL) and for cleaning applications associated with machining operations in the Mechanical Fabrication Department. This alternative has been operating successfully to date.

The third alternative has been implemented by the Klystron Microwave/Test Laboratory for critical cleaning applications associated with klystron tubes. This alternative employs a spray-on, citrus-based solvent, followed by a steam-detergent cleaning and a deionized water rinse. To date, this alternative has also been operating successfully.

3.2.3.2 Waste Reductions in Metal Finishing Operations

The SLAC Mechanical Fabrication Department (MFD) performs metal finishing operations to fabricate parts and equipment used in high-energy physics experiments. MFD has made headway in implementing three DOE-funded waste reduction projects. One project involves the recovery of acids used in etching operations. Equipment for this project has been installed and is being put into operation. This project is expected to reduce spent acids from these operations.

Reduction in acid and alkaline wastes will also be implemented by treatment in the existing RWTP. During CY97, SLAC applied for and obtained permits to reduce acid and alkaline wastes from metal finishing and heat exchanger cleaning operations. Treatment will allow SLAC additional capability to reduce hazardous waste from the site.

A second project involves reuse of deionized water used in metal finishing operations. This project reduces chemical usage and hazardous wastes generated from the rinsewater treatment facility. This project is planned for operation in 1998. The third project involves reduction of spent plating-bath filters. This project has been implemented and will show waste reductions in 1998.

3.2.3.3 Storm Water Pollution Prevention

The SLAC Plant Engineering Department has made progress in reducing pollution associated with collection and disposal of storm water around the site. This DOE-funded project involved identifying potential sources of storm water pollution and developing a mobile processing unit to treat the storm water in secondary containments and vaults for recycling or discharge to the sanitary sewer. The unit reduces the cost of off-site water treatment and disposal. Thus far, the system has adequately treated thousands of gallons of rain water in secondary containments, allowing re-use or discharge of the water to the sanitary sewer.

3.2.3.4 Reuse of Concrete Blocks

The PEP II Division reused a number of nonradioactive concrete blocks (magnet support blocks that were used in the old PEP facility). The blocks were diverted from landfill disposal by identifying potential reuses for both in-house and outside-user projects. SLAC is currently seeking potential re-use of a new batch of concrete blocks currently in storage.

3.2.4 Waste Minimization Reporting

SLAC's Waste Minimization Coordinator continues to attend bimonthly meetings on waste minimization and pollution prevention along with Waste Minimization Coordinators from other DOE facilities and DOE/OAK.

The Waste Minimization Coordinators have been working with representatives of DOE Headquarters (Office of Energy Research) and DOE/OAK (Office of Environmental Restoration and Waste Management) to promote the implementation of waste minimization and pollution prevention in accordance with DOE Order 5400.1 and Secretary of Energy Notice SEN 37-92.

Also in accordance with DOE requirements, SLAC will be preparing an annual waste reduction report for CY97 as summary data and reporting guidelines become available.

3.2.5 Trends in Nonhazardous Waste Reduction

The quantities of non-hazardous waste and the materials recycled or diverted from landfills from 1990 to 1997 are summarized in Table 4-1. Material recycled or diverted is shown with and without scrap metal recycling to show the contribution of scrap metals. In 1990, SLAC achieved 10 percent diversion of nonhazardous waste without scrap metal and 25 percent diversion with scrap metal. In 1997, SLAC increased to 31 percent diversion without scrap metal and 50 percent diversion with scrap metal.

In general, SLAC sends an average of 650 tons per year of nonhazardous waste to landfills. The higher disposal quantity in 1991 was the result of a concerted facility-wide cleanup. Of the 650 tons of nonhazardous waste typically generated, most of the waste consists of bathroom paper towels, food wastes, and paper and cardboard products.

Non-hazardous waste diversion in 1995 was different from most other years because of a one-time event in which 1000 tons of concrete were diverted from landfills so that 65 and 73 percent diversion was achieved with and without scrap metal, respectively.

Although SLAC's recycling activity has been effective over the years, it is not without cost. Additional efforts have been implemented in CY97 to test recycling measures that will reduce collection costs and capture some of the recyclable materials not captured in the existing program. A new pilot recycling project is in progress to test the feasibility of a new, lower-cost collection system.

3.2.6 Trends in Hazardous Waste Reduction

Table 4-2 shows the trends in the generation of hazardous waste for three major categories: operational, Toxic Substances Control Act (TSCA), and remediation-related hazardous waste. Operational hazardous wastes from SLAC routine operations and maintenance activities are directly applicable to the site's mission.

TSCA wastes result from removal of old electrical equipment (polychlorinated biphenyls [PCB]-containing equipment) and construction practices (asbestos-containing materials). These wastes result from the phasing out of these materials from use in SLAC operations. Remedial wastes are the result of past practices or accidental spills. TSCA and remediation wastes are 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.

SLAC has reduced operational hazardous waste since 1990 through a combination of programmatic measures, increased employee awareness and reduced equipment fabrication and construction activity. As of CY97, SLAC has reduced its hazardous waste by 57 percent relative to 1993 and by 77 percent relative to 1990.

SLAC will continue to strive for operational hazardous waste reductions based on trends in operation and maintenance activities of earlier years. Some increases in hazardous waste generation may be expected from new project activities and new maintenance projects. SLAC is expecting to continue its success in reducing hazardous waste generation.

3.2.7 Low-Level Radioactive Waste Reduction

The quantities of low-level radioactive wastes are the accumulation of waste generated over years of operation. SLAC's current inventory of low-level radioactive wastes is estimated at 85 cubic meters, excluding scrap metal that is planned for reuse.

Some of the metals may be returned to the environment for reuse because radioactive levels are very low and are candidates for regulatory exemption. This waste reduction approach is being further investigated, and is still in progress.

Table 3-1 Summary of Non-Hazardous Waste (NHW) Municipal Waste[a] Disposal & Recycling 1990 to 1997[b]

Calendar Year	NHW Disposed	Recycled Paper & Corrugated Cardboard	Redeemable Glass, Plastic, & Aluminum Containers	Diverted Garden & Wood Waste	Recycled Construction Materials	Recycled Scrap Metals	Total	Percent Material Recycled (Without Scrap Metal)	Percent Material Recycled (With Scrap Metal)
1990	541	61	2	0	0	113	717	10%	25%
1991	1,014	216	2	0	0	227	1,459	18%	31%
1992	654	233	5	104	0	66	1,062	34%	38%
1993	651	64	5	104	0	830	1,654	21%	61%
1994	800	184	6	87	0	400	1,477	26%	46%
1995	639	69	3	100	1,000	587	2,399	65%	73%
1996	711	95	6	146	0	444	1,403	26%	49%
1997	693	85	6	217	0	374	1,375	31$	50%

[a] Excludes wastewater discharged to the sanitary sewer.
[b] Quantities given are in tons.

Table 3-2 Summary of All Hazardous Waste[a] (HW) 1990 to 1997

Calendar Year	Operational HW (Routine)	Operational HW (Non-Routine)	TSCA Waste	Remediation Waste	Percent Material Operational HW Reduction (1993 Baseline)
1990	340	—	317	74	—
1991	411	—	327	679	—
1992	160	—	126	17	—
1993	147	—	227	151	0
1994	152	—	47	914	-3
1995	118	—	70	1,004	19
1996	85	—	39	20	42
1997	63	14	42	550	57

[a] Quantities given are in tons.

4 Environmental Non-Radiological Program Information

This section of the *1997 Site Environmental Report* provides an overview of the Stanford Linear Accelerator Center's (SLAC's) environmental activities performed in order to comply with laws and regulations, to enhance environmental quality, and to improve understanding of the effects of environmental pollutants from site operations.

4.1 Clean Air Act (CAA)

Federal air pollution regulations require states to conduct certain activities and to institute specific controls in support of the CAA. The states, in turn, delegate portions of their power and authority to local or regional agencies. Each of these agencies must adopt and enforce rules and regulations necessary to achieve and maintain both the Federal National Ambient Air Quality Standards and the State Ambient Air Quality Standards. The local agency regulating non-radiological stationary air pollution sources at SLAC is the Bay Area Air Quality Management District (BAAQMD).

Non-radiological air emissions at SLAC are primarily Volatile Organic Compounds (VOCs) from solvent cleaning and surface coating operations; nitrogen oxides (NO_X) from industrial boilers, and particulates (PM10[1]) from metal and wood-working activities in the various shops. SLAC currently has 25 air pollution sources (twelve permitted sources and thirteen exempt) listed with the BAAQMD. These sources and their CY97 emissions are identified in Table 4-1.

As required by the BAAQMD, SLAC maintains records for solvent usage for permitted solvent sources. Permit conditions may limit the amount of solvent which can be used at an individual source on an annual basis. Records for individual sources are compared to permit limits to ensure that the limits have not been exceeded.

As of December 1997, NESHAPS (40 CFR 63.460) Subpart T, National Emission Standards for Halogenated Solvent Cleaning, regulated operations that use hazardous air pollutants (HAPs). SLAC operates two degreasers that fall under this regulation. Regulatory reports are submitted directly to EPA until this program is delegated to the State of California and the BAAQMD.

[1] PM10 = Particulate matter less than 10 microns

Table 4-1 BAAQMD Permits and Emissions Annual Average (lbs/day)

S#	Source Description	Particulates	Organics	NO_X[a]	SO_2[b]	CO[c]
4	Degreaser	—	16	—	—	—
5	Spray-booth	—	3	—	—	—
10	Woodworking operations (exempt)	—	—	—	—	—
11	Metal cutting operations (exempt)	—	—	—	—	—
13	Metal grinding operations (exempt)	—	—	—	—	—
14	Sandblast booth (exempt)	—	—	—	—	—
16	Sandblast booth (exempt)	—	—	—	—	—
17	Metal and epoxy glass grinding (exempt)	—	—	—	—	—
21	Anodizing, pickling and bright dip operations	—	—	—	—	—
26	Cold cleaner	—	—	—	—	—
30	Sludge dryer	—	—	—	—	—
32	Cold cleaner	—	—	—	—	—
34	Cold cleaner	—	—	—	—	—
36	Wipe cleaning	—	12	—	—	—
37	Cold cleaner	—	9	—	—	—
42	Diesel Storage Tank P-3 (exempt)	—	—	—	—	—
43	Diesel Storage Tank P-4 (exempt)	—	—	—	—	—
44	Diesel Storage Tank P-5 (exempt)	—	—	—	—	—
45	Diesel Storage Tank P-6 (exempt)	—	—	—	—	—
46	Aerosol Paint Booth (exempt)	—	—	—	—	—
49	Cyanide Room Scrubber (exempt)	—	—	—	—	—
51	Small parts blasting booth (exempt)	—	—	—	—	—
52	Boiler	—	1	16	—	4
53	Boiler	—	1	15	—	4
54	NZE Degreaser	—	TBD[d]	—	—	—

[a] Nitrogen Oxides
[b] Sulfur Dioxide
[c] Carbon Monoxide
[d] To Be Determined

SLAC is required to comply with the reporting requirements of the Toxic Release Inventory (TRI). This report summarizes the uses and releases during CY97 of certain chemicals such as sulfuric acid and 1,1,1-trichloroethane (TCA). Information sources such as purchases of certain chemicals, usage records, and the annual chemical inventory were used to determine which chemicals exceeded the reporting thresholds.

If the usage any of these specific chemicals exceeds the reporting thresholds, a Form R report must be submitted. In CY97, SLAC did not exceed the 10,000 pounds threshold for these chemicals; therefore, no report was required.

4.2 Clean Water Act (CWA)

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 (NPDES), which regulates discharges of wastewater from point sources such as Publicly Owned Treatment Works (POTWs) and categorically regulated industrial facilities such as electroplating shops. In 1987, the CWA was amended again to include non-point source discharges such as storm water runoff from industrial, municipal, and construction activities. The CWA is the primary driver behind SLAC's water compliance programs.

4.2.1 Groundwater Monitoring Program

The restoration program at SLAC manages a groundwater monitoring program that includes planning, integration, and coordination of all supporting activities. Completed documents include:

- *Site Characterization and Evaluation of Remedial Alternatives Workplans and Progress Reports.*
- *Sampling and Analysis Plan* (comprised of the *Quality Assurance Project Plan.* and the *Field Sampling Plan.*), and associated *Standard Operating Procedures*, and

SLAC has a groundwater monitoring network comprised of 21 wells. These wells were constructed in areas of the facility that historically and/or currently store, handle, or use chemicals that may pose a threat to groundwater quality. As reported in previous ASERS, results of the analyses indicated that water in several of the wells at four sites contained levels of chlorinated solvents at or above the State of California Maximum Contaminant Levels (MCLs) for drinking water. The four sites identified are described in Section 6.

Relatively high total dissolved solids (TDS) values and low yields indicate that SLAC's groundwater is not suitable for drinking water. In CY97, samples were collected from the wells on a semi-annual basis and analyzed for a wide range of chemical constituents. Further definition of the extent of contamination is being performed during the site-wide investigations that began in CY97 and will continue through the year 2000.

4.2.2 Surface Water

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

The goal of the General Permit was to reduce pollution in the waters of the state. This was achieved by regulating the amounts of pollutants in industrial storm waters discharged to waters of the state.

During CY97, SLAC made progress in completing the following items:

- Training:
  - Incorporated BMPs into training.
  - Added a two-hour segment to existing Hazardous Materials training.
- Funding:
  - Significant progress was made on eliminating or redirecting improper drain connections (illicit connections) that may discharge to the storm drain system. Approximately $150K was spent toward the elimination of illicit connections.
  - Identified and prioritized 17 erosion control locations. EPR and the Facilities Department (FAC) are reviewing new operationally-driven projects. The El Ninò storms have increased the number of projects required to maintain the facility.
- Integration with Facilities Department (FAC) resulted in:
  - Tracking of erosion and sediment control projects
  - Inspection, clean-out, and maintenance of catch basins
  - Improved protection to catch basins with strawbales
- Met with RWQCB on a regular basis with positive results.
- Utilized stormwater autosamplers at IR 6, IR 8, Main Gate, and North Adit.
- Incorporated environmental protection clauses for both water and air in contracts with subcontractors.
- Began SWPPP revision.
- Completed the storm drain clean-out project in the fall of 1997.
- Placed BMPs on the internet. The website address is:

http://www.slac.stanford.edu/esh/reference/Stormwater/stormwaterBMP.html

The areas that have been identified as needing further improvement include housekeeping and erosion control.

4.2.3 Stormwater Monitoring Program

SLAC's storm water monitoring program consists of:

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

During the 1996/1997 wet season (October-May), SLAC analyzed storm water run-off samples for pH, electrical conductivity, total petroleum hydrocarbons (TPH) as diesel and motor oil, polychlorinated biphenyls (PCBs), pesticides, general minerals, heavy metals, and radioactivity.

There are no enforceable limits, but rather numerical objectives which apply to the data collected for this program based on the RWQCB Basin Plan. The data are used as a general reference for determining whether SLAC appears to be generating storm water pollutants and whether implementation of BMPs have been effective. The four locations are shown in Figure 4-1.

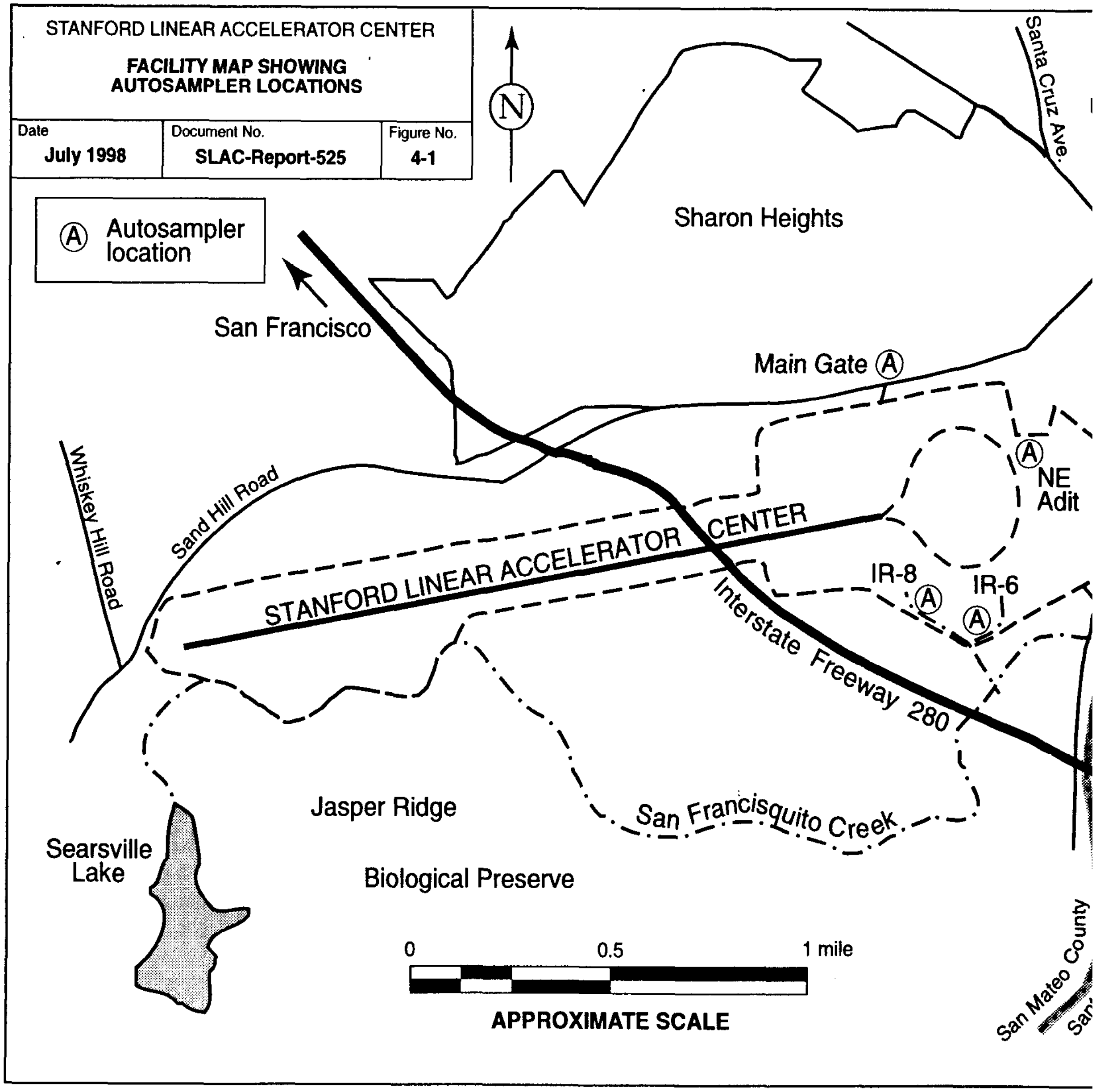

Figure 4-1 SLAC Autosampler Locations

The autosamplers were employed for sampling and proved to be a useful asset. The four locations are identified as:

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

The Main Gate and Northeast Adit watersheds are not, by definition, Industrial Activities areas, unlike the areas discharging at IR-6 and IR-8. IR-6 receives storm water contributions from the Research Yard, which includes SSRL and the PEP ring. IR-8, which also discharges south of SLAC, collects water from the campus, fabrication, and Master Substation areas of the facility.

The El Nino weather pattern brought unusually heavy rains in the 1997/1998 wet season (over 200% of normal). This excessive rainfall resulted in increased erosion and slumping of hillsides. Heavy flows of rain mobilized sediment and increased groundwater flows. Strawbales were used extensively to minimize sediment transport into catch basins.

As of July 1, 1998, eight of the original 17 projects identified last year have been completed, along with two projects identified after the original list was generated. These projects range from placing riprap in an unlined channel to cleaning out the storm-drain lines in the Research Yard, both of which are complete. The other projects are either in progress, awaiting regulatory approval or under the jurisdiction of another entity, such as Caltrans or the Stanford Management Company.

Natural drainages traverse the SLAC facility at two points; Sector 14 and Sector 18. Erosion and sediment control projects have been proposed for both drainages. SLAC obtained approval in a timely manner from the Department of Fish and Game (DFG), the Army Corps of Engineers (COE), and the U.S. Fish and Wildlife Service to perform erosion control measures at Sector 18. The RWQCB issued a water-quality certification waiver six months after the revised application was submitted. RWQCB approval for Sector 14 is still pending.

4.2.3.1 Metals

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

- Zinc
- Copper
- Molybdenum
- Lead

Some metals may be due to vehicle emissions such as:

- Motor oil.
- Coolant drippings.
- Brake linings.
- Tire fines.

4.2.3.2 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 appeared elevated at IR-6, which carries significant flow off-site, possibly from erosion in the Research Yard. The storm drain cleanout of August, 1997 may have contributed to the higher TSS values.

4.2.3.3 TPH as Diesel

All of SLAC's regular sampling stations receive run-off from paved areas such as roads and parking lots. No TPH was detected in this season's samples, possibly because of the excessive rainfall.

4.2.3.4 PCBs

PCBs were found at IR-6 at levels of 1.10 and 0.054 mg/l for the December 1997 sampling events, respectively. The source of these PCBs may be residuals contained in fine materials in the storm drain system. No PCBs were detected in November 1997. The storm drain lines were cleaned out in August, 1997. The 1.1 ppm anomaly was associated with sampling and analytical problems.

PCBs continue to be detected in samples from IR-6. The dislodging of residual material by the increased rainfall may have further flushed through the system. This area continues to be monitored. No PCBs were detected in samples taken at IR-8, or at the other sampling locations.

4.2.4 Industrial and Sanitary Wastewater

SLAC's industrial and sanitary wastewaters are treated by the South Bayside System Authority (SBSA) in Redwood City, California before being discharged to San Francisco Bay. SLAC has three wastewater discharge permits:

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

SLAC discharged a total of 15,903,645 gallons of wastewater to the sanitary sewer system in 1997, an average of 43,572 gallons per day. Permit requirements include:

1. Semi-annual sampling for heavy metals, Total Toxic Organics (TTO), and pH at the RWTP.
2. Semi-annual sampling for cyanide at the Plating Shop cyanide treatment tank.
3. Semi-annual sampling for 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 heavy metals and pH at the Sand Hill Road Flow Meter Station (FMS).

In CY97, SLAC's Sanitary Wastewater Monitoring Program consisted of:

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

SLAC conducted metal finishing operations in an on-site electro-plating shop during CY97. Rinsewater baths from the plating shop were processed through the RWTP prior to being discharged to the sanitary sewer. The RWTP discharged 2.23 million gallons of effluent to the sanitary sewer in CY97. Effluent from the RWTP met required federal metal finishing pre-treatment standards, which are specified in the permit.

As required by the federal standards, the SBSA periodically monitored the metal finishing discharges, as well as the effluent from a cyanide treatment tank in the Plating Shop. SLAC and SBSA collected "split" samples from the RWTP and cyanide tank for quality assurance purposes. SBSA and SLAC's analytical results for CY97 are presented in Table 4-2.

4.2.4.2 Total Facility Discharge (Permit: No. WB 970401-F)

This wastewater discharge permit covers SLAC's total[2] contribution to the sanitary sewer, including the combined flow from the RWTP and all other wastewater discharges on site.

SBSA monitors the discharge quarterly to assure compliance with the permit. SLAC collects "split" samples during these monitoring events and analyzes them to compare results with SBSA for quality assurance purposes. All analytical results from samples collected in CY97 are presented in Tables 4-3 and 4-4.

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

The BTP is permitted to treat effluent from the heat exchanger descaling operation prior to discharge to the sanitary sewer. It collects 4,000 gallon batches which are then treated for metals and pH. The BTP discharged approximately 4,000 gallons of effluent to the sanitary sewer in CY97.

[2] A small portion of SLAC's domestic wastewater is carried off-site via the sanitary sewer on the south side of the facility. The amount of wastewater is considered by the POTW to be trivial, and is not routinely monitored.

Table 4-2 CY97 Analytical Results for Split Samples of Metal Finishing Effluent From the RWTP

	SAMPLE DATES												
		1/3/97		2/3/97		7/31/97		10/28/97		1/7/97		10/1/97	
	Permit Discharge Limits[a]	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA
Cadmium (mg/l)	0.69	nd[b]	<0.007	0.028	<0.007	nd[b]	<0.007	nd[b]	<0.007	na[c]	na[c]	na[c]	na[c]
Chromium(mg/l)	2.77	0.0270	0.028	0.079	0.08	0.06	0.07	0.077	0.228	na[c]	na[c]	na[c]	na[c]
Copper(mg/l)	3.38	0.0870	0.040	0.022	0.04	0.08	0.09	0.17	0.180	na[c]	na[c]	na[c]	na[c]
Lead(mg/l)	.69	nd[b]	<0.05	0.0023	0.06	nd[b]	<0.05	0.0021	<0.05	na[c]	na[c]	na[c]	na[c]
Nickel(mg/l)	3.98	nd[b]	0.07	0.036	0.03	<0.061	<0.03	0.0016	0.04	na[c]	na[c]	na[c]	na[c]
Silver(mg/l)	.43	0.0180	0.37	0.001	0.004	0.0083	<0.009	0.018	0.049	na[c]	na[c]	na[c]	na[c]
Zinc(mg/l)	2.61	0.0270	0.031	nd[b]	0.01	nd[b]	0.024	nd[b]	0.016	na[c]	na[c]	na[c]	na[c]
pH	6.0—12.5	na[c]	7.4	na[c]	8.8	na[c]	8.4	na[c]	8.2	na[c]	na[c]	na[c]	na[c]
Cyanide (mg/l)	1.2	nd[b]	<0.01	nd[b]	0.01[d]	na[c]	<0.01	na[c]	0.022	na[c]	na[c]	na[c]	na[c]
Toxic Organics (mg/l)	2.13	na[c]	na[c]	0.011	0.0118	na[c]	na[c]	na[c]	na[c]	0.1480	0.1480	0.072	0.0622

[a] Federal daily maxima.
[b] Not detectable for that parameter.
[c] Not analyzed for that parameter.
[d] Cyanide sample taken on 2/4/97

Table 4-3 SBSA Split Sample Results of Sanitary Sewer Discharges from Sand Hill Road Flow Meter Station

		Sample Dates							
		2/5/97				5/12/97			
	Permit Discharge Limits[a] (lb/day)	SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Calculated Results[b] (lb/day)	SBSA Calculated Results[b] (lb/day)	SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Calculated Results[b] (lb/day)	SBSA Calculated Results[b] (lb/day)
Cadmium	0.036	nd[c]	<0.0070	NA[d]	<0.0022	nd[c]	0.0610	NA[d]	0.0193
Chromium	0.48	nd[c]	<0.0200	NA[d]	<0.0062	0.0043	<0.0200	0.0014	<0.0063
Copper	0.35	0.1200	0.1200	0.0374	0.0374	.01300	0.1300	0.0041	0.0412
Lead	0.33	0.0150	<0.0500	0.0047	<0.0156	0.0094	<0.0500	0.0030	<0.0159
Nickel	0.064	0.0076	<0.0300	0.0024	<0.0093	nd[c]	0.0500	nd[c]	0.0159
Silver	0.076	0.0016	0.0100	0.0005	0.0031	0.0037	0.0070	0.0012	0.0022
Zinc	0.7	0.1700	0.1920	0.0529	0.0598	0.3100	0.3780	0.0983	0.1198
Flow (gpd)	62,175	37,327	37,327	NA[d]	NA[d]	38,013	38,013	NA[d]	NA[d]
pH	6.0—12.5	na[e]	7.8	NA[d]	NA[d]	na[e]	8.00	NA[d]	NA[d]

[a] SBSA Annual Average Limits.
[b] Calculated results (lb/day) = metal concentration (mg/l) x flow rate (gal/day) x 8.34 lb/gal x 10^{-6} l/mg.
[c] Not detectable for that parameter.
[d] Not Applicable
[e] Not analyzed for that parameter.

Table 4-4 SLAC Split Sample Results of Sanitary Sewer Discharges from Sand Hill Road Flow Meter Station

		Sample Dates							
		8/28/97				11/26/97			
	Permit Discharge Limits[a] (lb/day)	SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Calculated Results[b] (lb/day)	SBSA Calculated Results[b] (lb/day)	SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Calculated Results[b] (lb/day)	SBSA Calculated Results[b] (lb/day)
Cadmium	0.036	nd[c]	<0.0070	NA[d]	<0.0024	0.0035	<0.0070	0.0025	<0.0036
Chromium	0.48	0.0047	<0.0200	0.0016	<0.0067	0.0070	<0.0200	0.0050	<0.0104
Copper	0.35	0.1000	0.1400	0.0337	0.0472	0.0960	0.1400	0.0674	0.0726
Lead	0.33	0.0074	<0.0500	0.0025	<0.0169	0.0065	<0.0500	0.0046	<0.0259
Nickel	0.064	0.0078	0.0300	0.0026	0.0101	0.0960	0.1100	0.0674	0.0570
Silver	0.076	0.0013	0.0030	0.0004	0.0010	0.0029	0.0030	0.0020	0.0016
Zinc	0.7	0.2600	0.2050	0.0877	0.0691	0.1000	0.1430	0.0702	0.0742
Flow (gpd)	62,175	NA[d]	40,441	NA[d]	NA[d]	84,161	62,175	NA[d]	NA[d]
pH	6.0—12.5	6.96	8.20	NA[d]	NA[d]	na[e]	8.2	NA[d]	NA[d]

[a] SBSA Annual Average Limits.
[b] Calculated results (lb/day) = metal concentration (mg/l) x flow rate (gal/day) x 8.34 lb/gal x 10^{-6} l/mg.
[c] Not detected for that parameter.
[d] Not Applicable
[e] Not analyzed for that parameter.

4.3 Resource Conservation and Recovery Act (RCRA)

The RCRA of 1976 provides "cradle-to-grave" authority to regulate hazardous wastes from their generation to their ultimate disposal. This is accomplished through a system of recordkeeping, permitting, monitoring, and reporting.

Management of hazardous waste at SLAC is performed by the Hazardous Waste Management Group of the Waste Management (WM) Department. SLAC is a generator of hazardous waste, and is not permitted to treat hazardous waste or store it for longer than 90 days. The San Mateo County Department of Health Services (County) is the agency responsible for inspecting SLAC as a generator of hazardous waste for compliance with Federal, state, and local hazardous waste laws and regulations.

The U.S. DOE Oakland Operations Office, (DOE/OAK) coordinates with the State of California Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC) on issues pertaining to radioactive and hazardous waste.

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

Hazardous waste generated from operations throughout the site is accumulated in Waste Accumulation Areas (WAAs). Each WAA is managed by a Hazardous Materials and Waste Coordinator (HWMC), who is provided training and written guidelines on proper management of WAAs. Training includes spill response preparedness, waste minimization, SLAC's waste-tracking system, and required "refresher" generator training.

SLAC has the potential to generate radioactive hazardous waste non-routinely. Waste that has been activated with accelerator-induced radioactivity (which is all that is found at SLAC), is considered to be hazardous, but, by regulation, is not defined as mixed. The type of waste generated at SLAC is sometimes referred to as "combined waste" by the state of California, indicating that the waste contains both accelerator-induced radioactivity and a state or federal hazardous component.

Historically, SLAC has generated small quantities of activated liquids used for experiments and cleaning of accelerator machine parts. Other machine parts and materials used in support of the machine that have the potential to become activated include brass fittings containing lead levels above the regulatory threshold, spent lead-acid batteries in emergency lighting systems, and cooling-line cleaning solutions.

The generation of combined waste at SLAC, as noted above, occurs on a non-routine basis. SLAC and the DOE are continuing to assess treatment and disposal options for waste streams in this category as well as opportunities for minimizing waste generation.

4.4 Toxic Substances Control Act (TSCA)

SLAC has some equipment filled with oil or other dielectric fluids which contain PCBs. 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 CY97.

SLAC continued to reduce its inventory of PCBs in CY97. This was achieved through the disposal or reclassification of transformers, as well as other PCB-containing equipment. Notable in CY97 was the draining of the PCB-contaminated 60/12-kV backup transformer (140 ppm of PCBs; 3,210 gallons) in the Master Substation during the first phase of a major upgrade to this area. This unit has been removed from its pad and is scheduled to be salvaged. A similar transformer was relocated together with this unit, but was not drained, as it contains no PCBs.

There are 14 TSCA transformers currently inventoried at SLAC, as compared to 33 in CY96. The last PCB transformer (>500 ppm) remaining at SLAC has been drained and retrofilled with non-PCB oil, and will be reclassified in CY98, leaving 13 PCB-contaminated (50-500 ppm) transformers. SLAC will continue to remove (or retrofill and reclassify) PCB-contaminated units over the next few years.

Other activities and actions completed or initiated at SLAC in CY97 included:

- Prepared 1996 PCB Annual Document Log, per TSCA.
- Completed PCB Transformer Quarterly Inspection Reports, per TSCA.
- Updated and validated the PCB/TSCA transformer and capacitor inventories.
- Completed procedures for management of oil-filled equipment.

4.5 The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) "Superfund"

4.5.1 Environmental Restoration

SLAC follows general CERCLA technical guidance in investigating and remediating soil and groundwater contamination. SLAC is not, however, listed in the National Priorities List (NPL) as a Superfund site and is not required to follow formal CERCLA procedures. The California Regional Water Quality Control Board (RWQCB) provides oversight and approval of restoration activities at SLAC.

In calendar year 1997 (CY97), SLAC's Environmental Restoration Program (ERP), following the general CERCLA guidance, continued investigation for site characterization and evaluation of remedial alternatives. Section 6.0 describes this work.

Four groundwater sites have been identified and are being monitored. One of these sites is monitored on a semi-annual basis under state RWQCB Waste Discharge Order No. 85-88.

In CY91, the first phase of an investigation was performed in two unlined drainage ditches located between IR-6 and IR-8. PCB contamination was found in portions of the eastern ditch (called off-site drainage), originating on SLAC property and extending approximately 350 feet off-site onto adjacent undeveloped property owned by Stanford but once leased to a private party. SLAC constructed a fence to prevent uncontrolled access to this contaminated area.

In CY92, soil and sediment samples were taken along a 2.5-mile length of San Francisquito Creek and analyzed for a variety of constituents. The results showed no detectable PCBs in the creek between Searsville Lake and the confluence with Los Trancos Creek. Lead analysis indicated only background levels. However, sample analysis of the storm drain catch-basin sediments upstream of the contaminated areas indicated both PCB and lead contamination.

Additional study of the drain system and removal and off-site disposal of contaminated sediments from the catch basins and the IR-6 off-site drainage channel occurred in CY95. The *IR-6 Drainage Channel: Engineering Evaluation and Cost Analysis* (EECA) was written in CY95 to establish clean-up standards based on risk analysis, and to guide the removal action. The RWQCB, as the lead regulatory agency, reviewed the EECA.

In CY97 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 and was concentrated in the Research Yard.

In CY97, all removable solids were flushed out of the Research Yard drain lines using a pressure-washing/vacuum system. The waste profile generated for the 1995 catch basin cleanout project was applied to this project, so no characterization sampling was necessary.

In addition, because the methodology effectively removed all solids from the lines, no post-cleaning samples were collected. Instead, a qualitative cleanup standard was used, based on occlusion rather than concentration. Approximately 12 cubic yards of material were removed from the drain lines.

A community relations plan was completed and distributed to the surrounding community in CY93. SLAC community relations activities currently center on the monthly meetings of the Steering Committee for the Coordinated Resource Management and Planning (CRMP) process for the San Francisquito Creek watershed.

These meetings bring together a wide variety of stakeholders and provide an excellent forum for exchanging information, coordinating activities, and building consensus. The SLAC staff periodically present project updates and participate regularly in various other meetings and events that are spun off from the CRMP, such as:

- Special projects undertaken by CRMP task forces.
- Evaluations of proposed construction projects.
- Development of watershed management plans.
- Preparation of brochures for creekside residents.
- Weekend cleanups of the creek area.

4.5.2 Superfund Amendments and Reauthorization Act (SARA)

The Emergency Planning and Community Right-to-Know Act (EPCRA), otherwise known as the Superfund Amendments Reauthorization Act (SARA) Title III report, and the State equivalent, known as the Hazardous Materials Business Plan (HMBP) report, were submitted to the San Mateo County Department of Health Services for CY97. See Table 4-5 for report information.

Table 4-5 EPCRA Compliance Information

Article	Title	REPORT
		Required and Submitted
302-303	Planning Notification	YES

Table 4-5 EPCRA Compliance Information

Article	Title	REPORT
		Required and Submitted
304	EHS Release Notification	YES
311-312	MSDS/Chemical Inventory	YES
313	TRI Reporting	NO

4.6 National Environmental Policy Act (NEPA)

NEPA provides a three-level mechanism to ensure that all environmental impacts of and alternatives to performing a proposed project are considered before it is carried out. The aspects that must be considered when scoping and preparing documentation for a proposed project include archaeological sites, wetlands, floodplains, sensitive species, and critical habitats. If any extraordinary circumstances are identified during project scoping, a range of options for the project must be developed and the impacts of those options evaluated.

SLAC formalized its NEPA program in CY92. All project or action proposals are reviewed to determine if NEPA documentation is required. If NEPA documentation is required, the project or action is entered into a database and tracked. The resulting draft NEPA document is reviewed by specified SLAC staff for concurrence, and is forwarded to the DOE Site Office for review and approval.

The three types of NEPA documentation, in order of increasing complexity, are Categorical Exclusions (CXs), Environmental Assessments (EAs), and Environmental Impact Statements (EISs). In CY97, SLAC submitted 8 CXs for General Plant Projects (GPPs), Accelerator Improvement Projects, and Capital Equipment Projects.

4.7 Assessments

SLAC's assessments during CY97 are described in Section 2.16.

5 Environmental Radiological Program Information

5.1 Airborne Monitoring

Airborne radionuclides are produced in the air volume surrounding major electron beam absorbers such as beam dumps, collimators, and targets. The degree of activation is dependent upon the beam power absorbed and the composition of the parent elements. The composition of air is well known, consisting of nitrogen, oxygen, and trace quantities of carbon dioxide and argon. Induced radioactivity produced at high energies is composed of short-lived radionuclides, such as oxygen-15 and carbon-11, with half-lives of 2 minutes and 20 minutes, respectively. Nitrogen-13, 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 produces argon-41, which has a half-life of 1.8 hours.

CY97 was an active year at the SLAC site. Every major facility at SLAC was 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 calendar year 1997 (CY97). There are two facilities at SLAC that are not totally enclosed, so emissions due to diffusion can occur.

During CY97 three new experimental programs began. The Next Linear Collider Test Accelerator (NLCTA) at End Station B (ESB), and the upgraded e+ /e-experimental structure (PEP-II) began initial beam-on tests. End Station A (ESA) also experienced some beam-on activities in 1997.

For most of the facilities at SLAC, activated air is not released to the environment until the facility is opened for personnel entry. For the purpose of maintaining radiation doses to personnel as low as reasonably achievable (ALARA), entries are administratively controlled to allow some time for short-half-life radionuclides to decay prior to entry. Cooldown periods are facility- and energy-dependent varying from 30 to 300 minutes in CY97, with the norm being 60 minutes.

Of all the SLAC facilities, only ESA and the Positron-Electron Program (PEP II) have the potential to allow diffuse emissions of activated airborne products. Diffusion from ESA and PEP II activities are via Beam Dump East (BDE) and Interaction Region 10 (IR-10), respectively.

The majority of SLAC's experimental facilities 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. The Beam Switchyard (BSY), Positron Source (e+), BDE at ESA, SLC's Final Focus e+ and e- beam dumps adjacent to the Stanford Large Detector (SLD), and the Final Focus Test Beam (FFTB) all experienced beam-on time and thus energy loss and activation of the air surrounding the energy-loss area itself.

Energy-loss and beam-dump areas are sealed from access or venting, unless there is an emergency, during operations, and during beam-off until the required "cool-down" period has passed. The exceptions are BDE and PEP II at IR-10 as noted earlier. Activation products are 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. In order to establish concentrations without measurable quantities, calculations were made using facility specifics. These calculations have been made using extremely conservative (protective of the public) assumptions.

As a DOE-funded program, SLAC must at a minimum meet the requirements set by its sponsor. DOE Order 5400.5, *Requirements for Radiation Protection for the Public*, 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-sponsored activity. This Order prescribes calculations to be made in order to ensure that off-site releases to the public are below 100 mrem. The results of these calculations are called Derived Concentration Guides or DCG's.

A number of assumptions must be made in order to make the DCG calculations, and SLAC has chosen 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 DCG's as calculated for SLAC's potential release of activated radioactive gases (O-15, N-13, C-11, and Ar-41) are presented in Table 5-1.

Table 5-1 Radioactive Gases Released to Atmosphere

Radionuclide	Half-Life	DCG [$\mu Ci/cm^3$][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] $\mu Ci = 3.7 \times 10^4$ 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 the Environmental Protection Agency (EPA) dictates. Under the EPA's National Emission Standards for Hazardous Air Pollutants (NESHAPs - 40 CFR 61), SLAC must meet the requirements of this subpart by calculation of potential doses to both the maximally exposed individual and the public as a whole due to the emissions of airborne radionuclides. Continuous monitoring is not required because all of SLAC's emissions points are defined by EPA as "minor sources" of air pollution.

NESHAPS emissions were derived using calculations based, again, on conservative assumptions. It has been 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 be < 1% of their saturation values.

These emissions were derived by calculating the saturation activity for the radionuclides listed in Table 5-1, and then hypothetically releasing them instantaneously after the cool-down period. For both the IR-10 and BDE release points (PEP II and ESA facilities, respectively), which are not totally contained, a diffusion mechanism was conservatively estimated to determine releases that occurred continuously during beam-on periods.

SLAC must demonstrate that it meets the NESHAPS requirements of off-site dose to the public of < 10 mrem. Fulfillment of this requirement is evident in the results of running the DOE-approved modeling program CAP88PC, Version 1.0 (refer to Table 5-2, column 2, and Appendix B of this report).

Table 5-2 Summary of Annual Effective Dose Equivalents Due to 1997 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	4.2 mrem	0.0008 mrem	4.2 mrem	6.85 person-rem
DOE Radiation Protection Standard	100 mrem	10 mrem	100 mrem	—
Percentage of Radiation Protection Standard	4.2%	<1%	4.2%	—
Background	100 mrem	200 mrem	300 mrem	1.47×10^6 person-rem
Percentage of Background	4.2%	<1%	1.4%	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.

The results of this modeling show that the maximum off-site dose, with all the conservative assumptions invoked, from potential airborne emissions from SLAC is only 7.7 x 10-4 mrem (7.7 x 10-6 mSv) annual effective dose equivalent (EDE). Thus, the public dose due to SLAC research is approximately 1,000 times lower than EPA's level of concern (10 mrem EDE).

5.2 Wastewater Monitoring

Wastewater containing small quantities of radioactivity within regulatory limits was periodically discharged to the sanitary sewers from the site. The only possible sources of liquid radioactive effluents were from low conductivity water (LCW) cooling systems in the BSY and certain other areas of the accelerator housing. In the event of leaks from these systems, water was collected in stainless steel lined sumps sized to contain the entire water volume. Along the Klystron Gallery there are a series of polyethylene tanks which are used to collect LCW from the alcoves of the gallery.

The greatest source of induced radioactivity was where the electron/positron beam was absorbed. The only significant radionuclides produced in water were the short-lived oxygen-15 and carbon-11, beryllium-7 (half-life of 54 d), and longer-lived tritium (half-life of 12.3 y). Other radionuclides which could potentially be in the water systems would come from activated corrosion products.

The activated corrosion products were typically gamma emitters. Oxygen-15 and carbon-11 are too short-lived to present an environmental problem in water. Beryllium-7 and the 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 CY97. Tritium emits a weak beta and is detected primarily through liquid scintillation analysis.

All water potentially containing radioactivity was collected into several holding tanks at various points along the accelerator in order to control and keep track of tritium quantities prior to release to the sanitary sewer. Water in these holding tanks was discharged into the sanitary sewer only after radioanalysis had been completed. A summary of radioanalysis records of the wastewater discharged for each quarter of CY97 are given in Table 5-3.

Table 5-3 Radioanalysis Results for Wastewater Discharged During CY97

Period Released	Quantity [gal[a]]	Radioactivity [mCi[b]]
First Quarter	44,980	15.9
Second Quarter	28,520	0.13
Third Quarter	62,100	2.46
Fourth Quarter	163,377	3.78
Total:	298,977	22.3

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

SLAC is also bound by the provisions in a contract for service with the West Bay Sanitary District (WBSD) (Permit No. WB970401-F) and State regulations (California Code of Regulations, Title 17, Section 30287) which limited SLAC to a maximum of 5,000 mCi (that is, 5 Ci, or 1.85 x 10^{11} Bq) of tritium and 1,000 mCi (1 Ci or 3.7 x 10^{10} Bq) of all other 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, *Requirements for Radiation Protection for the Public*. The total tritium activity released in CY97 was less than 1% of the annual limit.

5.3 Stormwater Monitoring

Samples of stormwater, as described in Section 4.2.3, were analyzed for radioactivity. The results of these samples showed no detectable levels of tritium or other radioactivity.

5.4 Groundwater

Tritium analyses were conducted on groundwater from EXW-4, MW-30, and all other wells that were sampled. The well sampling is described in section 6.1.2. Tritium was detected only in EXW-4 and MW-30. Results for tritium analyses for CY97 groundwater monitoring in Well EXW-4 were 6600 pCi/l, which is less than the California state drinking water maximum concentration level (MCL) of 20,000 pCi/l. However, groundwater at SLAC is not usable as drinking water due to a very high TDS content, and is not used for any other purpose.

Tritium concentrations in well EXW-4 have varied (generally between 5,000 and 13,000 pCi/l) since the 1960s. Tritium concentrations in samples from EXW-4 have shown a general decreasing trend since 1991. Well EXW-4 is located in the area of Beam Dump East (BDE). The most probable source of tritium in the groundwater is low-level activation due to beam particle penetration in the area.

Results for tritium analyses for CY97 groundwater monitoring in MW-30 were 630 pCi/l. Concentrations of tritium in MW-30, measured since the well was installed in CY90, have consistently been below 1,000 pCi/l, and are usually less than the detection limit of 500 pCi/l. Well MW-30 is located next to End Station A (ESA) at the beginning of BDE.

These and other wells will continue to be monitored on a 12 to 18 month schedule in order to define any long-term trends in tritium concentration. New monitoring wells are scheduled to be drilled in CY98 to investigate other areas that could possibly be sources of tritium in the groundwater at SLAC.

5.5 Passive Thermoluminescent Dosimeter (TLD) Monitoring Program

SLAC has a site boundary environmental TLD monitoring program. Landauer, a National Voluntary Laboratory Accreditation Program (NVLAP) 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 is 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 CY97.

The environmental measurements using TLDs are summarized in Appendix D. TLD results indicated that the site boundary location with the highest accumulated dose-equivalent in CY97 reported 32 mrem (0.32 mSv).

The TLD data for CY97 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 5-2 for a summary of the results and Appendix D for data.

5.6 Radiological Media Sampling Program

Media sampling was limited to industrial wastewater (the major pathway for radionuclide release to the environment) and stormwater. The low source terms proportionate to DOE's DCGs have identified only this route as a likely pathway for any potential off-site population exposure.

Limited soil sampling in past years has not revealed detectable levels of human-made radionuclides. Soil sampling will also be done when the new monitoring wells are drilled in CY98. Future monitoring will be part of the radiological Environmental Surveillance Program which is being developed under SLAC's Radiological Environmental Monitoring Plan.

5.7 Low-Level Radioactive Waste Reduction

The quantities of low-level radioactive wastes are the accumulation of waste generated over years of SLAC's operation. A significant portion of SLAC's low-level radioactive waste is in the form of scrap metals.

Depending on their condition and the radiological characteristics, some of the metals may be returned to the environment for reuse because radioactive levels are very low and are candidates for regulatory exemption. This waste reduction approach is called Return on Investment (ROI).

ROI is a DOE-sponsored pollution prevention activity that assists funded sites in removal of their materials or waste that are suspected of being radioactive. ROI activities were moved forward in CY97.

Characterization of some 250,000 pounds of suspected radioactive material/waste, segregation of potentially releaseable material, and residual radioactivity calculations were completed this year. SLAC expects this project to progress in CY98.

SLAC has found that simple things have had a marked effect on day-to-day production of radioactive waste. Better housekeeping in CY97 of accelerator areas has 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 has led to a more comprehensive approach in both characterization and management of activated material/waste. It was found that simple disarticulation of parts and equipment, where only certain material was activated, resulted in a significant reduction of waste needing to be managed as being radioactive.

6 Groundwater Protection

Stanford Linear Accelerator Center (SLAC) performs groundwater protection through monitoring of a network of wells located for environmental surveillance and through investigations of contaminated groundwater plumes to ensure protection of human health and the environment. Documents such as *Remedial Investigation/Feasibility Study (RI/FS) Workplans,* a *Sampling and Analysis Plan* and associated *Standard Operating Procedures,* and a *Quality Assurance Project Plan* support monitoring and investigation activities.

The *Annual Well Inspection and Maintenance Manual* guides inspection of wells to protect the integrity of the monitoring wells. In CY97, 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 are available at the SLAC library, or can be obtained from the Environmental Protection and Restoration (EPR) Department at SLAC.

6.1 Groundwater Characterization Monitoring Network

6.1.1 CY97 Summary of Results and Issues

Work continued in CY97 on putting in more wells around the four areas of known contamination to define the lateral and vertical extent of potential contamination. A larger than expected area with high concentrations of constituents of concern was encountered at the Former Solvent Underground Storage Tank (FSUST) area, which is described below. Investigations began in CY96 and continued in CY97 to characterize this source area and to define possible cleanup options.

In addition, the wells in areas with no detected (or very low) constituents of concern were sampled every 12 to 18 months. Figure 6.1 shows the location of Monitoring Well 30 (MW-30), which had 1.1 ppb of polychlorinated biphenyls (PCBs) detected in groundwater in February 1996. However, when the well was resampled in August 1996, and twice more in CY97, no PCBs were detected (with a detection limit of 0.5 ppb).

6.1.2 Background

SLAC characterizes groundwater at the site in order to determine and document the effects that the facility operations have had on groundwater quality. The groundwater monitoring network includes 8 wells which provide environmental surveillance of groundwater conditions. They are used to monitor general groundwater quality in the major areas of the facility that historically or presently store, handle, or use chemicals which may pose a threat to groundwater quality. In addition, SLAC's groundwater monitoring network includes wells that check groundwater at four distinct sites with known groundwater contamination.

During ongoing remedial investigations, the wells at areas with known groundwater contamination are sampled and analyzed on a semi-annual basis. Samples may be analyzed for one or more of the following:

- Volatile organic compounds
- Total Petroleum Hydrocarbons (TPHs)
- Metals
- Polychlorinated Biphenyls (PCBs)
- Total Dissolved Solids (TDS)
- General minerals
- Tritium

Volatile organic compounds have been detected at levels of concern at SLAC. The results of semi-annual sampling and analysis of wells are reported to the RWQCB in Semi-Annual Monitoring reports.

Table 6-1 summarizes the wells at SLAC by the number of wells, area of the facility, and the purpose of the well. The purpose of the well may be either contaminant plume monitoring or environmental surveillance, including general background monitoring. Seven wells were installed at SLAC in CY97. As noted in Table 6-1, the four areas with groundwater contamination are:

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

The locations with groundwater contamination are shown in Figure 6-1. The main organic contaminant in all of these areas is trichloroethene (TCE) and its breakdown products. TCE was historically used at SLAC as a cleaning solvent. TCE is no longer in general use at SLAC. It is used in very small quantities in a few research laboratories. The four contaminated groundwater sites are discussed in detail in the next section.

Table 6-1 Purpose and Location of Monitoring Wells

	Number of Active Wells	
Area of Site	Groundwater Contaminated Plume Monitoring	Environmental Surveillance
FSUST[a]	13 wells	
FHWSA[b]	10 wells	
Test Lab/Central Lab	6 wells	
Plating Shop	9 wells	
Research Yard		3 wells
Beam Dump East		1 well
Master Substation; Lower Salvage Yard		1 well
CHWMA[c]		1 well
End Station B		1 well
Vacuum Assembly Building		1 well
Other (remote area)		1 well

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

6.2 Groundwater Site Descriptions and Results

6.2.1 Former Solvent Underground Storage Tank (FSUST)

6.2.1.1 Background

A groundwater monitoring network is located in proximity to SLAC's Plant Maintenance building in the northwestern portion of the facility (see Figure 6-1). This network consists of thirteen wells, including two wells that were installed in CY97. The wells are being used to monitor the migration of chemical constituents associated with the FSUST, which contained 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 contaminated soil were removed in December 1983.

The California RWQCB requires 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 volatile organics (EPA Methods 8010/8020) by an analytical laboratory certified by the California Department of Health Services.

A larger than expected area with high concentrations of constituents of concern was encountered at the FSUST in CY96. Potential remedial alternatives were tested in CY97.

6.2.1.2 CY97 Results and Issues

Results of investigative work at the FSUST will be detailed in the site characterization and evaluation of remedial alternatives reports for the FSUST area. These reports will be submitted to the RWQCB in early CY98.

6.2.2 Former Hazardous Waste Storage Area (FHWSA)

6.2.2.1 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 MW-25 was installed in this area in 1990, and volatile organic compounds (VOCs) were detected in the groundwater. Six wells were installed in CY96, and three more in CY97. Figure 6-1 defines the extent of VOCs in groundwater.

Results of RI studies conducted through CY96 are presented in the April, 1997 *"Progress Report for the Remedial Investigation of the Former Hazardous Waste Storage Area"* (SLAC-I-750-3A33H-002) and are summarized in the 1996 ASER.

6.2.2.2 CY97 Results and Issues

Results of the CY97 drilling and testing program delineated the extent of contamination to the south. Two wells were drilled next to each other, one shallow in the Santa Clara Formation, and one deeper in the Ladera Formation. The concentration of contaminants in the shallow well exceeded the concentrations in the deeper well by almost an order of magnitude, indicating that the Ladera Formation is acting as a barrier to the rapid migration of contaminants vertically.

To further define the extent of soil contamination at the possible source areas, a passive soil gas survey was completed. Investigative work will continue in CY98 and CY99.

6.2.3 Plating Shop

6.2.3.1 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 of the three wells and an investigation began as described below.

Results of RI studies conducted in CY96 are presented in the March, 1997 *"Remedial Investigation Progress Report for the Plating Shop Area"* (SLAC-I-750-3A33H-001) and are summarized in the 1996 ASER.

6.2.3.2 CY97 Results and Issues

One deep well was installed in CY97. In addition, a soil gas survey and soil borings were drilled to delineate the sources of contamination. Results of the CY97 drilling and testing program indicate three possible source areas including the Steam Cleaning Pad, the Plating Shop, and the Rinse Water Treatment Plant (RWTP). Removal of impacted soil under the Steam Cleaning Pad is scheduled for CY98. Further investigative work at the Plating Shop is planned for CY99.

6.2.4 Test Lab and Central Lab

6.2.4.1 Background

Monitoring Well 24 (MW-24), was installed between the Test Lab and Central Lab in 1990 at the site of a former leaking diesel pump. Contaminated soil was removed and the well was installed to monitor for the possible presence of diesel fuel. However, diesel fuel has never been detected in this well. Chlorinated solvents have been detected, and investigative work is ongoing as described below.

Results of RI studies conducted in CY96 are presented in the April, 1997 *"Remedial Investigation Progress Report for the Test Lab and Central Lab Area"* (SLAC-I-750-3A33H-004) and are summarized in the 1996 ASER.

6.2.4.2 CY97 Results and Issues

In CY97, grab groundwater samples were collected from six borings and one well to better define the extent of contamination in groundwater. The level of contaminants detected in groundwater is low in all samples collected in this area. Further source investigation is planned for CY98 and CY99.

6.3 Quality Assurance

As described in the *Quality Assurance Project Plan* and the *Standard Operating Procedures,* SLAC conducts a data validation review for all data collected for RI/FS activities.

6.4 Groundwater Monitoring Program

Major documents to support the investigative work include:

1. *Remedial Investigation/Feasibility Study (RI/FS) Workplans.*
2. *Standard Operating Procedures.*
3. *Quality Assurance Project Plan.*
4. *Field Sampling Plan.*
5. *Annual Well Inspection and Maintenance Manual.*

The components of the Groundwater Monitoring Program include the following:

6.4.1 Documentation of the Groundwater Regime with Respect to Quantity and Quality

The groundwater regime at the SLAC site and nearby off-site areas has been comprehensively documented in the SLAC *Hydrogeologic Review* completed in CY94. This report compiled data and summarized results of the numerous geologic, hydrogeologic, and hydrogeochemical investigations that have 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 and monitoring purposes.

The report developed a conceptual model of the groundwater regime at SLAC. Of particular interest to studies of contaminant transport was the fact that the major bedrock unit underlying SLAC conveyed groundwater primarily by fracture flow. Based on numerous 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.

A *Beneficial Use Assessment*, which included a well survey of the area around SLAC, provided information on possible beneficial uses of groundwater at SLAC, as outlined in the *California Regional Water Quality Control Board Basin Plan*. This report concluded that because groundwater at SLAC has a very high TDS content and a very low rate of flow, it is not suitable for most potential beneficial uses.

An updated well survey will be completed in CY98 for this *Beneficial Use Assessment*. TDS concentrations in SLAC's groundwater generally exceeds 3,000 milligrams per liter and has been measured as high as 10,000 milligrams per liter.

6.4.2 Identification and Summary of Potentially Contaminated Areas

SLAC's 1992 report entitled *Identification and Summary of Potentially Contaminated Sites* provides a summary of areas that may be contaminated 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.

6.4.3 Strategies for Controlling Sources of Contaminants

Strategies for contaminant source control involve measures to control known soil or groundwater contamination, and procedures to address practices that may contribute to groundwater contamination. In addition, the Storm Water Pollution Prevention Plan (SWPPP) and the Spill Prevention, Control, and Countermeasure Plan (SPCC) discuss best management practices (BMPs) for preventing contamination at the SLAC facility. Environment, Safety, and Health (ES&H) Manual chapters on Secondary Containment and Oil-filled Equipment Management Programs 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.

6.4.4 State- and DOE-Required Remedial Action Program

An RI/FS Workplan written following CERCLA guidance addresses soil and groundwater contamination at SLAC. Associated documents include a *Sampling and Analysis Plan* and associated *Standard Operating Procedures, Quality Assurance Project Plan,* and *Field Sampling Plan*. These documents provide overall guidance for the remedial action program.

DOE 5400.4 required SLAC to follow CERCLA RI/FS guidance. Although no longer required, SLAC still follows applicable parts of CERCLA technical guidance in developing strategies and preparing documentation. Actual National Priority List (CERCLA) San Francisco Bay sites are under the oversight of the EPA or designated alternative agencies. The Regional Water Quality Control Board provides oversight of SLAC.

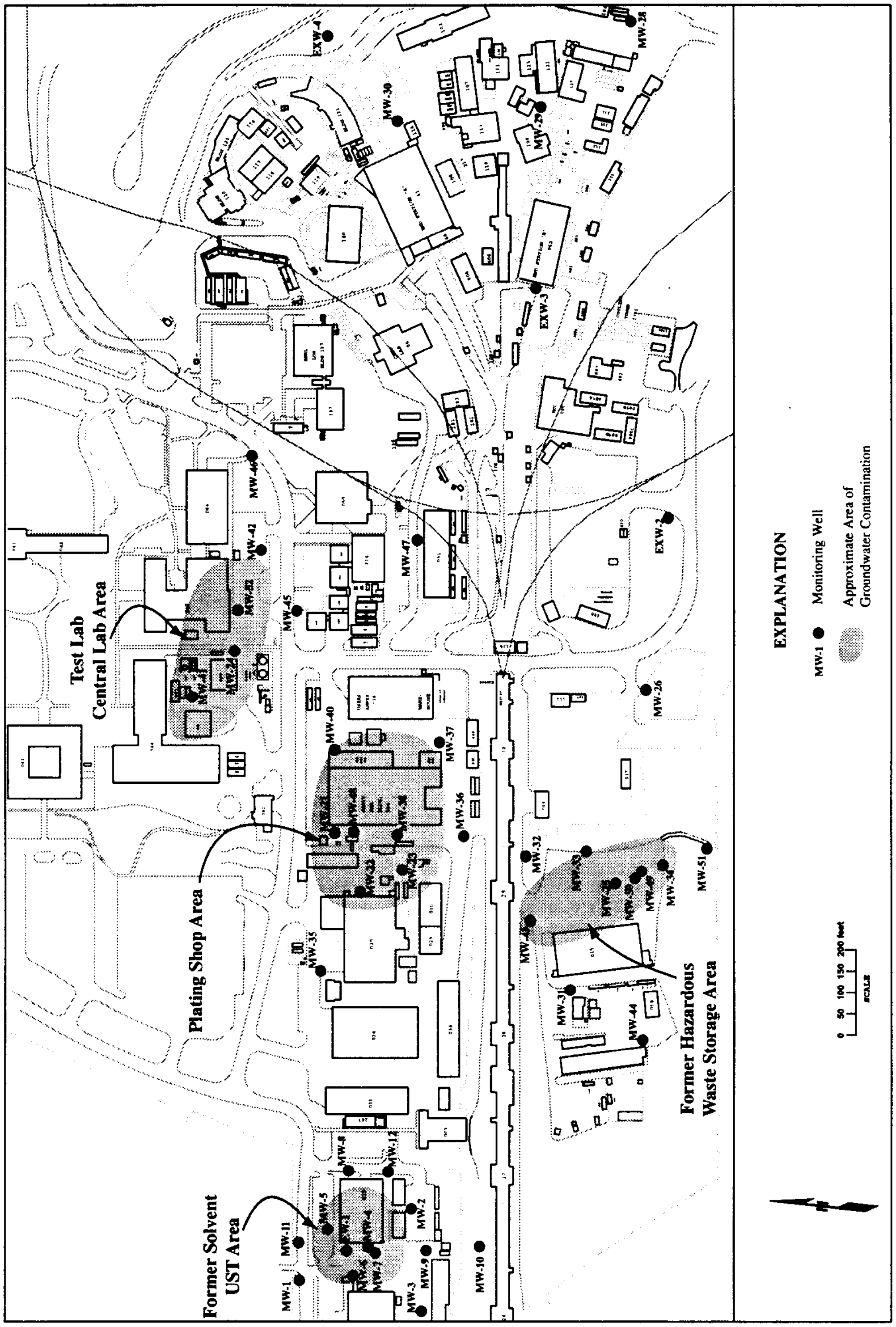

Figure 6-1 Location of Groundwater Monitoring Well Network and Areas with Groundwater Contamination

7 Quality Assurance

The Stanford Linear Accelerator Center's (SLAC's) site-wide Quality Assurance (QA) Program has been influenced by the requirements of Department of Energy (DOE) Order 5700.6C. The QA Program is described in the *SLAC Institutional Quality Assurance Program Plan* (SLAC-I-770-0A17M-001). This document was approved by the DOE in May 1993. The plan defines the roles, responsibilities, and authorities for implementation of the ten criteria from DOE Order 5700.6C.

The Safety, Health, and Assurance (SHA) Department is involved in the qualification process for environmentally sensitive services, including off-site analytical laboratories. SHA is responsible for: auditing the line QA and environment, safety, and health (ES&H) programs; maintaining the *SLAC Institutional Quality Assurance Program Plan*; and providing direction for implementation of the ten criteria from DOE Order 5700.6C.

The QA Program includes qualification of laboratories that provide analytical services, verification of certification to perform analytical work, and review of Environmental Protection Agency (EPA) performance test results. Also included in this review is adequacy of the internal quality control (QC) practices, recordkeeping, chain of custody, and the analytical laboratory QA program as a whole.

7.1 Laboratory Testing

Laboratory performance testing is performed as outlined in the latest revision of the *Environmental Laboratory Performance Program* (SLAC-I-770-2A17C-008). This information is used in conjunction with laboratory and field QA/QC to evaluate specific data packages.

7.2 Radioanalysis Laboratory

In CY97, SLAC participated in two external blind sample quality assessment programs, The DOE's Quality Assessment Program (QAP) run by Environmental Measurements Laboratory (EML) and the Performance Evaluation Studies Program operated by EPA's Environmental Monitoring Systems Laboratory - Las Vegas (EMSL-LV).

SLAC's participation in the QAP program consists of analyzing water samples provided by EML for gamma emitting radionuclides and reporting the results to EML. There are two QAP evaluations per year, one in March and one in September. The gamma-emitting radionuclides in the QAP samples that are found at SLAC are Co-60, Mn-54 and Cs-137. SLAC's performance in these evaluations was acceptable.

On April 10, 1997 SLAC initiated its participation in two of EMSL-LV's QA programs entitled the "Gamma-in-Water Study" and the "Tritium-in-Water Study".

Tritium in water studies are done in March and August. Gamma in water studies are done in June and November. SLAC participated in the Gamma in water studies of June and November and the Tritium in water study of August. Results of the studies are published approximately six weeks after each study. The results are given in terms of normalized standard deviations of the known value of each nuclide.

Warning limits are placed at two normalized standard deviations above or below the known value and the control limits are three normalized standard deviations above or below the known value. Responses outside of three standard deviations above or below the known value are considered out of control. In CY97, SLAC's radioanalysis laboratory was within all limits for those studies in which it participated.

7.3 Environmental Monitoring

The following procedures and policies that support the QA Program for environmental monitoring activities are used with:

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*

7.4 Environmental Restoration Program

The Environmental Restoration Program (ERP) uses the *Quality Assurance Project Plan* for the *Remedial Investigation and Feasibility Study* for soil and groundwater contamination investigations. The *Quality Assurance Project Plan* for the groundwater monitoring program and the associated *Data Management Plan* are used for the semi-annual groundwater monitoring program. These documents have all the components required of *Quality Assurance Project Plans* according to EPA, CERCLA, and DOE guidance documents. This includes defining required laboratory and field QA/QC procedures and corrective actions, as well as data validation and reporting.

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 is required where appropriate. For this report, the term dose equivalent simply will be called dose. SLAC's dose to the maximally exposed member of the general public due to accelerator operations was conservatively estimated to be 4.2 mrem (0.042 mSv) in CY97 from penetrating radiation. The 4.2 mrem (0.042 mSv) value is approximately 1.4% of the total natural background dose and is 4.2% of the dose limit for members of the general population, that is, 100 mrem (1 mSv) per year (DOE Order 5400.5).

There are three major pathways leading to human exposure from human-made ionizing radiation:

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

Of these three major pathways, only direct exposure to penetrating radiation is of any measurable significance from SLAC operations. The sources of this exposure are from 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 may escape from the heavily shielded enclosures.

In order to make an accurate and realistic assessment of radiation exposure to the public at low doses, it is necessary that exposure from the natural radiological environment be known, that is, background radiation. This is true because the instruments used respond to natural radiation sources as well as human-made sources, and the portion due to natural radiation must be subtracted from the total measurement. The population exposure assessments appearing in this report are in all cases overstatements, due to the conservative modeling assumptions used compared to the likely actual impact; hence, the resulting values are representative of 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 an 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 is the population dose in units of person-rem (person-cSv). This is simply the product of average individual dose and the total population exposed. For example, if 1,000 people are exposed to an average annual background dose of 0.1 rem (1 mSv), then the population dose is 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 may 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 of the 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 $(e^{-R/\lambda})/R$ 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 is 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 is used for photon skyshine as well as a conservative model.

In CY97, 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, include 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 32 mrem in CY97. Using this maximum dose value, it was estimated that the collective dose to the population within 80 km of SLAC was about 6.85 person-rem (0.0685 person-Sv).

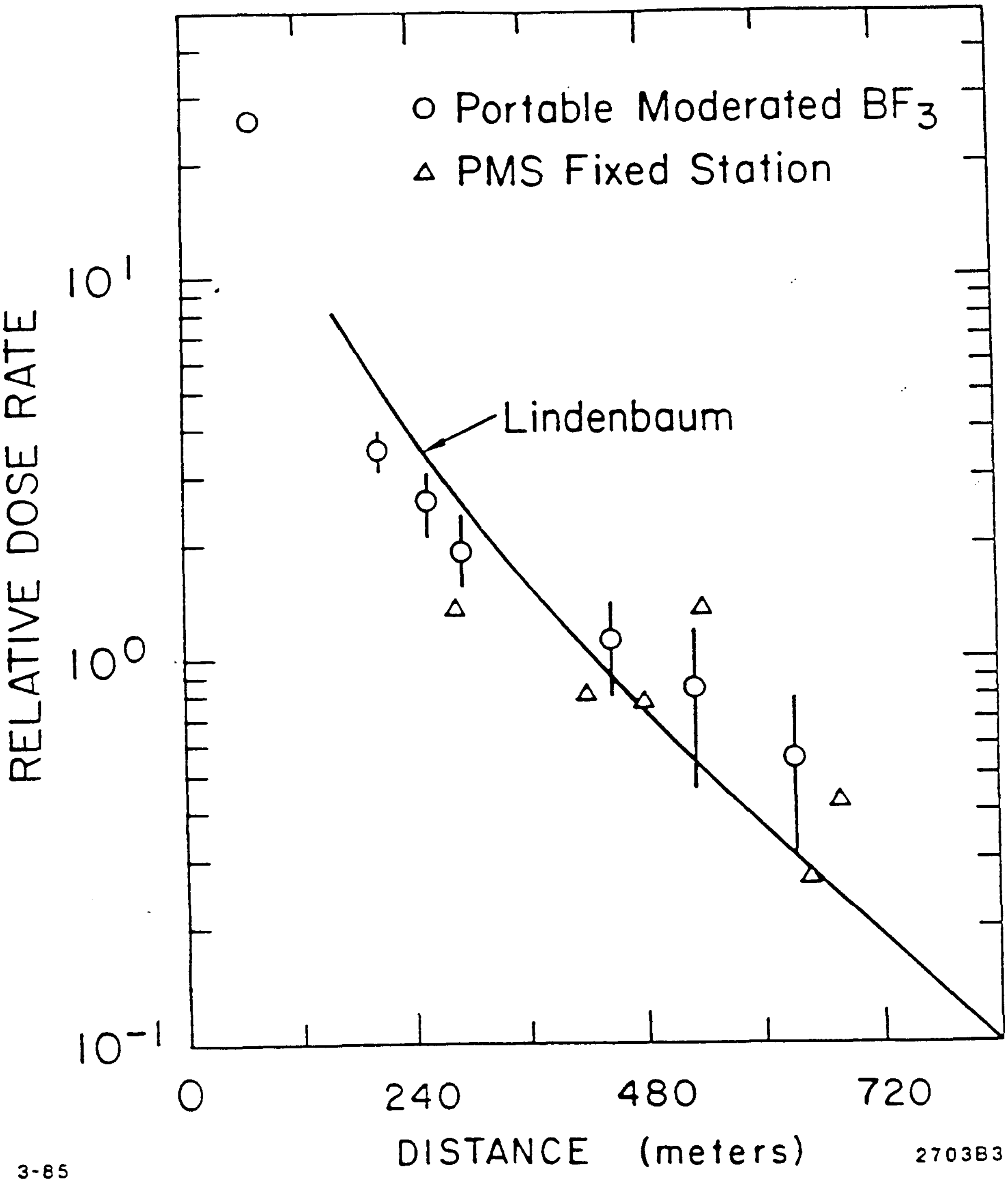

Figure A-1 Neutron measurements made along a line between End Station A and the site boundary.

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

B

NESHAPs Report

Original report published in June, 1998
Table and section formats reflect those of the original.

1 Facility Information

Stanford Linear Accelerator Center (SLAC) was in full compliance in calendar year 1997 (CY97) with the requirements set forth in 40 CFR Part 61 Subpart H.Site Description

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 (sometimes it 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. Facility use is dictated by experimental needs and schedules. 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 the January 1998 letter to the Environmental Protection Agency (EPA), SLAC discussed three separate issues, one being what constituted an air pollution "source" (see section 5 of this report). 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 current revamping 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.

All of the current research facilities at SLAC ran beam-on experiments in 1997. This is up from eight facilities running beam in CY96. The high energy ring (e-) portion of the renovated PEP II (a.k.a. Asymmetric B-Factory) was finished and was energized. PEP II's co-located low energy ring (e+) is still in construction and is expected to be commissioned in CY98. ESB has been refitted for the experiment known as NLCTA. NLCTA, with its' own injector and RF sources, began initial low-power runs in the latter part of CY97. There were ten potential beam loss areas identified at SLAC for CY97 where the saturation air radioactivity was produced.

SLAC's ten current research facilities are as follows:

- Accelerator Housing (LINAC).
- Positron Source.
- Stanford Linear Collider (SLC) Beam Dumps.
- Beam Switchyard (BSY).
- SLC Damping Rings.

- Stanford Synchrotron Radiation Laboratory (SSRL) Booster Injector.
- Final Focus Test Beam (FFTB).
- Next Linear Collider Test Accelerator (NLCTA).
- Asymmetric B-Factory (PEP II).
- End Station A (ESA).

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 ten 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, manways) or from the forced air ventilation ducts. All the access openings are closed and administratively secured during beam operation; therefore, potential releases occur only after turning off the beam. Ventilation is not used during beam operations.

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 common for a sealed area to remain closed (i.e., 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 SLAC's eight sealed experimental facilities, cool-down periods run from 30 to 300 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. In CY97, NLCTA started running late in the year at low power allowing a 30 minute decay time to adequately reduce the gases produced there.

Conversely, the PS (a.k.a. Positron Vault - PV) has very high energy beam losses due to interception of the linac's electron beam to produce positrons. Here, ALARA considerations demand a full 300 minute delay prior to breach of containment of the PV. Most of SLAC's experiments 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).

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. However, it would take considerable effort and resources to establish a fully acceptable and realistic scenario. As can be seen through these conservative calculations, SLAC emissions are still well below EPA's accepted limits.

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 many systems.

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 below.

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 manway 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, that is, no beams are being produced, the housing can be vented.

The radioactive gas concentration is very low in the accelerator housing because there is very little beam loss, as determined 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)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.0E-01	18	60	2.29E-09	0.00%
N-13	2.0E-02	18	60	5.54E-03	5.91%
C-11	3.0E-02	18	60	6.96E-02	74.35%
Ar-41	1.5E-03	18	60	1.85E-02	19.74%
Total:	1.5E-01			9.37E-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 Source

The positron source 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 Source Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.4E+00	6	300	2.80E-44	0.00%
N-13	3.0E-01	6	300	1.55E-09	0.00%
C-11	3.0E-01	6	300	6.42E-05	0.35%
Ar-41	2.0E-02	6	300	1.81E-02	99.65%
Total:	2.0E+00			1.81E-02	100.00%

* 1 Ci = 3.7×10^{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 Dumps

SLAC is operating a machine called the SLAC Linear Collider (SLC). The SLC is the upgraded linear accelerator which produces 50 GeV positrons and electrons. These beams are deflected into transport systems which guide them to an interaction point. After the interaction collision point, any electrons and positrons remaining in the beams are deflected into beam dumps. There are two beam dumps located in shielded rooms in the SLC arcs. The saturation activities for both of these beam dumps are listed in Table 4.

Table 4 SLC Beam Dumps Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	2.0E-01	20	120	6.47E-18	0.00%
N-13	4.0E-02	20	120	1.89E-04	0.39%
C-11	6.0E-02	20	120	2.00E-02	41.33%
Ar-41	3.0E-03	20	120	2.81E-02	58.27%
Total:	3.0E-01			4.83E-02	100.00%

* 1 Ci = 3.7×10^{10} Bq

The SLC arc and dump areas are not vented (release points) during beam operation. The distance from the north arc SLC vent to the nearest receptor is 274 m (900 feet).

1.2.4 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).

Table 5 Beam Switchyard Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.0E-01	11	120	1.78E-18	0.00%
N-13	2.0E-02	11	120	5.20E-05	0.39%
C-11	3.0E-02	11	120	5.49E-03	41.33%
Ar-41	1.5E-03	11	120	7.74E-03	58.27%
Total:	1.5E-01			1.33E-02	100.00%

* 1 Ci = 3.7×10^{10} Bq

1.2.5 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 their saturation activities are listed in Table 6.

Table 6 Damping Rings Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.8E-02	24	60	5.49E-10	0.00%
N-13	3.2E-03	24	60	1.18E-03	17.84%
C-11	6.0E-04	24	60	1.86E-03	28.05%
Ar-41	2.2E-04	24	60	3.58E-03	54.11%
Total:	2.2E-02			6.62E-03	100.00%

* 1 Ci = 3.7×10^{10} Bq

1.2.6 SSRL Booster Injector

SSRL has a 3 GeV booster ring and linac (injector) that produce very low concentrations of radioactive gases. The radionuclides and their saturation activities are listed in Table 7.

Table 7 SSRL Booster/Injector Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	3.7E-04	13	60	6.12E-12	0.00%
N-13	7.0E-04	13	60	1.40E-04	37.18%
C-11	8.0E-05	13	60	1.34E-04	35.63%
Ar-41	1.2E-05	13	60	1.02E-04	27.19%
Total:	1.2E-03			3.76E-04	100.00%

* 1 Ci = 3.7×10^{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).

1.2.7 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 8.

Table 8 Final Focus Test Beam Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	1.7E-04	2	60	4.32E-13	0.00%
N-13	3.1E-04	2	60	9.54E-06	46.80%
C-11	3.3E-05	2	60	8.51E-06	41.77%
Ar-41	1.7E-06	2	60	2.33E-06	11.43%
Total:	5.1E-04			2.04E-05	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).

1.2.8 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 their saturation activities are listed in Table 9.

Table 9 End Station A Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	6.3E-05	7	0	4.41E-04	21.60%
N-13	1.2E-04	7	0	8.40E-04	41.14%
C-11	1.3E-05	7	0	8.89E-05	4.35%
Ar-41	9.6E-05	7	0	6.72E-04	32.91%
Total:	2.9E-04			2.04E-03	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.

1.2.9 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 10.

Table 10 NLCTA Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	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.

1.2.10 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 their saturation activities are listed in Table 11.

Table 11 PEP II Activity

Isotope	Saturation Activity (Ci)	Number of Releases per Year	Typical Decay Time (min)	Activity Released (Ci/y)	Percent of Contribution
O-15	3.00E-05	1080	0	3.24E-02	70.26%
N-13	5.60E-06	1080	0	6.05E-03	13.11%
C-11	6.00E-06	1080	0	6.48E-03	14.05%
Ar-41	1.10E-06	1080	0	1.19E-03	2.58%
Total:	4.3E-05			4.61E-02	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 12 Summary Activity by Location for CY97

Isotope	Accelerator Housing [Ci[1]]	Positron Source [Ci*]	SLC Beam Dump [Ci[1]]	Beam Switchyard [Ci [1]]	SLC Damping Rings [Ci[1]]	SSRL Booster/ Injector [Ci[1]]	FFTB [Ci[1]]	ESA [Ci[1]]	NLCTA [Ci[1]]	PEP II [Ci[1]]	All Site Total (Ci[1])	Percent of Contribution
O-15	2.3E-09	2.8E-44	6.5E-18	1.8E-18	5.5E-10	6.1E-12	4.3E-13	4.4E-04	8.8E-08	3.2E-02	3.3E-02	14.37%
N-13	5.5E-03	1.5E-09	1.9E-04	5.2E-05	1.2E-03	1.4E-04	9.5E-06	8.4E-04	1.4E-07	6.0E-03	1.4E-02	6.12%
C-11	7.0E-02	6.4E-05	2.0E-02	5.5E-03	1.9E-03	1.3E-04	8.5E-06	8.9E-05	6.8E-09	6.5E-03	1.0E-01	45.38%
Ar-41	1.8E-02	1.8E-02	2.8E-02	7.7E-03	3.6E-03	1.0E-04	2.3E-06	6.7E-04	2.5E-08	1.2E-03	7.8E-02	34.12%
Total:	9.4E-02	1.8E-02	4.8E-02	1.3E-02	6.6E-03	3.8E-04	2.0E-05	2.0E-03	2.6E-07	4.6E-02	2.3E-01	N/A
Percent of Contribution	40.99%	7.93%	21.13%	5.81%	2.90%	0.16%	0.01%	0.89%	0.00%	20.18%	N/A[2]	100.00%

[1] 1 Ci = 3.7 x 10^{10} Bq
[2] N/A = Not Applicable

2 Air Emissions Data

Nearest Point Source	Type Control[3]	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)
SLC Beam Dump	Not vented during beam operation	100%	274 m (NE)
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 (N)

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

Table 13
Total Radioactive Gases Potentially Released in CY97
(Decay/Venting Delay Corrected)

Isotope	All Site Total (Ci[4])	Percent of Contribution
O-15	3.3E-02	14.37%
N-13	1.4E-02	6.12%
C-11	1.0E-01	45.38%
Ar-41	7.8E-02	34.12%
Total (Ci[4]):	2.3E-01	100.00%

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

[4] 1 Ci = 3.7×10^{10} Bq

3 Dose Assessments

3.1 Description of the Dose Model

The EPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC Version 1.0, 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 CY97 radioactivity air emissions were conservatively derived and are shown in Table 12 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 CY97, 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 CY97 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 1.2.8 and 1.2.10, 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. It is assumed 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 .

Included as attachments are the Synopsis Report and the Dose and Risk Equivalent Summaries generated by CAP88-PC for each of the source terms: Accelerator Housing (Linac97), Positron Source (PV97), SLC Beam Dumps (SLC-SLD97), Beam Switchyard (BSY97), SLC Damping Rings (DR97), SSRL (SSRL97), FFTB (FFTB97), NLCTA (NLCTA97), PEP II (PEP II97), and ESA (ESA97).

Determination of the MEI resulted in locating that individual at the Addison Wesley Publishers Building on the north side of the SLAC facility. Details of this evaluation can be found in Table 14.

Part 2 of the assessment model utilized the radial population grid (shown in Table 15) 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 CY97 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 a reasonably conservative results for both the MEI and the collective EDE.

Included in this report are the following attachments for this population assessment case (SLAC 97): General Data, Dose and Risk Equivalent Summaries, Weather Data, and the Dose and Risk Conversion Factors.

Table 14 Determination of Maximally Exposed Individual

Run Name		Source	Contributors	Location		EDE (mrem/yr)	Total (mrem/yr)
SLC-SLD97	1	SLC Beam Dumps		274m	NE	2.4E-04	
			SSRL	792m	ENE	2.0E-07	
			BSY	1,097m	NE	4.1E-06	
			LINAC	1,372m	ENE	1.6E-05	
			Positron Vault	2,195m	E	5.0E-06	
			Damping Rings	3,962m	E	4.3E-07	
			FFTB	852m	ENE	7.7E-09	
			ESA	822m	ENE	9.4E-07	
			NLCTA	730m	NE	7.1E-11	
			PEP II	915m	ENE	5.8E-06	
							2.7E-04
SSRL97	2	SSRL		427m	N	1.4E-06	
			Dumps	731m	NW	3.6E-05	
			BSY	640m	NNE	1.2E-05	
			LINAC	792m	NE	3.9E-05	
			Positron Vault	1,554m	NE	4.1E-06	
			Damping Rings	3,353m	ENE	3.0E-07	
			FFTB	487m	N	4.9E-08	
			ESA	457m	N	5.8E-06	
			NLCTA	580m	N	2.8E-10	
			PEP II	427m	N	6.4E-05	
							1.6E-04
BSY97	3	BSY		457m	NNW	2.8E-05	
			SSRL	640m	NW	2.6E-07	
			Dumps	1,280m	WNW	7.1E-06	
			LINAC	366m	NNW	2.4E-04	
			Positron Vault	640m	NE	2.1E-05	
			Damping Rings	2,743m	ENE	4.4E-07	
			FFTB	700m	NW	9.8E-09	
			ESA	670m	NW	1.2E-06	
			NLCTA	820m	WNW	3.8E-11	
			PEP II	610m	W	6.1E-06	
							3.0E-04
Linac97	4	Linac		305m	N	7.2E-04	
			BSY	457m	NW	2.5E-05	
			SSRL	640m	WNW	1.6E-07	
			Dumps	1,280m	WNW	7.1E-06	
			Positron Vault	792m	NE	1.4E-05	
			Damping Rings	2,438m	ENE	5.5E-07	
			FFTB	700m	WNW	6.2E-09	
			ESA	670m	WNW	7.2E-07	
			NLCTA	820m	WNW	3.8E-11	
			PEP II	610m	W	6.1E-06	
							7.7E-04
PV97	5	Positron Vault		640m	NNE	2.2E-05	
			LINAC	731m	NNW	5.4E-05	
			BSY	914m	NW	6.3E-06	
			SSRL	1,097m	NW	8.2E-08	
			Dumps	1,676m	NW	7.2E-06	
			Damping Rings	2,195m	NE	5.1E-07	
			FFTB	1,157m	NW	3.1E-09	
			ESA	1,127m	NW	3.9E-07	
			NLCTA	820m	WNW	3.8E-011	
			PEP II	610m	W	6.1E-06	
							9.7E-05

* Location is defined as the distance and direction from the source to the closest and highest dose individual.

Table 14 (continued) Determination of Maximally Exposed Individual

Run Name		Source	Contributors	Location		EDE (mrem/yr)	Total (mrem/yr)
DR97	6	Damping Rings		274m	WNW	1.9E-05	
			Positron Vault	2,195m	W	9.3E-07	
			LINAC	2,743m	W	1.3E-06	
			BSY	3,048m	W	2.5E-07	
			SSRL	3,353m	W	3.5E-09	
			Dumps	3,962m	W	5.7E-07	
			FFTB	3,353m	W	1.3E-10	
			ESA	3,353m	W	1.9E-08	
			NLCTA	3,600m	WSW	7.5E-013	
			PEP II	3,440m	WSW	7.2E-08	
							2.2E-05
FFTB97	7	FFTB		487m	N	4.9E-08	
			Damping Rings	3,353m	ENE	3.0E-07	
			Positron Vault	1,554m	NE	4.1E-06	
			LINAC	792m	NE	3.9E-05	
			BSY	640m	NNE	1.2E-05	
			SSRL	427m	N	1.4E-06	
			Dumps	731m	NW	3.6E-05	
			ESA	457m	N	5.8E-06	
			NLCTA	580m	N	2.8E-10	
			PEP II	427m	N	6.4E-05	
							1.6E-04
ESA97	8	ESA		457m	N	5.8E-06	
			Damping Rings	3,353m	ENE	3.0E-07	
			Positron Vault	1,554m	NE	4.1E-06	
			LINAC	792m	NE	3.9E-05	
			BSY	640m	NNE	1.2E-05	
			SSRL	427m	N	1.4E-06	
			Dumps	731m	NW	3.6E-05	
			FFTB	487m	N	4.9E-08	
			NLCTA	580m	NE	2.8E-10	
			PEP II	427m	NNE	3.0E-05	
							1.3E-04
NLCTA97	9	NLCTA		580m	NNW	1.4E-10	
			Damping Rings	3,353m	ENE	3.0E-07	
			Positron Vault	1,554m	NE	4.1E-06	
			LINAC	792m	NE	3.9E-05	
			BSY	640m	NNE	1.2E-05	
			SSRL	427m	N	1.4E-06	
			Dumps	731m	NW	3.6E-05	
			ESA	457m	N	5.8E-06	
			FFTB	487m	N	4.9E-08	
			PEP II	427m	NNE	3.0E-05	
							1.3E-04
PEP II97	10	PEP II		427m	NNE	3.0E-05	
			Damping Rings	3,353m	ENE	3.0E-07	
			Positron Vault	1,554m	NE	4.1E-06	
			LINAC	792m	NE	3.9E-05	
			BSY	640m	NNE	1.2E-05	
			SSRL	427m	N	1.4E-06	
			Dumps	731m	NW	3.6E-05	
			FFTB	487m	N	4.9E-08	
			ESA	457m	N	5.8E-06	
			NLCTA	580m	NNW	1.4E-10	
							1.3E-04

* Location is defined as the distance and direction from the source to the closest and highest dose individual.

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 NESHAPs-mandated CAP88PC modeling, and the use of grab samples to confirm the conservatism.

This intentional "double conservatism" in SLAC's 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 1.0 to calculate the dose for CY97.

Maximally Exposed Individual Effective Dose Equivalent:	7.7E-04 mrem/year (7.7E-06 mSv/year)
Location of Maximally Exposed Individual:	305 meters North (Addison Wesley)

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 Facility Manager

[signature] 4 June 1998

Signature Date

John S. Muhlestein

DOE Stanford Site Office Director

[signature] 6-22-98

Signature Date

3.2 POPULATION DATA

Table 15 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

4 Additional Information

As mentioned earlier in this report, all ten SLAC research facilities had beam-on activities in calendar year 1997 (CY97). ESA had no beam-on research activities in CY97, and was activated only briefly at the end of CY97. Two other facilities (that had no activities in CY96), have been refitted for new research experiments in high-energy physics. Both PEP and the ESB began low-power testing in 1997.

SLAC is the final stages of finishing the redefinition of the PEP II collider (Asymmetric B-Factory). PEP II will have both low- and high-energy storage rings co-located in the existing PEP rings. The high-energy ring will store 9 GeV electrons, while the low-energy ring will have 3 GeV positrons. They are thus asymmetric with respect to energy. The facility is expected to be fully operational in the latter half of CY98.

ESA has been refitted to perform as the technical research area for the next generation of linear accelerator. NLCTA began initial lower-power testing by the end of CY97. NLCTA has it's own injector and RF sources, and will continue to test the new accelerator theories by means of real-world experimentation.

As is shown in section 3.3 of this report, even with all ten facilities powered-up, SLAC's potential emission of activated gases is extremely minor. At a calculated release of less than eight ten-thousandths (<0.0008) of a mrem per year, SLAC is far below the ten mrem (0.1 mSv) NESHAPs 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 CY97, the collective effective dose equivalent for the population within 80 km from SLAC 's site boundary (4,917,443 persons) was estimated to be 4.39×10^{-3} person-rem (4.39×10^{-5} person-Sv).
- The reported source terms in the NESHAP's report for CY97 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.
- SLAC followed-up the 18 December 1997 meeting with EPA, Region IX. Three elements of the NESHAPs program at SLAC program were detailed at the meeting. Specifically:
  (1) The use of SFO meteorological data.
  (2) Potential SLAC air emissions source terms.
  (3) Confirmatory monitoring was addressed. (Letter, Sit to Rosenblum, subject: *Discussion of SLAC's NESHAPs Program Elements*, dated 9 January 1998.)

C Calibration and Quality Assurance Procedures

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

C.1 Direct Radiation Monitoring Equipment

A regular calibration procedure was performed on the PMSs in CY97. 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. The calibration procedure was not performed in CY97. An improved calibration program is under development.

C.2 Liquid Radiological Effluents

Water samples are analyzed in-house with a liquid scintillation counter (LSC) and a hyper-pure germanium (HPGe) detector as necessary. Both pieces of equipment are calibrated with appropriate National Institute of Standards and Technology (NIST) traceable sources.

D Environmental TLD Measurements for CY97

The following appendix contains data on environmental TLD measurements for CY97. It includes:

- Summary of net photon and neutron doses for CY97.
- Environmental TLD Monitoring Stations (Table D-1).

Notes:

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 CY97

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	-4.8	+/-	6.6	M[a]
SB at Injector	2	-0.7	+/-	6.6	M[a]
Computer Center SE Corner	3	0.4	+/-	6.9	M[a]
SB at Region 4	4	-1.7	+/-	6.2	M[a]
SB at North Damping Ring	5	12.6	+/-	6.2	M[a]
I-280 Overpass South	6	4.4	+/-	6.3	M[a]
SB at Sector 10 south	7	3.4	+/-	6.2	M[a]
SB across from B of A	8	2.3	+/-	6.4	M[a]
Alpine Gatehouse	9	-4.8	+/-	6.0	M[a]
Meteorological Tower	10	-2.5	+/-	6.1	M[a]
SB at SLD	11	-1.0	+/-	6.1	M[a]
SB at Region 12	12	1.6	+/-	6.6	M[a]
SB at Region 2	13	-13.1	+/-	6.0	M[a]
SLAC Entrance Gatehouse	14	-1.8	+/-	6.0	M[a]
SLAC Cafeteria	15	-0.1	+/-	6.3	M[a]
SB at Region 8	16	-6.2	+/-	5.9	M[a]
SB at Addison Wesley Building	17	-3.7	+/-	7.7	M[a]
SB at Positron Vault	18	3.1	+/-	6.0	M[a]
Control	19	3.1	+/-	6.1	M[a]
SB at Sector 20 south	20	16.4	+/-	6.2	M[a]
SB at South Damping Ring	21	-3.1	+/-	6.1	M[a]
I-280 Overpass North	22	23.1	+/-	6.2	M[a]
SB at Sector 21 south	23	14.8	+/-	6.3	M[a]
OHP Department Head Office	24	6.8	+/-	6.0	M[a]
PMS 1	26	8.4	+/-	7.1	M[a]
PMS 2	27	8.0	+/-	8.1	M[a]
PMS 3	28	-2.1	+/-	5.8	M[a]
PMS 4	29	-5.4	+/-	6.1	M[a]
PMS 5	30	-2.3	+/-	6.8	M[a]
PMS 6	31	6.6	+/-	6.6	M[a]
PMS 7	32	2.1	+/-	6.5	M[a]
SB at Sector 24 north	33	24.1	+/-	6.0	M[a]
SB at Sector 17 north	34	7.2	+/-	6.6	M[a]
SB at Sector 5 north	35	32.2	+/-	6.3	M[a]

[a] Below the minimum detection limit.

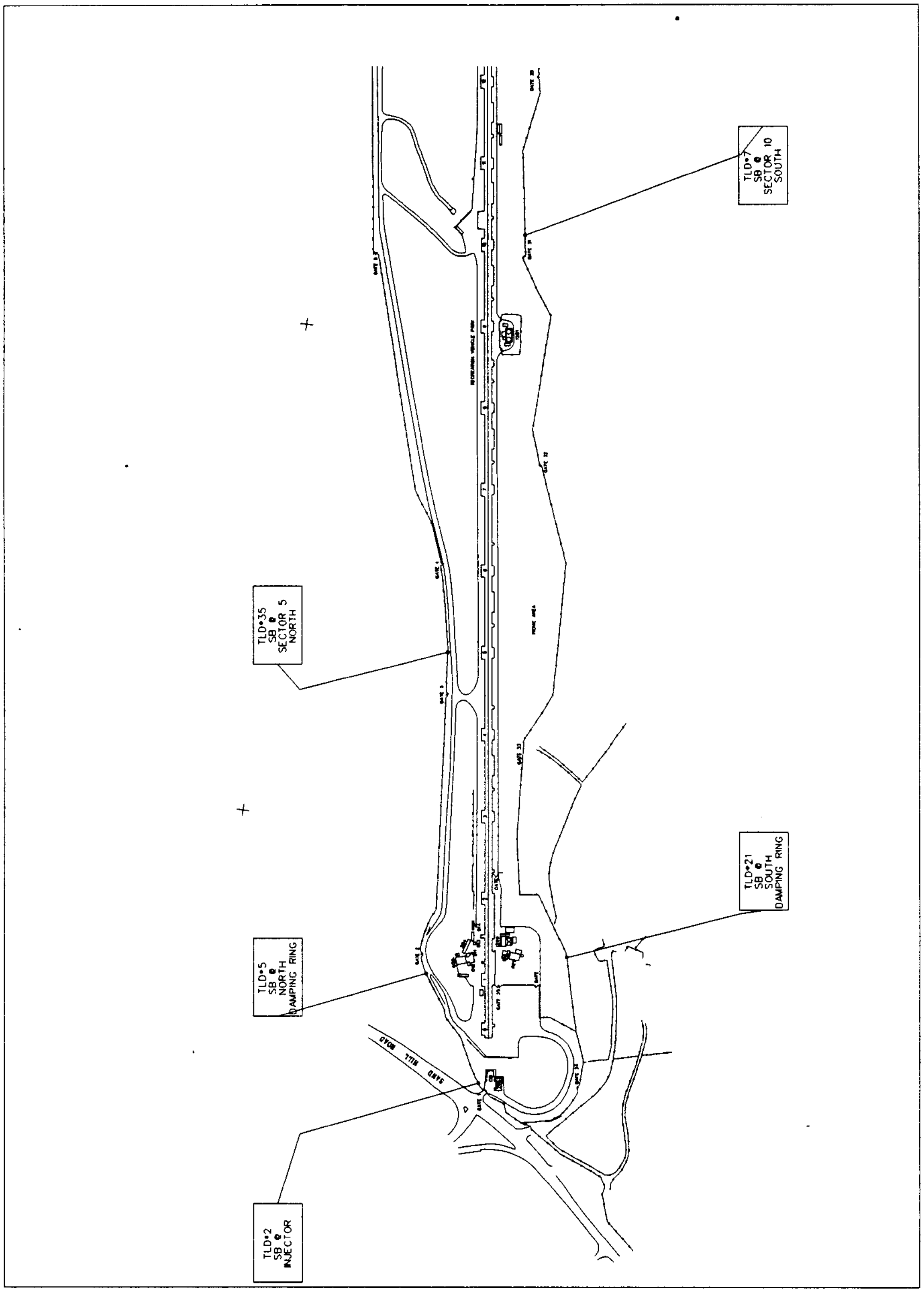

Figure D-1 Environmental TLD Monitoring Stations, Sectors 0 through 12

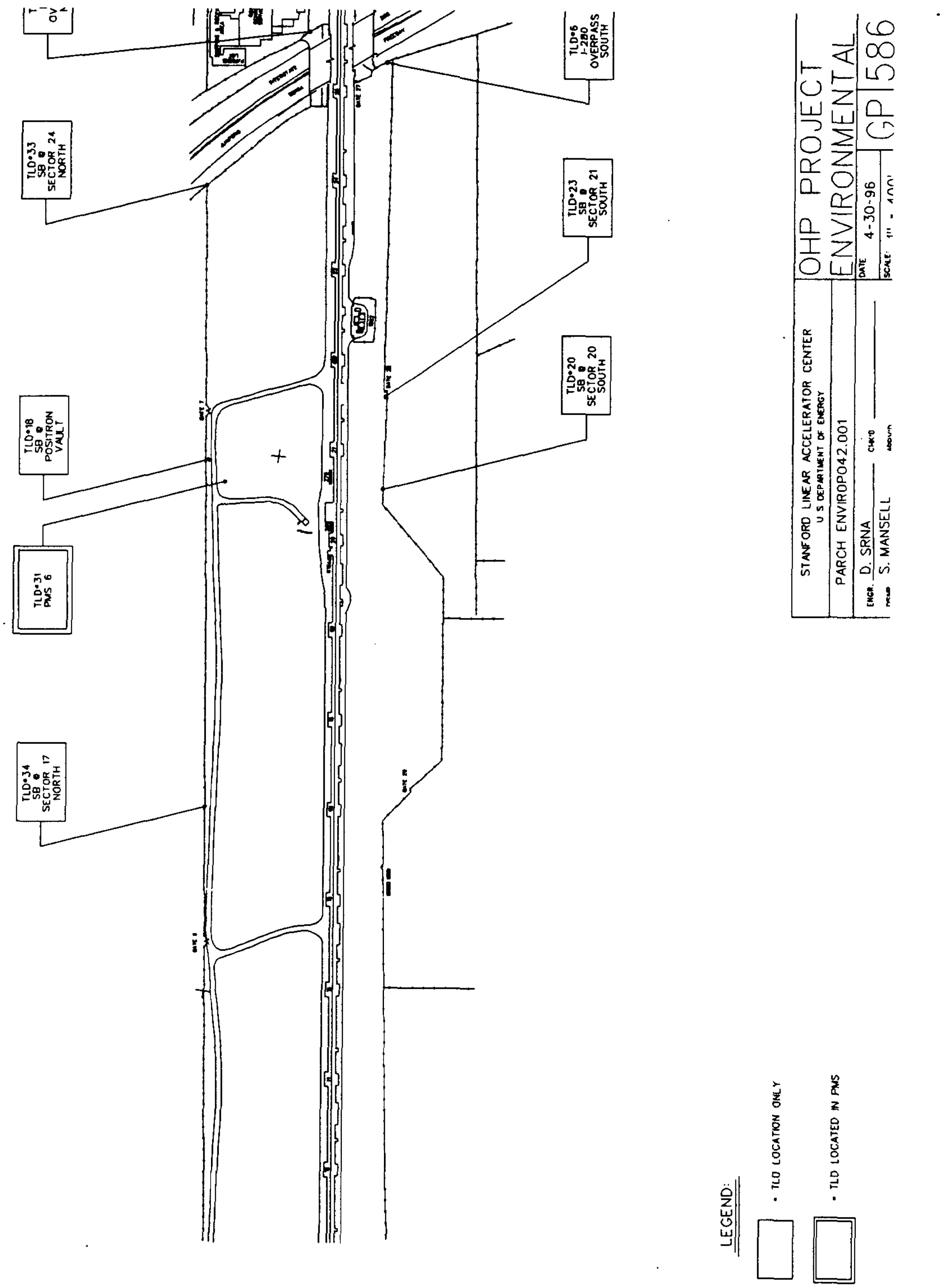

Figure D-2 Environmental TLD Monitoring Stations, Sectors 12 through 27

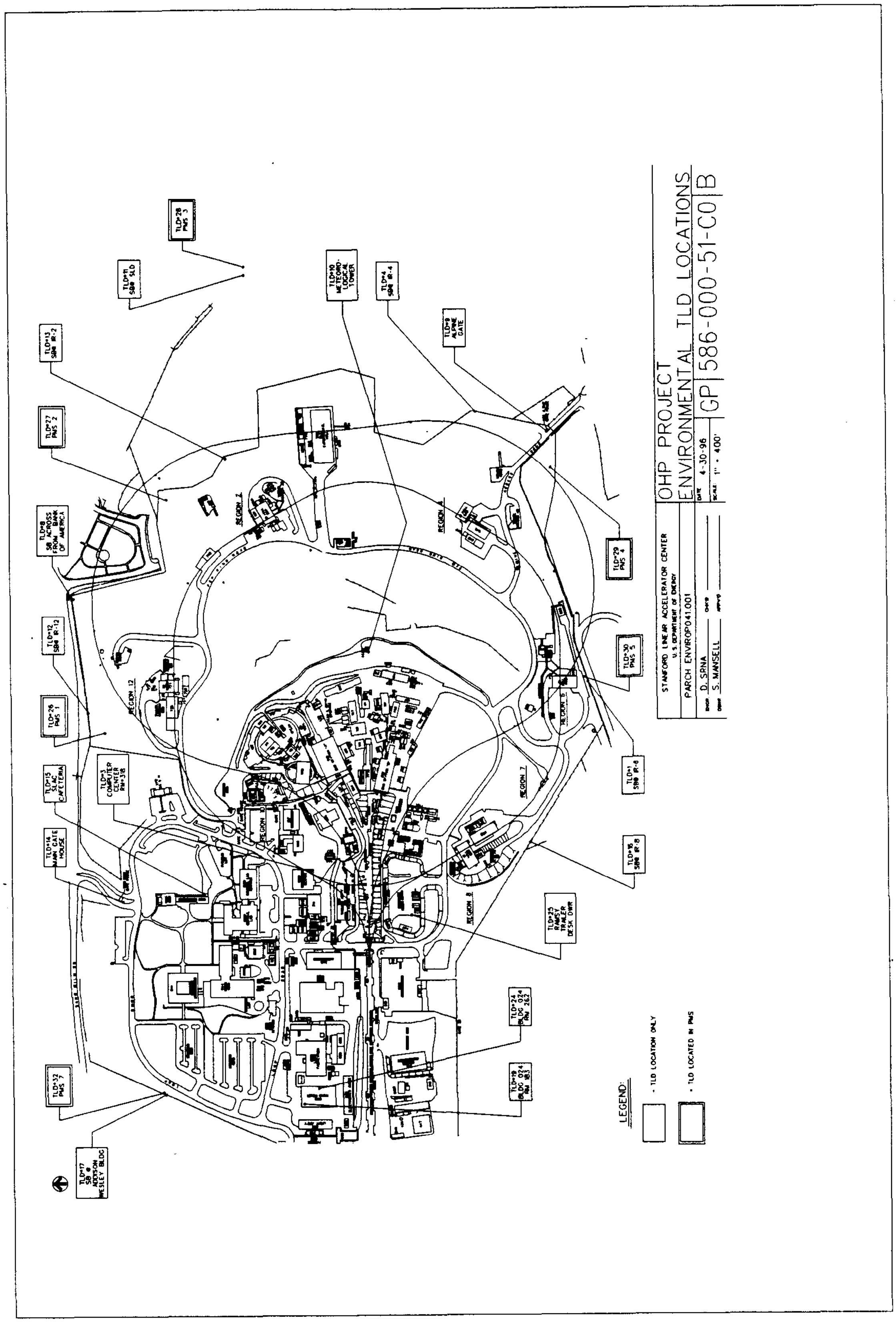

Figure D-3 Environmental TLD Monitoring Stations, Sector 27 through SLC

E Acronym List

A

AIP	Agreement In Principle
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

C

CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWMA	Central Hazardous Waste Management Area
CPM	Counts Per Minute
CRMP	Comprehensive Resource Management and Planning
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year

D

DCA	Dichloroethane
DCE	Dichloroethene
DCG	Derived Concentration Guide
DOE	Department of Energy
DOE/OAK	DOE Operations Office, Oakland, CA

E

EA	Environmental Assessment
EC	Electrical Conductivity
EDE	Effective Dose Equivalent

E

EECA	Engineering Evaluation and Cost Analysis
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPR	Environmental Protection and Restoration
ERP	Environmental Restoration Program
ES&H	Environment, Safety, and Health
ESA	End Station A
ESA	Endangered Species Act
ESHCC	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
FUST	Former Underground Storage Tank

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
MCL	Maximum Contaminant 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
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
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

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

P

POTW	Publicly Owned Treatment Work
PPO	Program Planning Office
PS	Positron Source

Q

QA	Quality Assurance
QC	Quality Control

R

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RP	Radiation Physics
RQ	Reportable Quantity
RWQCB	Regional Water Quality Control Board
RWTP	Rinse Water Treatment Plant

S

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
SLAC	Stanford Linear Accelerator Center
SLC	Stanford Linear Collider
SLD	SLAC Large Detector
SPCC	Spill Prevention, Control, and Countermeasure 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
TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimeter
TPH	Total Petroleum Hydrocarbons
TRI	Toxic Release Inventory

T

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
WM	Waste Management
WTS	Waste Tracking System

F ASER Distribution List

Bill Griffin
Head,
Environment, Safety, and Health Section
Fermi National Accelerator Laboratory MS 119
P.O. Box 500
Batavia, IL 60510

District Manager
West Bay Sanitary District
500 Laurel Street
Menlo Park, CA 94025

Rebecca Failor
Environmental Monitoring Program Leader
L-629
P.O. Box 808
Lawrence Livermore National Laboratory
Livermore, CA 94550

Paul Frame
PTP/TMSD
ORISE
PO Box 117
Oak Ridge, TN 37830

Steve Hsu
State of California
Department of Health Services
Radiological Health Branch
P.O. Box 942732
Sacramento, CA 95634-7320

Bill Klokke
South Bayside System Authority
1400 Radio Road
Redwood City, CA 94065

Leslie Laudon
State Water Resources Control Board
Division of Clean Water Programs
P.O. Box 94412
Sacramento, CA 95834-2120

William Lent
San Mateo Department of Health Services
Office of Environmental Health
County Office Building
590 Hamilton Street
Redwood City, CA 94063

Librarian
Oak Ridge National Laboratory
Technical Information Center
Oak Ridge, TN 37830

Felicia Marcus
U.S. Environmental Protection Agency
Region IX
75 Hawthorne
San Francisco, CA 94105

Bob May
TJNAL/SURA Radiation Control Group
Mail Stop 12 A 1
12000 Jefferson Avenue
Newport News, VA 23606

John Muhlestein
U.S. Department of Energy
Oakland Operations Office
Stanford Site Office
Stanford Linear Accelerator Center
P.O. Box 4349 M/S 8A
Stanford, CA 94309

John B. Murphy
Oak Ridge National Laboratory
Building 4500N, MS 6198
Oak Ridge, TN 37831

Charles NeSmith
State Water Resources Control Board
Division of Clean Water Programs
Solid Waste Assessment Test Unit
P.O. Box 944212
Sacramento, CA 94244-2120

James Nusrala
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street
Oakland, CA 94612

OSTI
U.S. Department of Energy Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, Tennessee 37831

Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1111 Jackson Street
Oakland, CA 94612

Phil Rutherford, Manager
Radiation Protection & Health Physics Services
Rocketdyne Division
Rockwell International Corporation
6633 Canoga Ave.
P. O. Box 7922 (MS T100)
Canoga Park, CA 91309-7922

John Semerau
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Annette Walton
Stanford Management Company
2770 Sand Hill Road
Menlo Park, CA 94025

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 readership—whether they be regulators, scientists, or the public—a clear accounting of the range of environmental activities we undertake, the methods we employ, the degree of accuracy of our results, the status of our program, and significant issues affecting programs.

It is important that the information we provide is easily understood, of interest, and communicates SLAC's effort to protect human health and minimize our impact on the environment. We would like to know from you whether we are successful in achieving these goals. Your comments are appreciated.

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?	☐	☐
	Are the figures understandable?	☐	☐
	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.	Are the methodologies described reasonably understandable?	☐	☐
8.	Is the acronym list useful?	☐	☐
9.	Are the appendices useful?	☐	☐

Other comments:

This survey may be folded and stapled and returned to SLAC. Laboratory staff may send their survey forms through laboratory mail to Gene Holden, Mailstop 84.

---FOLD HERE---

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

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