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RD97-134

Rocketdyne Propulsion & Power
DOE Operations
Annual Site
Environmental Report
1996

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ROCKETDYNE PROPULSION & POWER
DOE OPERATIONS
ANNUAL SITE
ENVIRONMENTAL REPORT
1996

Prepared by the Staff of Environmental Remediation

Edited by R. J. Tuttle, CHP

November 10, 1997

BOEING

Site Environmental Report Reader Survey

To Our Readers:

The 1996 Annual Site Environmental Report publishes the results of environmental monitoring in support of DOE-sponsored programs at Rocketdyne's Santa Susana Field Laboratory and DeSoto sites, and documents our compliance with federal, state, and local environmental regulations. In providing this information, our goal is to give our readership - regulators, scientists, and the public - a clear understanding of our environmental activities, the methods we use, how we can be sure our results are accurate, the status of our programs, and significant issues affecting our programs.

It is important that the information we provide is easily understood, of interest, and communicates Rocketdyne's efforts 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 and will help us to improve our communications.

1. Is the writing ❑ too concise? ❑ too wordy? ❑ uneven? ❑ just right?
2. Is the technical content ❑ too concise? ❑ too wordy? ❑ uneven? ❑ just right?
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		Yes	No
4.	Is the report comprehensive? (please identify issues you believe are missing in the comments section)	❑	❑
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	Are the figures understandable?	❑	❑
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	Too many?	❑	❑
6.	Are the data tables of interest?	❑	❑
	Would you prefer short summaries of data trends instead?	❑	❑
7.	Is the background information sufficient?	❑	❑
	Are the methodologies described reasonably understandable?	❑	❑
8.	Are the glossaries and appendices useful?	❑	❑

Other comments:

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Please return this survey to Radiation Safety - M/S T487, Rocketdyne Propulsion & Power, 6633 Canoga Avenue, Canoga Park, CA 91309

OPTIONAL INFORMATION

Name: ____________________ Occupation: ____________________

Address: ____

CERTIFICATE OF ACCURACY

I certify that I have personally examined and am familiar with the information submitted herein and, based on inquiry of those individuals immediately responsible for preparing this report, I believe that the submitted information is true, accurate, and complete.

Mark J. Gabler, Director
Energy Technology Engineering Center

October 30, 1997

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

DEC 4 1997

Distribution:

SUBECT: 1996 Site Environmental Report (SER) for the Energy Technnology Engineering Center (ETEC)

This report, prepared by the Rocketdyne Division of Boeing North American, Inc. (RD) for the U.S. Department of Energy, Oakland Operations Office (DOE-OAK), provides a comprehensive summary of the DOE environmental protection activities at the Energy Technology Engineering Center (ETEC) for Calendar Year 1996. Site Environmental Reports (SERs) are prepared annually for all DOE sites with significant environmental activities, and distributed to relevant external regulatory agencies and other interested organizations or individuals.

To the best of my knowledge, this report accurately summarizes the results of the 1996 environmental monitoring and restoration program at ETEC for the DOE. This assurance can be made based on DOE-OAK and RD review of the SER, and quality assurance protocols applied to monitoring and data analyses at ETEC.

A reader survey form is provided with the SER to provide comments or suggestions for future versions of the report. Your response is appreciated. Questions or comments regarding this report may also be made directly to DOE-OAK, by contacting Steve Black of the Environment, Safety, and Health Division at (510) 637-1595, or by mail to the address above.

Sincerely,

James T. Davis
Associate Manager for
Environmental Management

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TABLES

FIGURES

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1. EXECUTIVE SUMMARY

Rocketdyne currently operates several facilities in the San Fernando Valley/Simi Valley area, for manufacturing, testing, and research and development (R&D). These operations include manufacturing liquid-fueled rocket engines, such as the Space Shuttle Main Engine (SSME) and engines used for expendable launch vehicles used to place artificial satellites into orbit. This work includes fabrication and testing of rocket engines, lasers, and heat-transfer systems; and R&D in a wide range of high-technology fields, such as the electrical power system for the Space Station. Previously, this work also included development, fabrication, and disassembly of nuclear reactors, reactor fuel, and other radioactive materials, under the Atomics International Division (AI). AI was merged into Rocketdyne in 1984 and many of the AI functions were transferred to existing Rocketdyne departments. This nuclear work was terminated in 1988, and subsequently, all radiological work has been directed toward decontamination and decommissioning (D&D) of the previously used nuclear facilities and associated site areas. The majority of this work is done for the Department of Energy (DOE). This Annual Site Environmental Report for 1996 concentrates on the environmental conditions related to DOE operations at Area IV of SSFL and at De Soto.

The results of the radiological monitoring program for the calendar year of 1996 continue to indicate that there are no significant releases of non-natural radioactive material from Rocketdyne sites. The atmospheric discharge of radioactive materials in ventilation exhausts, airborne dust from remediation activities, and direct radiation exposure are the only potential exposure pathways to the general public from Rocketdyne's radiological cleanup and waste packaging operations. All radioactive wastes are processed for disposal at DOE disposal sites and other sites licensed for radioactive waste. Liquid radioactive wastes are not released into the environment and do not constitute an exposure pathway. Groundwater and surface water in the environment are sampled and analyzed to ensure detection of any non-natural radioactivity. Neither groundwater nor surface water is used as a source of drinking water or agricultural irrigation. Except for low concentrations of tritium in some of the groundwater wells and a seepage location, well below Federal and State drinking water standards, only naturally occurring radioactivity has been found in this water. The groundwater wells that show tritium, and the seepage location, are associated with an excavated test reactor facility (Building T010). The excavated area is saturated by water drift from a cooling tower and this mobilizes tritium that was produced in the soil by operation of the test reactor.

Radioactivity in the facility ventilation exhaust effluents, and in the ambient air, is analyzed to assess any impact of the remaining radiological operations on the public and the environment. Little radioactivity is dispersed by these operations and very little is released to the environment, because of highly efficient air filtration systems. Only small amounts of non-natural radioactivity are found in the exhaust effluents. Except for localized areas of facility and soil contamination, only naturally occurring radioactivity can be detected in soil and vegetation samples. Some areas of soil contamination were exposed to the wind and potential airborne suspension has been estimated for these sources.

Calculated radiation doses to the public, due to airborne releases and direct radiation, are a factor of thousands to millions of times lower than the applicable limits as well as the naturally existing background levels. These hypothetical doses are too small to permit direct measurement. Conservative calculations provide upper-limit estimates of possible doses to the public. The radiation dose to a member of the public due to direct radiation is estimated to be less than 0.0003 mrem. This can be compared with the annual dose from natural sources of about 100 mrem. The maximum public dose due to airborne radioactivity released from SSFL facilities is estimated to be less than 0.0064 mrem. This is far below the annual dose from natural airborne activity, about 100 to 200 mrem.

The non-radiological monitoring program has increased in recent years, with more extensive sampling of the groundwater at the Santa Susana Field Laboratory (SSFL). Nine new wells were installed in 1993 and 1994 to characterize the hydrogeology and water quality of known groundwater chemical contamination, horizontally and vertically, and in relation to the potential source areas. Three new wells were installed in Area IV in 1994 for extraction and treatment of degraded groundwater. No new wells were drilled in 1996. In 1996, there were 216 onsite and 16 offsite wells sampled under the program. These water samples were analyzed for chemical and radiological constituents, as appropriate.

Surface discharges of water, after use in rocket-engine testing and other industrial purposes, are analyzed at least monthly for 84 analytes and quarterly for 169 analytes per discharge location. Three existing trichloroethylene occurrences in the groundwater in the northwest part of Area IV were monitored in 1996. No new offsite plume of degraded groundwater was detected from these wells.

During 1996, 37 agency inspections, audits, and visits were conducted. Several Notices of Violations (NOVs) were issued during 1996. One set of NOVs involved groundwater monitoring wells. Rocketdyne responded to these by marking standard reference points, disagreeing that a release of untreated uncontaminated water constituted a violation, and agreeing to avoid below-grade completions of monitoring wells. The other set addressed the function of the Radiation Safety Committee. An annual meeting and committee audit of use locations had not been done in 1995. In response, the Committee was reconstituted and made active in 1996. A citation was issued by the State of Tennessee for an improperly labeled shipment of radioactively contaminated material.

In summary, this report provides information showing that there are no indications of any potential impacts on the health and safety of the public, near or distant, due to the operations conducted at the Santa Susana Field Laboratory and the De Soto site. All measures and calculations of offsite conditions demonstrate compliance with applicable regulations. These measurements confirm that the control of releases of hazardous substances from Rocketdyne operations is extremely effective.

At the end of 1996 (December 6), the merger with The Boeing Company of the aerospace and defense operations of Rockwell International, including the Rocketdyne Division and the DOE operations at the Santa Susana Field Laboratory, was completed. This report uses historically correct terms for the organizations involved in the environmental monitoring and protection during 1996.

2. INTRODUCTION

This annual report discusses environmental monitoring at two manufacturing and test operations sites operated in the Los Angeles area by Rocketdyne Propulsion & Power of Boeing North American, Inc. (formerly Rockwell International Corporation). These are identified as the Santa Susana Field Laboratory (SSFL) and the De Soto site. The sites have been used for manufacturing, R&D, engineering, and testing in a broad range of technical fields, primarily rocket engine propulsion and nuclear reactor technology. The De Soto site essentially comprises office space and light industry with no remaining radiological operations, and has little potential impact on the environment. The SSFL site, because of its large size (2,668 acres), warrants comprehensive monitoring to ensure protection of the environment.

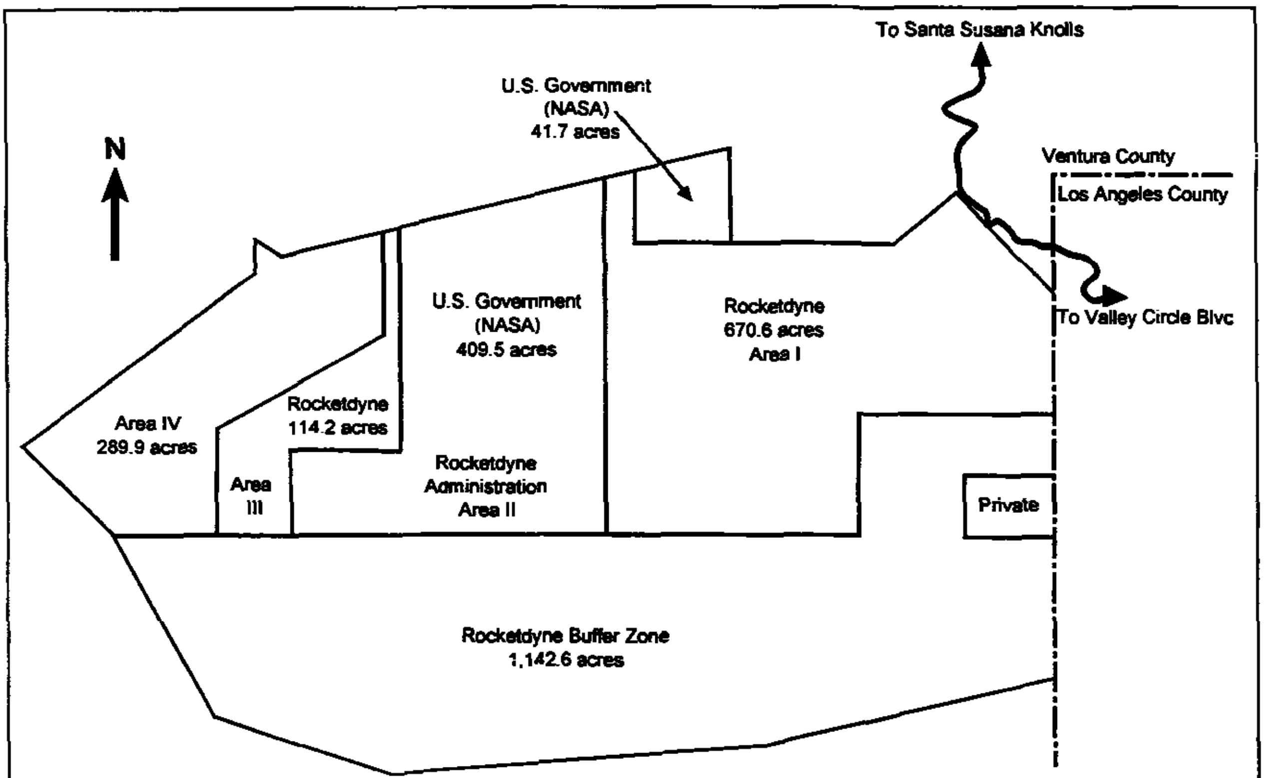
SSFL consists of four administrative areas used for research, development, and test operations as well as a buffer zone. The arrangement of these areas is shown in Figure 2-1.

A portion of Area I and all of Area II are owned by the U.S. Government and assigned to the National Aeronautics and Space Administration (NASA). A portion of Area IV is under the jurisdiction of the Department of Energy (DOE).

The primary purpose of this report is to present information on environmental and effluent monitoring of DOE-sponsored activities to the regulatory agencies responsible for radiological operations, the U.S. DOE, the Nuclear Regulatory Commission (NRC), and the California State Department of Health Services (DHS) Radiologic Health Branch (RHB). For that reason, information concentrates on Area IV at SSFL, which is the only area where DOE radiological operations have been performed. While the major focus of attention is radiological, this report also includes a discussion of non-radiological monitoring at SSFL. In addition, this report attempts to communicate to our workers and neighbors, and our regulators and customers, factual information regarding the radiological condition of our environment. To assist us in this purpose, a reader response survey form has been included in the front of this report. We would appreciate your comments.

Areas I, II, and III have been used for developing and testing rocket engines and propellants, lasers, and other energy technologies since 1949. No operations with nuclear fuel or nuclear reactors were conducted in those areas. Since 1956, Area IV has been used for work with nuclear materials, including fabricating nuclear reactor fuels, testing nuclear reactors, and disassembling used fuel elements. This work ended in 1988 and subsequent efforts have been directed toward decommissioning and decontamination (D&D) of the former nuclear facilities.

Work in nuclear energy R&D in what has become Rocketdyne Propulsion & Power of Boeing North American began under North American Aviation, Inc. in 1946. During the evolution of these operations, small test and demonstration reactors and critical assemblies were built and operated, reactor fuel elements were fabricated, and used reactor fuel elements were disassembled and declad. These projects have been completed and terminated in the course



Subdivisions			
Owners	Jurisdiction	Acres	
Rocketdyne	Rocketdyne--Area IV	289.9	
	Rocketdyne	784.8	
	Rocketdyne (Buffer)	1,142.6	2,217.3
Government	NASA (former AFP 57)	409.5	
	NASA (former AFP 64)	41.7	451.2
Total Acres			2,668.5

Figure 2-1. Santa Susana Field Laboratory Site Arrangement

of the past 30 years. Most of this work was performed at SSFL and is described in detail in the Rocketdyne document "Nuclear Operations at Rockwell's Santa Susana Field Laboratory—A Factual Perspective" (Ref. 1). No work with nuclear materials has been conducted at SSFL since 1988, and the only work related to these operations since that time and during 1996 was the ongoing cleanup and decontamination of the remaining inactive nuclear facilities, and the offsite disposal of radioactive waste.

The nuclear operations and the ensuing cleanups have been conducted under State and Federal licenses and under contract to DOE and its predecessors. In April 1990, the NRC Special Nuclear Materials license was amended to permit only decommissioning operations. Following transfer of ownership of the Hot Laboratory (Hot Lab) from Rockwell International to the DOE, and reflecting the close involvement of DOE in the decommissioning operations, the NRC terminated the Special Nuclear Materials license in September 1996 and relinquished responsibility and jurisdiction over the Hot Lab to the DOE.

The location of the SSFL site in relation to nearby communities is shown in Figures 2-2 and 2-3. Undeveloped land surrounds most of the SSFL site. There are occasional cattle grazing on land near the southern portion of the site, and the Santa Monica Mountains Conservancy's Sage Ranch Park is at the northeastern boundary of SSFL. No significant agricultural land use exists within 30 km (19 miles) of the SSFL site. While the land immediately surrounding SSFL is undeveloped, at greater distances there are suburban residential areas. For example, 2.7 km (1.7 miles) toward the northwest from Area IV is the closest residential portion of Simi Valley. The community of Santa Susana Knolls lies 4.8 km (3.0 miles) to the northeast, and a small truck farm exists approximately 7 km (4.4 miles) to the northeast. The Bell Canyon area begins approximately 2.3 km (1.4 miles) to the southeast, and the Brandeis-Bardin Institute is adjacent to the north. A sand and gravel quarry was operated approximately 2.4 km (1.5 miles) to the west but is now abandoned.

The Los Angeles basin is a semiarid region whose climate is controlled primarily by the semipermanent Pacific high-pressure cell that extends from Hawaii to the Southern California coast. The seasonal changes in the position of this cell greatly influence the weather conditions in this area. During the summer months, the high-pressure cell is displaced to the north. This results in mostly clear skies with little precipitation. During the winter, the cell moves sufficiently southward to allow some Pacific lows with their associated frontal systems to move into the area. This produces light to moderate precipitation with northerly and northwesterly winds.

During the summer, a shallow inversion layer generally exists in the Los Angeles area. The base and top of this inversion layer usually lie below the elevation of the SSFL site. Thus, any atmospheric release from the SSFL site during the summer would likely result in considerable atmospheric dispersion above the inversion layer prior to any diffusion through the inversion layer into the Simi or San Fernando Valleys. In the winter season, surface air-flow is dominated by frontal activity moving easterly through the area. Storms passing through the area during winter are generally accompanied by rainfall. Airborne mixing varies depending on the location of the weather front relative to the site. Generally, a light to moderate southwesterly wind precedes these storms, introducing a strong onshore flow of marine air and producing slightly unstable air. Wind speeds increase as the frontal systems approach, enhancing mixing and dispersion. Locally, average wind speeds range from 0 to about 4.4 m/s, mostly from the north and northwest.

Except for the Pacific Ocean approximately 20 km (12 miles) south, no recreational body of water of noteworthy size is located in the surrounding area. Four major reservoirs providing domestic water to the greater Los Angeles area are located within 50 km (30 miles) of SSFL. However, the closest reservoir to SSFL (Bard Reservoir) is more than 10 km (6 miles) from Area IV. The nearest groundwater well that is used for a municipal water supply is more than 16 km (10 miles) from Area IV, north of Moorpark.

The SSFL site occupies 2,668 acres located in the Simi Hills of Ventura County, approximately 48 km (30 miles) northwest of downtown Los Angeles. The SSFL site is situated on rugged terrain, typical of mountain areas of recent geological age. Elevations of the site vary from 500 to 700 m (1,650 to 2,250 ft) above sea level (ASL). Rocketdyne- and DOE-owned facilities (Figures 2-4 and 2-5) share the Area IV portion of this site.

Within Area IV of the SSFL site is a 90-acre area where DOE contract activities are conducted. All the DOE work is now performed by the Energy Technology Engineering Center (ETEC). The major operational nuclear installation within the DOE area is the Radioactive Materials Handling Facility (RMHF)[1]. This facility has been used for storage of sealed irradiated nuclear reactor fuel materials and for packaging radioactive wastes resulting from nuclear facility decommissioning operations. No nuclear fuel has been present at the RMHF since May of 1989 when the last packages of disassembled Fermi-reactor fuel were shipped to another DOE site. Radioactively contaminated water produced in the decontamination operations is evaporated and the sludge is dried and disposed as packaged dry waste together with other dry wastes at a DOE disposal site.

The SSFL site also contains facilities in which operations with nuclear materials licensed by the NRC and radioactive materials licensed by the State of California were conducted, principally at the Hot Lab. The NRC Special Nuclear Materials license was terminated on September 9, 1996, and jurisdiction for the Hot Lab was transferred to the DOE.

Licensed programs conducted during 1996 were directed toward D&D of the Hot Lab, which was last used for nuclear reactor fuel disassembly in 1987. After the NRC license was terminated the D&D work has continued under DOE responsibility.

[1] Formerly the Radioactive Materials Disposal Facility (RMDF).

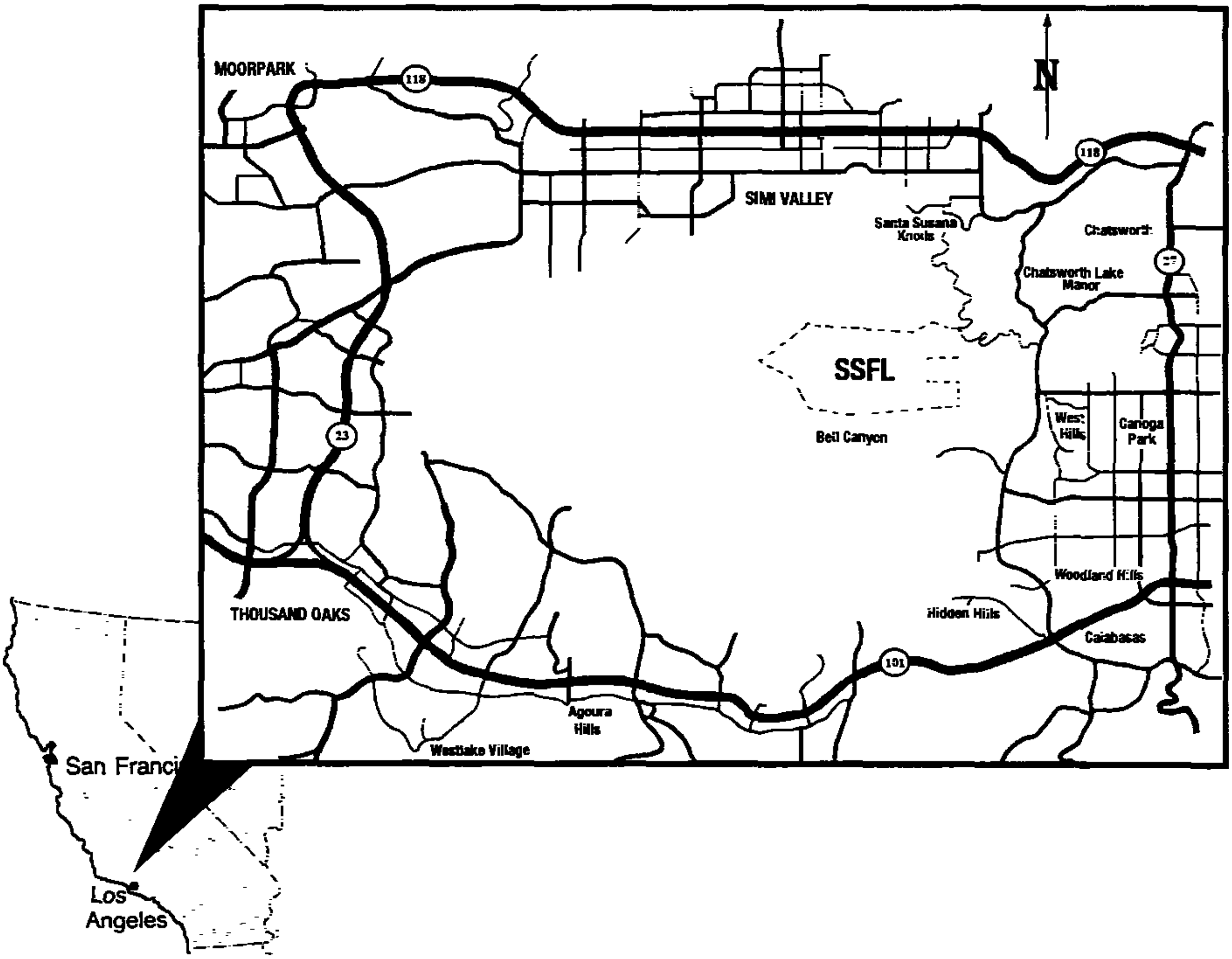


Figure 2-2. Map Showing Location of SSFL

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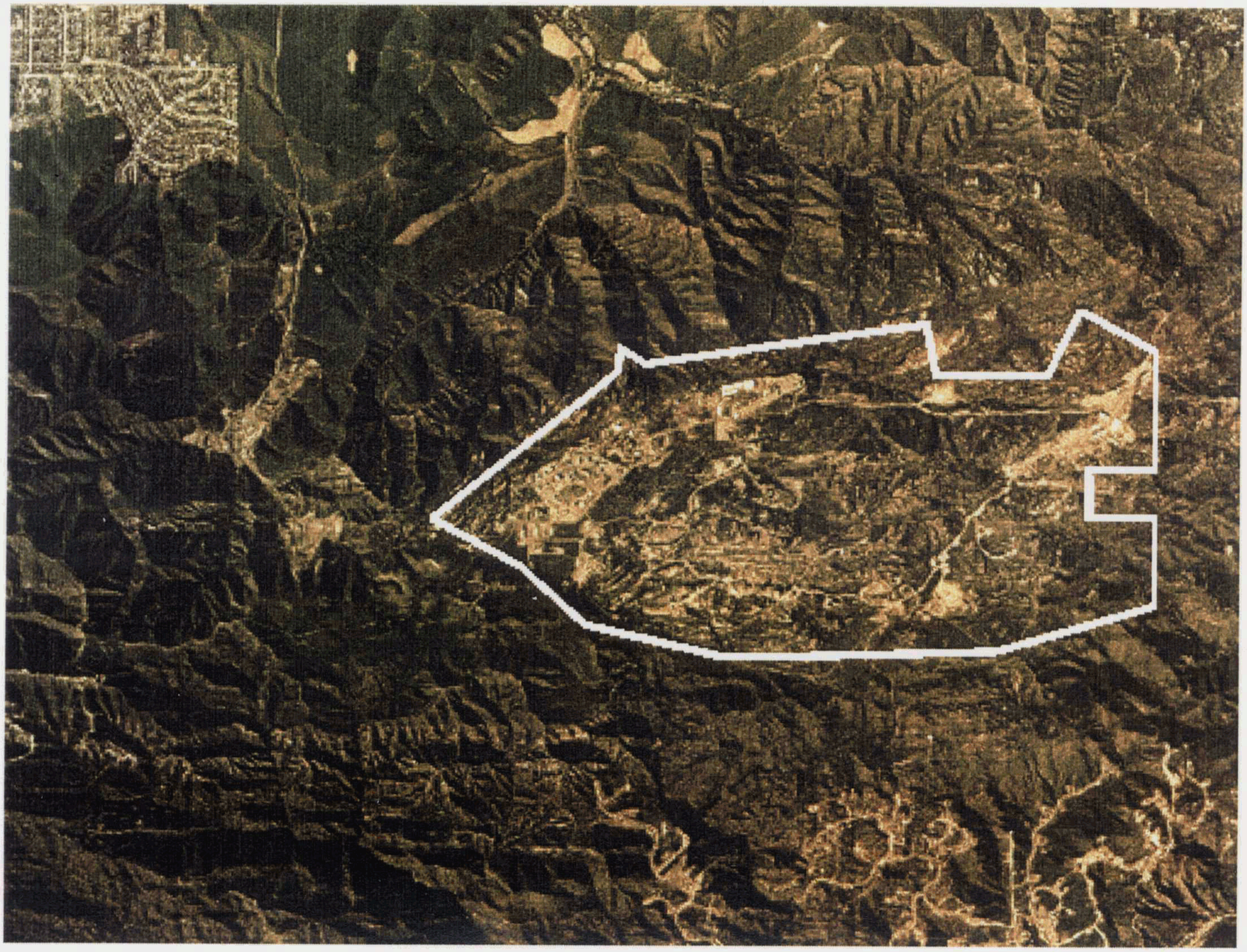

Figure 2-3. Area Surrounding SSFL

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Figure 2-4. Rocketdyne Propulsion & Power - Santa Susana Field Laboratory Site, Area IV

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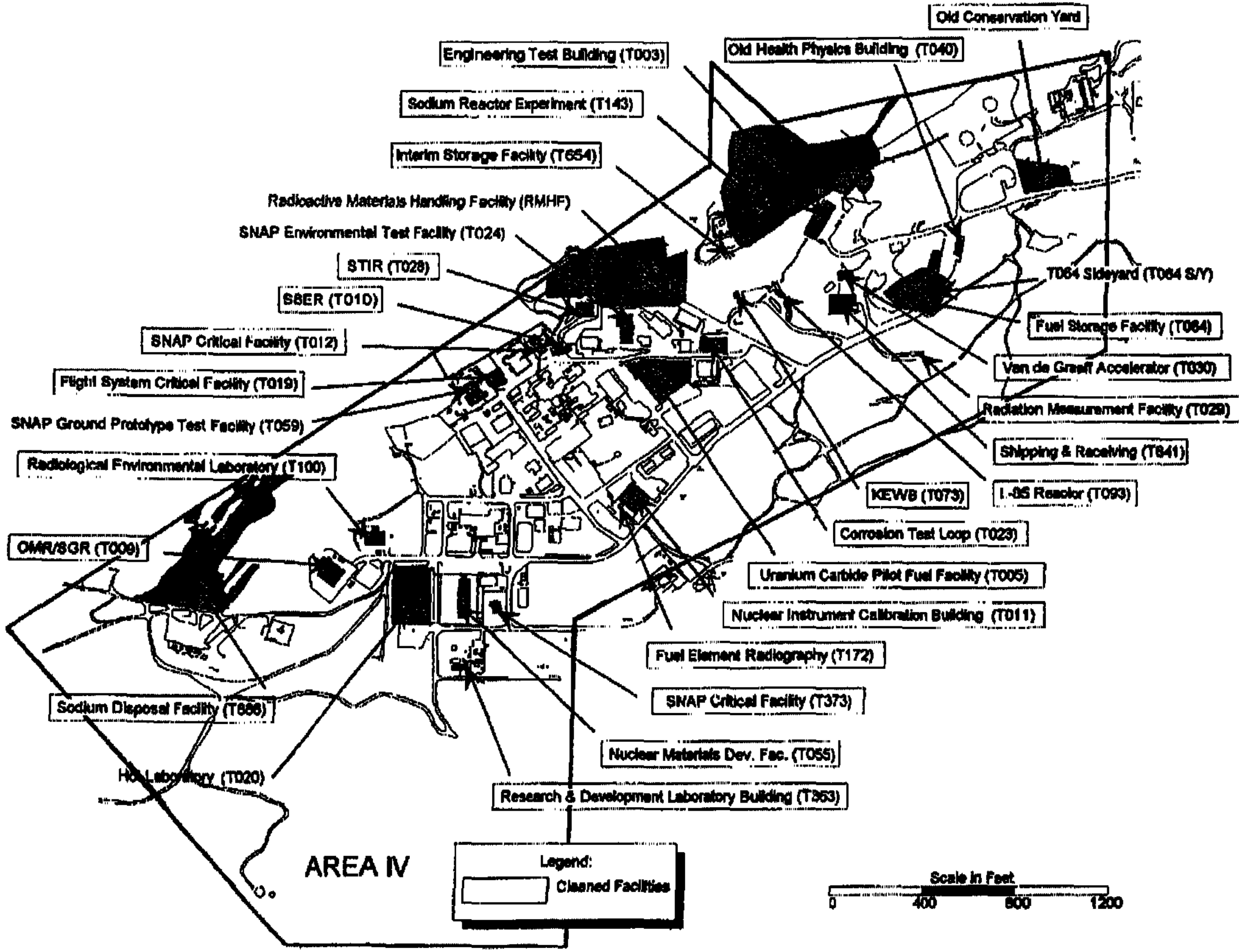

Figure 2-5. Map of Santa Susana Field Laboratory Area IV Facilities

Up until 1995, research using radioactive materials for DOE and licensed by the State of California was conducted at the De Soto site (Figure 2-6) in the Building 104 Applied Nuclear Technology Laboratories. Irradiation operations in the Gamma Irradiation Facility, also located at Building 104, were terminated in 1994 and the radiation sources were shipped offsite. Operations at the Helium Analysis Laboratory were terminated in May 1995, and the equipment was relocated to Battelle - Pacific Northwest National Laboratories (PNNL) in Richland, Washington. This transfer terminated all work (other than D&D) with radioactive materials at the De Soto site.

Surrounding the De Soto complex is light manufacturing, other commercial establishments, apartment buildings, and single-family houses. The De Soto location is at an altitude of 267 m (875 ft) ASL on generally flat terrain.

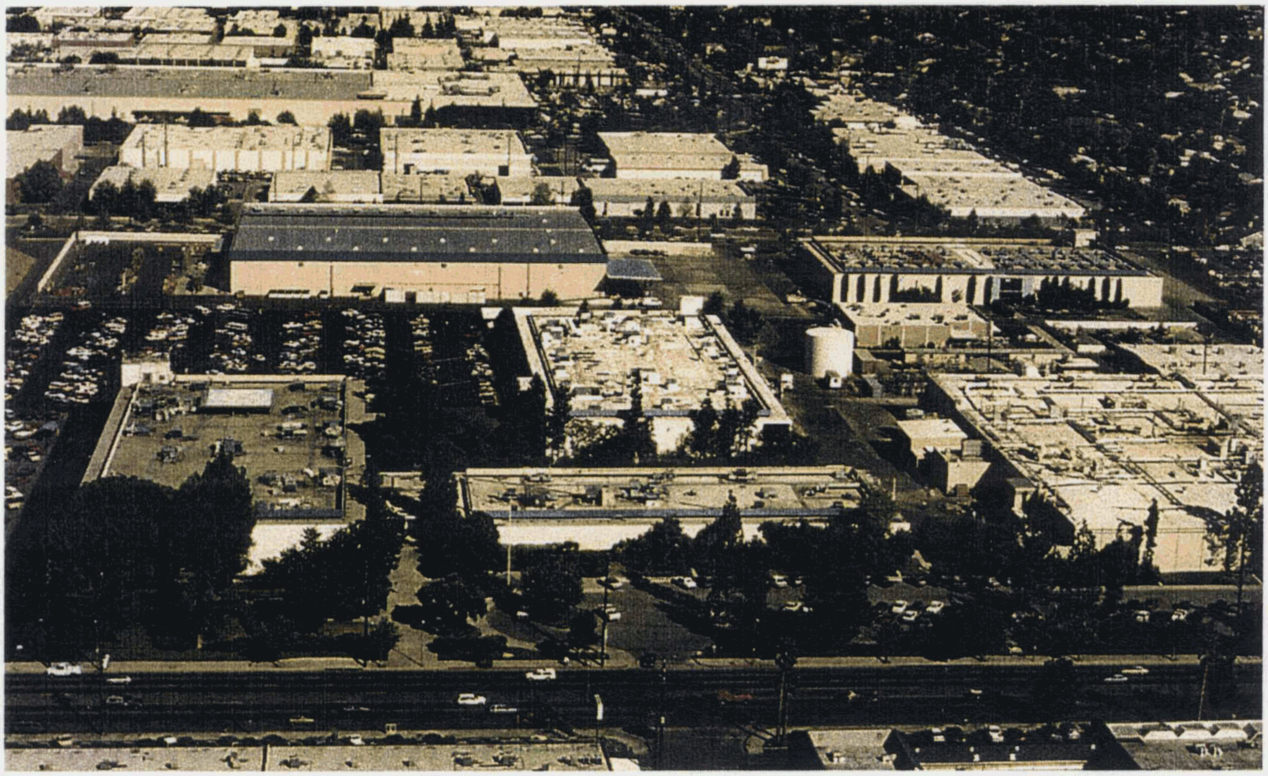

Figure 2-6. Rocketdyne Propulsion & Power - De Soto Site

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2.1 FACILITY DESCRIPTIONS

2.1.1 Santa Susana Field Laboratory Site

2.1.1.1 Hot Lab - NRC and California State-Licensed Activities

Operations at Building T020 (Hot Lab) that may have generated radioactive effluents in the past consisted of hot cell examination and decladding of irradiated nuclear fuels and examination of reactor components. Only filtered atmospheric effluents are released from the building during D&D activities. Since T020 was shut down in 1988, only decontamination of the facility was performed in 1996. No radioactive liquids are released from the facility. Prior radioactive material handled in unencapsulated form in this facility included the following radionuclides that are now present only in minor amounts as facility contamination: U, Pu, as constituents in the various fuel materials; Cs-137 and Sr-90 as mixed fission products; and Co-60.

2.1.1.2 DOE Contract Activities

RMHF

Operations at Buildings T021 and T022 (RMHF) that may generate radioactive effluents consist of the processing, packaging, and temporary storage of liquid and dry radioactive waste material for disposal. Only filtered atmospheric effluents are released from the buildings to uncontrolled areas. No radioactive liquids are released from the facility. Contamination from nuclear fuel and decontamination operations contains uranium and plutonium plus Cs-137 and Sr-90 as mixed fission products, and Co-60 and Eu-152 activation products.

Building T059

Operations at Building T059 that may generate radioactive effluents consist of removal of activated steel and concrete as part of the D&D of this former Systems for Nuclear Auxiliary Power (SNAP) reactor ground test facility. (The Atomics International Division designed, built, and tested at SSFL several SNAP reactors, as part of the "Systems for Nuclear Auxiliary Power." All reactors in this program were given even numbers, while those units that used the decay of radioactive material to provide heat were given odd numbers. One reactor, SNAP-10A, was launched into Earth orbit in 1965, operated successfully, was automatically shutdown, and remains in a distant orbit.) Only filtered atmospheric effluents may be released from the building to uncontrolled areas during operations. No radioactive liquid waste is released from the facility. Activation products consist primarily of Fe-55, Eu-152, and Co-60, and minimal amounts of H-3.

In 1996, LLTR dismantling of the Large Leak Test Rig (LLTR), equipment that had been used for safety tests, was initiated, starting in the High Bay and working down to the Vault area. Since no radiological work was performed in the building in 1996, no effluent monitoring was performed.

T886, Former Sodium Disposal Facility

All radioactive contamination was removed from the Former Sodium Disposal Facility, in 1994. Final and confirmatory surveys have shown that no radioactivity exceeding allowable limits remains in that area. The DHS/RHB and DTSC have interest in performing further sampling, particularly in the Upper Basin, and soil samples were taken for this purpose in 1997.

Buildings T005, T023, and T064

D&D activities for Buildings T005, T023, and T064 were completed in 1993. ORISE (Oak Ridge Institute for Science and Education, the primary verification contractor for DOE) performed verification surveys at T005, T023, and T064. The results confirmed Rocketdyne survey results showing that these buildings met DOE guidelines for removal of the radioactive material management area (RMMA) designation. RMMA designation was removed by DOE in October 1994. T005 was released for unrestricted use by the California Department of Health Services (DHS) Radiologic Health Branch (RHB) on March 22, 1995. The release docket for T023 was completed. The building structure at T064 was released by DOE for demolition. The adjacent grounds are in the process of decontamination by removal of low-level contaminated soil.

Buildings T012 and T363

D&D activities for Buildings T012 and T363 were completed in 1995. Final Rocketdyne radiological surveys (Ref. 2, 3, and 4), and confirmatory radiological surveys by ORISE (Refs. 5 and 6), were performed for both buildings in 1996. The results of these surveys showed that the facilities met the radiological requirements for release without radiological restrictions. Release for unrestricted use of T012 and T363 has been requested of DOE and DHS/RHB, respectively.

Building T030

A supplemental final survey was performed for Building T030, a facility that had housed a small accelerator in the 1960s. This survey was intended to supplement the survey performed in 1988 to identify suspect areas (Ref. 7). While that survey did not indicate a need for further attention, this supplemental survey provided a completely documented final survey report (Ref. 8) to justify release for unrestricted use. This final survey report responded to questions raised by ORISE during a confirmatory facility survey in 1995 (Ref. 9). The supplemental survey included extensive surface contamination tests for tritium, since that was the only radioactive material brought into the facility during the use of the accelerator. Since the accelerator produced some neutron flux during operation, surveys also tested for activation. This survey showed no activity above background. Release of Building T030 for unrestricted use has been requested of DOE. The building is scheduled for demolition.

Hot Lab

The NRC license for the former Hot Lab was terminated on September 27, 1996, and the facility was transferred to DOE jurisdiction. Decommissioning work continued under DOE sponsorship.

ETEC Operations

The primary purpose of operations at ETEC is the environmental restoration of SSFL areas and facilities that have been impacted by DOE operations. A longer-term objective is to provide a transition of the DOE facilities to a commercially available test facility.

During 1996, there was very little work done on heat transfer systems or power generation. However, several permits and environmental considerations still apply to that work.

2.1.2 De Soto Site

Building 104 - California State-Licensed Activities

Operations at Building 104 that could have generated radioactive effluents consisted of research studies in applied physics and physical chemistry using activated materials. Analysis of low-level activated test samples in the mass spectrometer laboratory was terminated in May 1995. The laboratory was relocated to a DOE facility at Battelle - Pacific Northwest National Laboratories (PNNL) in early 1996. Currently, planning is underway to perform D&D of the vacated Helium Analysis Laboratory. Air-flow through the dormant laboratory areas is still maintained. This ventilation exhaust is passed through HEPA filters before being released from the building to uncontrolled areas. No liquid effluents are released.

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3. COMPLIANCE SUMMARY

This section summarizes Rocketdyne's compliance with federal, state, and local environmental regulations. Two main categories are presented; Section 3.1 discusses compliance status, and Section 3.2 discusses current issues and actions.

3.1 COMPLIANCE STATUS

3.1.1 Radiological

The results of radiological environmental monitoring indicate that there are no significant releases of non-natural radioactive material from the SSFL or De Soto sites. Atmospheric transport of radioactive materials and direct exposure during ETEC's environmental remediation and waste management operations are the only credible pathways to the general public. A small seepage of water containing low levels of tritium occurs in an offsite area that is very isolated, where no exposure is likely. This seepage results from drift and spray of water from a cooling tower. The tower is operated intermittently during the summer, and saturates the ground where a reactor test building had been excavated in 1978. This cooling tower was not operated in 1996. Operation of this reactor produced small amounts of tritium in the ground, and this activity is mobilized by the inleakage of the water from the surface. As excess water enters at the excavated site, some water seeps from the hillside downslope. The tritium content is below the limit for suppliers of drinking water. (Analytical results for tritium in groundwater are presented in Section 5.5.2.)

Airborne Releases

Small amounts of radioactive materials may be released in ventilation exhaust from facilities at SSFL and De Soto, along with naturally occurring airborne radioactivity. These releases are minimized by using high-efficiency particulate air (HEPA) filters, and are continuously monitored by sampling the exhaust effluent. Radionuclide-specific analyses determine the radioactive composition of these effluents, and maximum offsite doses at the nearest residence from this source are estimated by using the EPA computer program CAP88-PC (Ref. 11).

Considering airborne releases from the RMHF exhaust stack, and including the end of the year for the Hot Lab, and two diffuse area sources, the maximum individual annual exposure was estimated at 1.32×10^{-4} mrem/yr for DOE operations at SSFL. Similarly, licensed operations at the Hot Lab (until October 1996) and the De Soto site were estimated to have resulted in 1.7×10^{-6} mrem/yr and 9.5×10^{-6} mrem/yr, respectively. All effective dose equivalents for the maximally exposed individual are far below the EPA NESHAPs limit of 10 mrem/yr, and below the action level of 1% of the limit (0.1 mrem/yr) as specified in 40 CFR 61, Subpart H (DOE facilities) and Subpart I (licensed facilities). Additional calculations were done for the licensed facilities (Hot Lab, for part of the year, and De Soto) using the EPA computer program COMPLY (Ref. 12) to demonstrate compliance under Subpart I of the NESHAPs regulations. These calculations showed compliance at the simplest level in COMPLY.

Water Releases

All liquid radioactive wastes are processed by either solidification or evaporation prior to subsequent disposal at DOE disposal sites. Liquid radioactive wastes are not released into the environment and do not constitute an exposure pathway. Groundwater and surface water are sampled and analyzed to assure detection of any non-natural radioactivity.

At SSFL, 232 groundwater monitoring wells are sampled and analyzed periodically and no indication of non-natural radioactivity has been found, with the exception of low levels of tritium in Well RD-34A (approximately 4,250 pCi/L in 1996, see Section 5.5.2), considerably below the Federal and State standards for drinking water suppliers of 20,000 pCi/L. This limit has been imposed on groundwater as part of the State of California groundwater goals. Tritium was detected just above the analytical detection limit (200 pCi/L) in six other wells. Wells with detectable tritium are quite widely separated, near Building T059, in the canyon north of the RMHF, and at the Former Sodium Disposal Facility (T886). However, the stratified structure of the bedrock might permit production of these occurrences by a single source, such as the reactor operation at T010, which was terminated in 1965. Occasional results for gross alpha and gross beta radioactivity that exceeded the maximum contamination level (MCL) are attributed to naturally occurring uranium (Ref. 14).

Extracted groundwater from the French drain at T059 is periodically sampled and analyzed by gamma spectroscopy. These water samples are tested by gamma spectroscopy for any transfer of gamma-emitting activation products from the underground reactor test vault containment into the surrounding soil. Potential radionuclides include Co-60 and Eu-152, both of which are easily detected, and none have been found to date. This water was sampled in August, and no non-natural radioactivity was detected.

Surface water from two NPDES discharge points and five storm water runoff catch basins are also monitored. The Rocketdyne NPDES permit allows the discharge of reclaimed wastewater and storm water runoff from water retention ponds into Bell Creek, a tributary to the Los Angeles River, in addition to the discharge of storm water runoff from the northwest slope (Area IV) locations. Excess reclaimed water, including treated sanitary sewage and runoff from Area IV, is now discharged on a continuous basis through the R-2A outfall location (Outfall 002). Discharge along the northwest slope of Area IV (Outfalls 003 through 007) generally occurs only during and after periods of heavy rainfall. Two of these drainage channels (003 and 004) flow directly from DOE territory. The permit applies the numerical limits for radioactivity in drinking water supplies to drainage through these outfalls. The permit requires radiological measurements of gross alpha, gross beta, tritium, strontium-90, radium-226, and radium-228. No NPDES samples exceeded drinking water supplier limits for radioactivity, as imposed by the permit. Exceedances were observed for several conventional parameters. These exceedances are listed in Table 3-1. In 1996, there were 64 sampling events, and 2468 analyses were performed, and there were 15 exceedances. Only those from Outfalls 005 and 006 were from DOE operations.

In the cases of excess total suspended solids and settleable solids from the main water discharge point at SSFL, Outfall 002, the water was "dirty" from excess soil (dust and dirt, mud) carried by the water. Water from Outfall 005 was slightly alkaline. It comes from an area in which the soil is alkaline due to disposal of sodium in the associated ponds. (This disposal was stopped over 20 years ago, but the soil retains a residual alkalinity.) The single failures of the chronic toxicity test and the nitrate and nitrite limit were not determined.

Table 3-1. NPDES Permit Limit Exceedances in 1996

Permit Type	Outfall	Parameter	Date of Exceedance	Description Solution
NPDES	002	Total Suspended Solids > 15 mg/L	2/1/96	No action
NPDES	002	Total Suspended Solids > 15 mg/L	2/21/96	No action
NPDES	002	Total Suspended Solids > 15 mg/L	3/13/96	No action
NPDES	002	Total Suspended Solids > 15 mg/	7/18/96	No action
NPDES	002	Total Suspended Solids > 15 mg/L	8/15/96	No action
NPDES	002	Total Suspended Solids > 15 mg/L	10/30/96	No action
NPDES	002	Total Suspended Solids > 15 mg/L	11/21/96	No action
NPDES	002	Total Suspended Solids > 15 mg/L	12/22/96	No action
NPDES	002	Settleable Solids > 0.1 mg/L	11/21/96	No action
NPDES	002	Settleable Solids > 0.1 mg/L	12/22/96	No action
NPDES	005	pH > 9.0	3/12/96	No action
NPDES	005	pH > 9.0	3/13/96	No action
NPDES	005	pH > 9.0	10/30/96	No action
NPDES	005	Chronic Toxicity > 1 TUC	1/31/96	No action
NPDES	006	Nitrate and Nitrite > 10 mg/L	11/21/96	No action

Site Boundary Exposures

The external radiation exposure estimates at the maximum exposed boundary location and at the nearest residence are based on results from site ambient radiation dosimeters and several facility workplace radiation dosimeters. Adjacent to the RMHF, the external exposure from direct radiation at the maximum exposed boundary location was estimated from the 1996 measurements to correspond to an average annual dose of approximately 31 mrem above natural background. (This is equivalent to an average exposure rate of 3.5 μR/hr.) A similarly calculated value of 0.00028 mrem/yr was found for the nearest residence. These values are considerably below the DOE long-term limit of 100 mrem/yr. For the Hot Lab, the removal of the radioactive liquid waste holdup tank in 1994 eliminated any source of external exposure, so that radiation exposures there are now indistinguishable from natural background.

At the De Soto facility, the external exposure from direct radiation at the maximum exposed boundary location was not distinguishable from natural background.

Environmental Monitoring and Site Characterization

A broad-scope radiological characterization survey of Area IV has been performed. This work involved measurement of ambient radiation and radiological analyses of selected soil samples. The field work was completed in September 1995. The report of this survey was sent to DOE-OAK for review in April 1996 and approved for release in July 1996, with Revision A issued August 15 (Ref. 17). Over 10,000 ambient gamma measurements and 149 scheduled soil samples were taken over the 290 acres of Area IV

The ambient radiation exposure rate was measured at uniformly spaced locations over a large extent of Area IV and at offsite background locations. These measurements used an easily portable NaI gamma-radiation detector (1 by 1 in. size) to provide numerical data of adequate statistical precision for accurate comparisons to be made between individual measurements and selected sets. While the energy response of this type detector differs from the energy dependence of the unit of exposure rate, µR/hr in this case, daily correlation with a high-pressure ion chamber (HPIC) assured accurate reporting of the local exposure rate. Use of the small NaI instrument also permitted inclusion of the previous measurements made offsite by EPA using a similar instrument. While the EPA readings were based on a laboratory calibration of the instrument, and provided less precise data, the results fit quite well with the more accurate results obtained in the Area IV survey. The Area IV survey provided 10,479 onsite measurements, which excluded operating facilities and identified areas of contamination. For comparison with the onsite data, offsite surveys in several independent and Rocketdyne campaigns provided 214 measurements.

As a result of this survey, three small localized areas were identified in Area IV as requiring remediation. One was a natural uranium mineral deposit. This area was remediated, in 1994, soon after discovery, on the principle of eliminating elevated radioactivity in Area IV at SSFL. The second was elevated Cs-137 soil contamination in a prior remediated sideyard of T064. The third was elevated Cs-137 soil contamination in an area within 100 ft of the T064 sideyard. Both of these latter associated areas are currently undergoing remediation and resampling.

Statistical comparisons of the offsite data with results from the rest of Area IV confirmed that, except for the Cs-137 activity, Area IV was statistically similar to or only slightly different from local background, in terms of radiation and several radionuclides. Even though the Area IV Cs-137 was statistically different from local background, it was similar to U.S. background and well below risk-based derived cleanup limits for Cs-137.

3.1.2 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulates reporting and emergency response for hazardous substances released into the environment and for the cleanup of abandoned hazardous waste sites or other historical hazardous waste releases. Under the historical release authority of CERCLA, a Preliminary

Assessment/Site Investigation (PA/SI) review of SSFL Area IV was conducted by the EPA Site Evaluation Section. A report of findings, dated 11 August 1989, was transmitted to ETEC in April 1990.

Prior to ranking the facilities nationwide, the EPA had requested additional air monitoring be provided for SSFL. Rocketdyne submitted the last quarterly status report in June 1992. The EPA contracted an outside contractor, PRC Inc., to assist in the national ranking of the facilities. The SSFL ranked below the criteria for being included on the National Priority Listing. There was no further activity on this in 1996. However, discussions with both the DOE and NASA customers have resulted in agreement to incorporate CERCLA-type protocols per DOE policy into the cleanup activities at SSFL. CERCLA-type protocols were initiated early in the process, but since of the State has RCRA authority instead of the EPA, cleanup activities will be conducted under RCRA corrective-action rules.

The Superfund Amendments and Reauthorization Act (SARA) extended the regulatory provisions of CERCLA. SARA Title III requires extensive hazardous material reporting, community right-to-know, and emergency response planning provisions. ETEC has met the SARA reporting requirements. The SSFL Hazardous Materials Release Response Business Plan and Inventory was issued to Ventura County Environmental Health Department on April 12, 1996, addressing the following SARA Title III provisions:

1. Planning, Emergency Response
2. Reporting, Leaks and Spills
3. Reporting, Chemical Inventories
4. HAZMAT Training Program
5. Facility Maps and Diagrams.

SARA Title III also addresses reporting toxic chemical (EPA Form R) usage. Rocketdyne annually submits an EPA Form R report to the Environmental Protection Agency for toxic chemicals handled at ETEC facilities exceeding the reporting threshold quantity of 10,000 lb. The Form R (Toxic Release Inventory) submission was sent to federal agencies by the August 1, 1996 deadline. In 1994, ETEC used ammonia and sulfuric acid exceeding the threshold quantity. For 1996, ETEC reported only ammonia, since sulfuric acid was delisted by the EPA. Only ammonia met the threshold quantity for reporting during 1996. (See Table 3-2.)

Table 3-2. Summary of ETEC Compliance with EPCRA in 1996

Requirement	Done	Not Done	Not Required
EPCRA 302-303: Planning Notification	yes		
EPCRA 304: EHS Release Notification	yes		
EPCRA 311-312: MSDS/Chemical Inventory	yes, 312		
EPCRA 313: TRI Reporting	yes		

3.1.3 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) gives the EPA broad authority to regulate the handling, treatment, storage, and disposal of hazardous wastes. DOE owns and co-operates two RCRA-permitted Treatment, Storage, and Disposal Facilities with ETEC. Permit numbers are listed in Section 3.2.5.

The Radioactive Materials Handling Facility (RMHF) operates as an Interim Status Facility. This facility is used primarily for the handling and packaging of radioactive waste. The Interim Status is required for the storage of small amounts of mixed waste (waste containing both hazardous and radioactive constituents) resulting from decontamination and decommissioning activities at ETEC. Final disposition of the mixed waste is being addressed under the Site Treatment Plan, which is authorized by the Federal Facilities Compliance Act.

The Hazardous Waste Management Facility (HWMF) includes a storage area (T029) and a treatment facility (T133) for reactive metal waste, such as sodium. The RCRA Part B permit for the facility was renewed by the California Department of Toxic Substances Control (DTSC) in 1993. In February 1994 DTSC inspected the facility for compliance with the permit and approved operation. No violations were noted. No further inspections have been performed. ETEC remains in compliance with permit requirements.

RCRA also has governing authority of underground tanks which contain hazardous materials. None of the tanks at SSFL are currently subject to those regulations. Area IV now has 11 underground storage tanks, 3 radioactive water and 8 sodium tanks. The sodium tanks are no longer required to be covered by permits by the Ventura County Environmental Health Division (VCEHD). The radioactive water storage tanks are exempt from permitting by the VCEHD. The California Department of Health Services and the Department of Energy are the lead agencies for tanks containing radioactive material. In 1994 one tank for radioactive water was removed as part of the D&D of the Hot Lab and stored at the RMHF pending decontamination. This tank continues in use as a storage tank for its contents. The other two tanks are in operation at RMHF. Three sodium storage tanks were emptied, cleaned in 1996, and removed from SSFL in 1997, as scrap metal.

Under the Hazardous and Solid Waste Amendments of 1984, RCRA facilities can be brought into the corrective action process when an agency is considering any RCRA permit action for the facility. The SSFL was initially made subject to the corrective action process in 1989 by EPA, Region IX. The EPA has performed the Preliminary Assessment Report and the Visual Site Inspection portions of the RCRA Facility Assessment (RFA) process.

The State of California DTSC has RCRA authorization and has become the lead agency in implementing the corrective action process for the SSFL. ETEC has performed soil sampling at various SWMUs and Areas of Concern (AOCs) that were identified in the RFA report. This has enabled ETEC to determine if further action and/or interim measures will be necessary for SWMUs to be incorporated into the RCRA Facility Investigation (RFI).

Pursuant to Health and Safety Code, Section 25187, Cal-EPA, Region 3, DTSC issued on 2 December 1992 a Stipulated Enforcement Order to Rockwell International Corporation regarding SSFL, including ETEC. The Order was issued by the State Attorney General's office and requires Rockwell to comply with specific terms and conditions, as a Corrective Action order.

The current conditions report and a draft of the RCRA Facility Investigation Work Plan for the Area IV SWMUs were submitted to the DTSC in October 1993. In Area IV, one SWMU, the T056 Landfill, was proposed for the RFI. In 1994, DTSC issued a letter to Rocketdyne conditionally approving the draft RFI work plan, subject to satisfactory resolution of their comments. A RFI workplan addendum was submitted to DTSC in March 1995, which responded to the DTSC comments. In January 1996, DTSC forwarded draft comments to Rocketdyne on the Area IV SWMUs and AOCs. In November 1996, DTSC approved a revised workplan addendum, which included two additional AOCs in Area IV (Old Conservation Yard and Building T020). Field work began in November 1996 and is scheduled for completion in 1998.

3.1.4 Federal Facilities Compliance Act

ETEC is managing its modest inventory (approximately 50 m^3) of mixed wastes in accordance with the Federal Facilities Compliance Act (FFCA)-mandated Site Treatment Plan (STP) approved in October 1995. All known mixed wastes are covered wastes in the STP and any new potential mixed waste discovered is reported to the California Department of Toxic Substances Control (DTSC) for inclusion in the STP. Characterization, treatment and disposal plans for each of several different waste streams are defined in the STP with enforceable milestones. These include characterization, reporting, study of treatment options, shipping schedules, and actual removal. ETEC has met all STP milestones to date. Regular updates to reflect changes in inventory or status of mixed wastes and certifications of milestone completion are submitted to DTSC in accordance with the STP.

3.1.5 National Environmental Policy Act

The National Environmental Policy Act (NEPA) establishes a national policy to ensure that consideration is given to environmental values and factors in federal planning and decision-making. For those projects or actions that are expected to either affect the quality of the human environment or create controversy on environmental grounds, DOE requires that appropriate NEPA actions (Categorical Exclusion [CX], Environmental Assessment [EA], Finding of No Significant Impact [FONSI], or Notice of Intent [NOI], draft Environmental Impact Statement [EIS], final EIS, Record of Decision [ROD]) have been incorporated into project planning documents. DOE has implemented NEPA as defined in Federal Register Volume 57, Number 80, pages 15122 through 15199.

ETEC assesses the environmental impact of each project planned for implementation. Based on the assessments, DOE is requested to issue determinations of compliance to the NEPA. ETEC submitted 3 requests for NEPA determinations in calendar year 1996.

Level/ DOE No.	NEPA Determination for	Remarks/Action
CX ET-EM-96-27	Minor construction and fabrication	96ETEC-DRF-0007, 3/22/96 Approved
CX ET-EM-96-28	Disposal of bulk sodium	96ETEC-DRF-0008, 3/22/96 Approved
CX ET-EM-96-29	Tank cleaning	96ETEC-DRF-0009, 3/22/96 Approved

CX - Categorical Exclusion

There were no draft or final environmental impact statements or reports, site assessments, or remedial action reports produced during 1996. Additionally, there were no actions taken by local authorities relative to CERCLA/SARA activities or Notices of Violation for the DOE area.

3.1.6 Clean Air Act

The Clean Air Act (CAA) resulted in federal regulations that set air quality standards and required state implementation plans, National Emissions Standards for Hazardous Air Pollutants (NESHAPs), New Source Performance Standards, and monitoring programs in an effort to achieve air quality levels beneficial to the public health and welfare. The SSFL is regulated by the Ventura County Air Pollution Control District (VCAPCD) and must comply with VCAPCD Rules and Regulations. The EPA can enforce VCAPCD rules and also regulates pollutants such as Ozone Depleting Substances (ODS's) under 40 CFR 82. The De Soto facility is under the jurisdiction of the South Coast Air Quality Management District (SCAQMD). VCAPCD and SCAQMD rules and regulations incorporate, by reference, NESHAPs regulations as codified under the CAA. One inspection was performed by VCAPCD, for asbestos. No violations were identified.

Several steps in asbestos program management have been incorporated into facility renovation and demolition. These generally include assessment or identification of asbestos-containing materials (ACMs), abatement activities such as worker protection and surveillance, and clearance requirements such as cleanup and disposal. Within Area IV, approximately 100% of the buildings have been surveyed, and materials in question have been analyzed for asbestos. Where required, asbestos abatement will occur when renovation or demolition projects are identified.

Atmospheric pollutant discharge limitations are imposed by VCAPCD Permit 0271 on natural gas personnel comfort space heaters, boilers in various buildings in Area IV, several natural gas/oil-fired sodium heaters operated by ETEC for component testing, and the Kalina facility. The permit for 1996 was renewed on June 13, 1996.

VCAPCD Rule 74.15, as adopted in March 1989 and revised in December 1991, sets limits for oxides of nitrogen (NOx) and carbon monoxide (CO) emissions on boilers, steam generators, and process heaters. The Sodium Component Test Installation (SCTI) finished installing the new low-NOx burners in 1991 as well as the carbon monoxide continuous emissions monitoring system. An extended variance to the rule was applied for and granted, running through December 31, 1992 to allow for source testing and adjusting of the H-1 and H-2 sodium heaters and the H-101 boiler to bring them into compliance. Further extensions of the variance were granted to November 30, 1994. ETEC operated under Variance 392-3 until the amended Rule 74.15 was adopted on November 8, 1994. VCAPCD is in the process of revising permit No. 0271. ETEC has been assured by VCAPCD that ETEC is not in violation as long as VCAPCD is processing the permit renewal.

A permit modification application was submitted to VCAPCD on June 3, 1994 to update the permit for language changes, revisions to existing conditions and proposed operations. Included were changes to the Kalina Plant operations that raised the permitted ammonia emissions from 9.3 tons per year and 2.12 lb per hour to 51 and 80, respectively. The current permit reflects these changes.

Rocketdyne extended the lease for NOx credits for the Saber Facility Boiler in the Bowl Area until January 1998.

Title V of the Clean Air Act requires issuance of a federal permit for major sources of air pollution. As the present time, ETEC is not a major source of air pollution, therefore no Title V permit is required. ETEC is operating under VCAPCD Rule 76, Federally Enforceable Limits on Potential to Emit.

Although ETEC has traditionally had little or no ODS's, Rocketdyne has for years maintained a Hazardous Materials Elimination Team to eliminate ODS's at Rocketdyne. This multifunctional team has the responsibility to identify suitable alternatives for various toxic chemicals and has been instrumental in eliminating CFC-113 and 1,1,1-trichloroethane from all of Rocketdyne's Southern California manufacturing operations. ETEC provided DOE with a complete inventory of Class I and Class II ODS's in October 1996.

3.1.7 Clean Water Act

The Clean Water Act (CWA) is the primary authority for water pollution control programs, including the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES program regulates point source discharges of surface water to drainage channels (i.e., to locations other than sewage systems), the preparation of Spill Prevention Control and Countermeasure (SPCC) plans, and the discharge of storm water runoff associated with industrial activities. Inland surface water quality objectives are applied as effluent standards for offsite discharge of storm and industrial waste water via the SSFL water reclamation system.

Surface water discharges from SSFL are regulated under the California Water Code (Division 7) as administered by the California Regional Water Quality Control Board (CRWQCB). The existing NPDES Permit (CA0001309) for SSFL, which was revised and became effective December 7, 1992, is expected to remain in force through November 10, 1997. The revised NPDES Permit incorporated federal storm water regulations by requiring development and implementation of a site-wide Storm Water Pollution Prevention Plan (SWPPP). This document is revised as needed and includes by reference many existing pollution prevention plans, policies, and procedures implemented at the SSFL site. Several key elements of the plan, including maps, are continually updated. Water from Rocketdyne operations is collected into and discharged from Perimeter Pond and Pond R2A. Sewage from Area IV (including DOE facilities) is treated at the Area IV sewage treatment plant, which discharges to Pond R2A. Most surface runoff from Area IV also drains to Pond R2A. The northwest slope of Area IV drains through five small catch basins, two of which drain directly from DOE areas.

Another key element is the Rocketdyne procedure "SSFL Storm Water Pollution Prevention Requirements." The Spill Prevention Control and Countermeasure (SPCC) plan serves to identify specific procedures for handling oil and hazardous substances to prevent uncontrolled discharge into or upon the navigable waters of the State of California or the United States. The U.S. EPA requires the preparation of an SPCC plan by those facilities which, because of their location, could reasonably be expected to discharge oil in harmful quantities into or upon navigable waters. A revised Spill Prevention Control and Countermeasure (SPCC) plan was submitted as a part of the revised Spill Prevention and Response Plan to the local Administering Agency on April 12, 1996.

Additionally, an updated hazardous materials inventory was submitted to the VCEHD as an update of the business plan on the same date as the SPCC. The hazardous materials disclosure fee was also submitted.

The re-application package for the NPDES permit was submitted to the CRWQCB on May 10, 1997 and is currently undergoing review. Until a new permit is issued, the current permit guidelines will apply.

During periods of rainfall which create adequate runoff for sampling, grab samples of surface water runoff are collected at the discharge points for the Perimeter Pond, R2A Pond, and the five storm water catch basins along the northwest slope of Area IV. When rainfall occurs more than once a week or continuously, samples are taken weekly. During non-rain event discharges from the Perimeter Pond and R2A Pond discharge locations, samples are collected during each discharge event. When discharges occur on a continual basis in excess of a month, samples are collected monthly. The sampling performed at the five northwest slope locations includes quarterly monitoring for a list of analytes referred to as "priority pollutants." There were 15 minimal exceedances of permit limits, with no issuance of violations of the NPDES permit resulting from these analytical results in 1996. The turbidity problems experienced at the sewage treatment plants in previous years have been eliminated through numerous changes in managerial, operational, and maintenance procedures. Discharges from Pond R2A, Outfall 002, resulted in 10 exceedances, for Total suspended Solids and Settleable Solids. The northwest slope runoff basins for the Former Sodium Disposal Facility (SBP-1 and SBP-2, Outfalls 005 and 006) showed 5 exceedances for high pH (alkaline, 3 cases), chronic toxicity (1 case), and high nitrate and nitrite (1 case). No exceedances were shown by the DOE runoff basins (003 and 004).

Characterization of the groundwater at the site continues. The most recent phase of DOE-funded groundwater well construction in Area IV approved by DTSC was completed in June 1994. The plan included nine new wells located in Area IV and offsite northwest of Area IV. In 1993, five of these nine wells were installed. In 1994, the four remaining monitoring wells were constructed, 300 to 1,250 feet offsite to the northwest of Area IV. TCE continued to be detected during 1996 at concentrations ranging from 1.4 to 19 μg/L in groundwater approximately 75 to 250 feet offsite and northwest of Area IV. TCE and other VOCs were also detected in three onsite areas along the northwestern property boundary.

3.1.8 Building T886 Former Sodium Disposal Facility Closure Order

The T886 Former Sodium Disposal Facility was used for removing sodium and sodium-potassium alloys from metal components used in DOE testing programs. The site formerly consisted of a cleaning facility and an Upper Basin and a Lower Basin. A Clean-up and Abatement Order was issued on April 30, 1991 by the Los Angeles Regional Water Quality Control Board for Closure of the Lower Basin. The Lower Basin, Upper Basin, and portions of the western area were excavated in 1992-1993. All excavated waste that contained both non-natural radioactivity and hazardous waste (mixed waste), was shipped to a licensed offsite disposal facility in 1994. The low level radioactive waste was shipped to an offsite disposal facility in 1995.

Chemical analyses of soil has indicated the presence of residual chemical contaminants in the excavated region. The contaminants of concern were PCBs, dioxins, and mercury. As a result, interim measures have been implemented after consultation with the Department of Toxic Substances Control, including establishment of sediment weirs downslope of the facility. A health-based risk assessment has been performed and is under DTSC review. Further excavation at the facility is planned as a result of the risk assessment. Results from radiological analyses have shown no activity above allowable limits.

3.1.9 Public Participation

During 1996, Rocketdyne implemented various methods for community outreach, which are detailed in the Santa Susana Field Laboratory Community Involvement Plan. Rocketdyne participated in meetings of the EPA-chaired SSFL Work Group created in 1990 to facilitate exchange of information relating to environmental activities at the SSFL. In support of SSFL Work Group meetings, Rocketdyne provided information about current environmental and remediation activities at the site. Throughout 1996, Rocketdyne continued to supply documents for public review to three information repositories: California State University-Northridge Urban Archives Center and the Simi Valley and Platt Branch libraries.

Three fact sheets discussing environmental activities at the field lab were distributed to the community mailing list. The fact sheets provided information to the community about the Hazardous Waste Management Facility (April 1996), the Former Sodium Disposal Facility (August 1996), and the Area IV Radiological Characterization Study (September 1996).

In April 1996, members of Rocketdyne's Environment, Health and Safety department escorted a group of teachers and students from California State University, Northridge on a tour of the Santa Susana Field Laboratory. The purpose of the tour was to provide students with a site specific example of the principles the students were studying in hydrogeology courses. The tour focused on environmental remediation activities at the SSFL with special emphasis on Rocketdyne's groundwater cleanup and surface water monitoring programs.

In May 1996, three ETEC employees were guest lecturers at Moorpark College where they discussed environmental restoration and energy research activities. The college students were provided with visits of the Santa Susana Field Laboratory to complement the classroom lectures with field exercises. Also in May 1996, Rocketdyne distributed a letter to the community mailing list on behalf of the Department of Energy. The letter provided general information about the radiological decontamination and "release" process for three DOE-owned buildings at the SSFL. The letter also informed the public that the supporting data for the verification and certification process was available for public review in Rocketdyne's information repositories.

Two availability sessions were offered to the public in June 1996. Availability sessions are informal meetings that provide the public with an opportunity to direct questions and express concerns to Rocketdyne's staff and technical experts. Similar to an information fair, the availability sessions made use of display boards and exhibits where presenters explained information and used visual displays to enhance understanding of general and environmental activities at the field lab. Also in June 1996, Rocketdyne distributed a fact sheet to the community mailing list on behalf of the California Department of Toxic Substances Control (DTSC). The fact sheet discussed DTSC's approval of the closure plan for two former hazardous waste storage areas at the field lab. The fact sheet also identified resources available to the public for additional information.

As a sponsor of a Valley Cultural Center "Concert in the Park" in August, Rocketdyne exhibited information about current programs and safety, health and environmental activities. Members of Rocketdyne's community relations and technical staff were present during the event to speak one-on-one with members of the community.

In October 1996, over 150 community members visited the Santa Susana Field Laboratory for a site-wide bus tour. The tour included a stop where members of the community could view display boards and exhibits, and speak with technical experts about safety, health and environmental activities at Rocketdyne.

As a result of the public's expressed interest in visiting the SSFL to observe the RCRA Facility Investigation (RFI) soil sampling activities, Rocketdyne launched the RFI Community Outreach Program during December. Rocketdyne invited interested community members to participate in a training session that would provide general information about the SSFL, an overview of the RFI and visitor safety requirements. Those community members who completed the training are welcome to visit the field lab to observe the RFI soil sampling activities.

3.1.10 1996 Agency Inspections/Audits

A list of inspections and audits by the various agencies overseeing the SSFL and De Soto sites is given in Table 3-3. There were several Notices of Violations in these inspections and audits.

In February, the Department of Toxic Substance Control issued 3 Notices of Violation, resulting from a Comprehensive Monitoring Evaluation of the SSFL groundwater sampling system. One NOV criticized the condition of survey marks on groundwater monitoring wells, used to determine the elevation of water in the wells. In response, standard reference points were marked on each well casing. Another NOV concerned the possible release of untreated groundwater from sampling at a remote well-site. This NOV was rebutted by Rocketdyne. The third NOV presented disagreements on the quality of the surface completions of some groundwater monitoring wells. Rocketdyne agreed in principle, and indicated that below-grade well completions would be eliminated where possible.

The March inspection by VCEHD produced three minor observations on labeling. These were corrected at the time of the inspection.

In June, the Radiologic Health Branch issued 2 Notices of Violation regarding a lack of routine meetings of the Radiation Safety Committee, which administratively oversees the uses of radioactive material and X-ray machines at Rocketdyne, and the absence of routine inspections of these operations by the Committee. These deficiencies were corrected by reconstituting the Committee, holding an annual meeting, and conducting a Committee inspection.

DTSC issued 1 NOV ("Summary of Violation", SOV) for waste stored at RMHF for a period of time exceeding 1 year. DTSC was informed that this storage was allowed under the Federal Facilities Compliance Act, and has not pursued the issue further.

In addition to these inspections, DTSC provided an extensive list of deficiencies relative to the RFI Workplan Addendum (1/22/96). Also, a Notice of Noncompliance was issued by the State of Tennessee Division of Radiological Health, relative to an improperly identified shipment of radioactive material to a Tennessee licensed facility (3/22/96). This shipment included a small piece of radioactive steel in a lead shield, to be decontaminated for salvage. The radioactive steel had been included inadvertently and was not listed as part of the shipment. Additional controls over outgoing shipments were instituted.

Table 3-3. 1996 Agency Inspections/Visits Related to Environmental Remediation

Date	Agency	Subject Area	Results
February 1996	Dept. of Toxic Substances Control	Groundwater CME	3 minor NOVs
March 1996	Ventura County Environ-mental Health Division	Santa Susana Site	No NOVs
March 1996	DOE	Hake Investigation	No NOVs
March 1996	Dept. of Toxic Substances Control	Evaluate SSFL Solid Waste Mgmt Units	No NOVs
April 1996	DOE	DOELAP Accreditation	No NOVs
May 1996	DOE	Management appraisal for H&S Programs at ETEC	No NOVs
May 1996	Dept. of Health Services	Disposal of non-radiological waste	No NOVs
May 1996	Dept. of Toxic Substances Control	SSFL monthly meeting	No NOVs
May 1996	Dept. of Toxic Substances Control	Discuss and visit SSFL RCRA sites	No NOVs
May 1996	Dept. of Toxic Substances Control	Locate metal sampling locations	No NOVs
June 1996	DHS/RHB	License inspection	2 NOVs
June 1996	DHS	Waste Inspections	No NOVs
June 1996	DOE	ETEC Facility Release Working Group	No NOVs
June 1996	Dept. of Toxic Substances Control - Region I	Update of Cal EPA records	No NOVs
June 1996	Dept. of Toxic Substances Control - Region III	Site Survey for Sampling Locations	No NOVs
July 1996	DHS/RHB	TLD exchange	No NOVs
July 1996	DHS/RHB and ORISE for DOE	Survey T012, T363	No NOVs
July 1996	DOE	Area IV groundwater	No NOVs
July 1996	DHS/RHB	Release of Hot Lab waste	No NOVs
September 24, 1996	DOE	DOE/SSFL work group	No NOVs
October 1996	DOE	Litigation	No NOVs
November 11, 1996	Dept. of Toxic Substances Control- Region III	Routine inspection of RMHF	1 NOV
November 13, 1996	DHS/RHB	Confirmatory surveys of Hot Lab clean waste	No NOVs
December 12, 1996	CRWQCB	Annual NPDES inspection at SSFL	No NOVs
December 1996	Dept. of Toxic Substances Control	Discuss SSFL remediation issues	No NOVs

[a]NOV = Notice of Violation

3.2 CURRENT ISSUES AND ACTIONS

Surface water discharges from SSFL are regulated under the California Water Code (Division 7) as administered by the California Regional Water Quality Control Board (CRWQCB). The existing NPDES Permit (CA0001309) for SSFL, which was revised and became effective December 7, 1992, is expected to remain in force through November 10, 1997. The re-application package for the NPDES permit was submitted to the CRWQCB on May 10, 1997 and is currently undergoing review. Until a new permit is issued, the current permit guidelines will apply.

3.2.1 Progress in Decommissioning Operations

Hot Lab (T020)

Decommissioning of the former Hot Lab proceeded during 1996. The facility ventilation system was removed, and temporary portable units were put into service. The facility was gradually demolished, and clean and contaminated debris was segregated to permit effective disposal of waste. Concrete saw cutting was used to section the hot cell and decontamination room shielding into manageable blocks. Clean blocks were set aside for disposal as conventional waste after inspection and approval by the DHS/RHB. Contaminated blocks were transferred to another facility for further cleaning. An improved scabbling machine was put into service for cleaning the concrete floors and worked exceptionally well. The remaining above-grade structure of the facility was completely removed. Preliminary saw-cutting of the concrete slab floor was completed in preparation for removal of the basement in 1997. The grade-level structure was then weatherproofed for the winter.

A major administrative change was made by the termination of the NRC Special Nuclear Materials license, SNM-21, to permit the work to be carried out under DOE regulations and orders. This termination was approved by NRC on September 27, 1996.

T064 Soil

Detailed surveys were made of the contaminated soil areas around Building T064. The remaining components of the sanitary sewage system installed during construction of the building, which had been abandoned in place about 1960, were removed. This involved excavation of the covering soil, the septic tank and distribution box, and removal of the gravel bed of the leach field. Further soil removal will be done in 1997, until the grounds are suitable for a final survey to permit release for use without radiological restrictions.

3.2.2 Establishment of Allowable Limits for Soil at SSFL

While allowable limits for surface contamination, to permit release of former radiological facilities for use without radiological restrictions, have existed for many years, few acceptable limits for contamination in soil have been standardized. Releases of facilities involving soil contamination have therefore been based on case-by-case decisions by the regulatory agencies.

However, DOE orders require the development of allowable limits, approved by the Field Office, to provide a consistent basis for release of contaminated land areas. Therefore, a series of pathways analyses, using the DOE program RESRAD (Ref. 10), were performed in order to establish suitable limits on residual radioactive contamination in soil at SSFL. These limits are provided in Table 3-4 for individual radionuclides that might be found in contaminated areas at SSFL.

Limits for combinations of these radionuclides can be derived by use of the "unity sum rule," where the fractions of the limit for each radionuclide present must sum to less than one.

Table 3-4. Soil Guidelines for SSFL Facilities

Radionuclide	Soil Guidelines (pCi/g)
Am-241	31.3
Co-60	1.94
Cs-134	3.33
Cs-137	9.20
Eu-152	4.51
Eu-154	4.11
Fe-55	629,000
H-3	31,900
K-40	27.6
Mn-54	6.11
Na-22	2.31
Ni-59	151,000
Ni-63	55,300
Pu-238	37.2
Pu-239	33.9
Pu-240	33.9
Pu-241	1,250
Pu-242	35.5
Ra-226 [a]	5 and 15
Sr-90	36.0
Th-228 [a]	5 and 15
Th-232 [a]	5 and 15
U-234 [b]	30
U-235 [b]	30
U-238 [b]	35

[a]DOE Order 5400.5 limits are 5 pCi/g averaged over first 15 cm of soil depth and 15 pCi/g averaged over 15 cm layers below the top 15 cm.
[b]Generally more conservative NRC limits for uranium isotopes are selected.

These pathways analyses considered several possible future uses of the site. Industrial, recreational (wilderness), and residential scenarios were used in the calculations. Use of groundwater for drinking, cooking, and garden irrigation was assumed in the residential case, even though this is a very unlikely situation. All local water is provided by metropolitan water districts. For these calculations, annual limit on dose of 15 mrem was adopted in June 1996, consistent with the NRC, DOE, and EPA guidance at the time, as published in 1994. These limits were approved by DOE and accepted by the State of California, as an amendment to the California Radioactive Materials license. They will be used in conjunction with the ALARA principle. Residual contamination will be below the allowable limits and As Low As Reasonably Achievable.

3.2.3 Epidemiological Study

In an effort to determine if employment at Rocketdyne/Atomics International had produced any significant health effects, the California Public Health Foundation was awarded DOE grant funds to perform an epidemiological study of workers at the site. In February 1993, an advisory panel selected the University of California, Los Angeles (UCLA) to perform the study. The study focused on the possible effects of radiation exposure on cancer mortality of Rocketdyne and Atomics International workers. UCLA researchers began the study in January 1994 and published the results of their analysis in the fall of 1997.

3.2.4 Resource Conservation and Recovery Act

Under the Hazardous and Solid Waste Amendments of 1984, RCRA facilities can be brought into the corrective action process when an agency is considering any RCRA permit action for the facility. The SSFL was initially made subject to the corrective action process in 1989 by EPA, Region IX. The EPA has performed the Preliminary Assessment Report (i.e., record search) and the Visual Site Inspection portions of the RCRA Facility Assessment (RFA) process.

Pursuant to Health and Safety Code, Section 25187, Cal-EPA, Region 3, DTSC issued on 2 December 1992 a Stipulated Enforcement Order to Rockwell International Corporation regarding SSFL, including ETEC. The Order was issued by the State Attorney General's office and requires Rockwell to comply with specific terms and conditions, as a Corrective Action order.

The State of California DTSC has RCRA authorization and has become the lead agency in implementing the corrective action process for the SSFL. ETEC has performed soil sampling at various SWMUs and Areas of Concern (AOCs) that were identified in the RFA report. This has enabled ETEC to determine if further action and/or interim measures will be necessary for SWMUs to be incorporated into the RCRA Facility Investigation (RFI).

The current conditions report and a draft of the RCRA Facility Investigation Work Plan for the Area IV SWMUs were submitted to the DTSC in October 1993. One SWMU in Area IV, the T056 Landfill, was proposed for the RFI. In 1994, DTSC issued a letter to Rocketdyne conditionally approving the draft RFI work plan, subject to satisfactory resolution of their comments. A RFI workplan addendum was submitted to DTSC in March 1995 that responded to the DTSC comments. In January 1996, DTSC forwarded draft comments to Rocketdyne on the Area IV SWMUs AOCs. In November 1996, DTSC approved a revised workplan addendum. Field work also began in November 1996 and is scheduled for completion in November 1997.

3.2.5 Permits and Licenses (Area IV)

Listed below are the permits and licenses applicable to activities in Area IV[2].

	Facility	Valid
Air (VCAPCD)		
Permit	Facility	Valid
0271	Combined permit renewal	1/1/96-12/31/96
Treatment Storage (EPA)		
CAD000629972 (93-3-TS-002)	Hazardous Waste Management Facility (T133 and T029)	11/30/93-11/30/03
CA3890090001	Radioactive Materials Handling Facility (RMHF)	Part A interim status updated 4/93
NPDES (CRWQCB)		
CA0001309	Santa Susana Field Laboratory	12/7/92-11/10/97
Nuclear Regulatory Agency		
SNM-21	Hot Laboratory (T020)	Amendment 8 issued 4/20/92 Terminated 9/27/96
State of California		
Radioactive Materials License (0015-70)	All Rocketdyne facilities	Amendment 92 issued 1/24/96 ongoing
Well Permits (VCPWA)		
1573, 1808, 2138, 2322, 2328, 2331, 2342, 2916, 3359, and 3455	Santa Susana Field Laboratory - Area IV and offsite monitor wells	Latest (No 3455) issued 7/1/93

[2]The waste discharge requirements for the sewage treatment plant in Area III that receives the Area IV sewage are included in the NPDES permit.

There were 14 underground storage tanks that are exempt from permitting in Area IV during 1996. Three sodium tanks were cleaned in 1996 and removed in 1997. One radioactive water tank (UT-7) was transferred from the Hot Lab to the RMHF, where it continues to store its contents. A list of the remaining tanks is shown in Table 3-5.

Table 3-5. SSFL Current Underground Storage Tanks

UST	Building Location	Capacity (gallons)	Tank Type	Contents
UT-7	T022	3,000	Stainless Steel Vaulted	RA water[a]
UT-15	T022	8,000	Stainless Steel Vaulted	RA water[a]
UT-16	T021	200	Stainless Steel Vaulted	RA water[a]
UT-24	T059	12,000	Stainless Steel Vaulted	Sodium
UT-29	T356	13,000	Stainless Steel Vaulted	Sodium
UT-30	T356	10,000	Stainless Steel Vaulted	Sodium
UT-31	T356	10,000	Stainless Steel Vaulted	Sodium
UT-32	T356	10,000	Stainless Steel Vaulted	Sodium
UT-33	T356	12,000	Stainless Steel Vaulted	Sodium
UT-34	T462	36,000	Stainless Steel Vaulted	Sodium
UT-35	T462	34,000	Stainless Steel Vaulted	Sodium

[a]Radioactive (RA) water tanks are regulated by U.S. Department of Energy (DOE).

[b]Sodium tanks are exempt from UST permitting per Ventura County regulations.

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4. ENVIRONMENTAL PROGRAM INFORMATION

At SSFL, the Energy Technology Engineering Center has responsibility for the former nuclear facilities and related cleanup operations. ETEC's Environmental Management (EM) Department is responsible for environmental restoration and waste management operations in Area IV, where the nuclear operations were conducted. The Department's mission is to "Perform remediation of the ETEC facilities with full regulatory compliance, total regard for personnel safety and protection of the environment, within agreed to budgets and schedules." Supporting the EM department in this work are ETEC's General Support & QA Department and Rocketdyne's Environment, Health & Safety (now Safety, Health & Environmental Affairs [SHEA]), Transportation, Quality Assurance, Procurement, and Technical Skills Development Departments.

Environmental restoration activities at ETEC include decontamination and decommissioning (D&D) of radioactively contaminated facilities, assessment and remediation of soil and groundwater, surveillance and maintenance of work areas, and environmental monitoring. Waste management activities include waste characterization and certification, storage, treatment, and offsite disposal. Waste management activities are performed at two permitted facilities; the Radioactive Materials Handling Facility (RMHF) for radioactive and mixed waste, and the Hazardous Waste Management Facility (HWMF) for alkali metal waste.

4.1 ROCKETDYNE ENVIRONMENTAL PROTECTION AND REMEDIATION

Environmental protection at Rocketdyne is managed under the Environment, Health & Safety Department, and this department provides support to ETEC for environmental management and restoration. The stated policy of this Department is "To support the Corporation's commitment to the well-being of its employees, community and environment. It is Rocketdyne's policy to maintain facilities and conduct operations in accordance with all federal, state and local requirements and contractual agreements. Rocketdyne employees are responsible for implementing and complying with this policy." Responsibilities for environmental protection at Rocketdyne fall under two sub-departments: Environmental Protection and Environmental Remediation. The responsibilities for each are listed below.

Environmental Protection (EP) is responsible for developing and implementing cost effective and efficient programs designed to ensure achievement of the policy objectives related to environmental protection. EP's responsibilities include:

- Ensuring compliance with applicable federal, state, and local rules and regulations, including maintaining a working knowledge of applicable environmental laws, performing compliance audits, reviewing new and modified facility projects, coordinating solid and hazardous waste disposal, maintaining required records, preparing and submitting required regulatory reports, applying for and maintaining permits and assuring compliance with permit conditions, performing sampling and analysis.

- Responding to uncontrolled releases, and reporting releases as required by law and contractual requirements.
- Suspending operations determined to be in violation of environmental regulations.
- Participating in rule and regulatory development, including evaluating impacts on Rocketdyne programs, coordinating with other Rocketdyne functions, as appropriate, and informing management and staff of new or revised requirements.
- Providing a program, in conjunction with Technical Skills and Development, for motivating, informing and training employees about their duties to comply with environmental regulations and protect the environment.
- Recognizing and responding to the community's concerns regarding the environmental impact of Rocketdyne operations including escorting and cooperating with regulatory officials interested in environmental matters and responding to requests for information referred to Communications.
- Working with Rocketdyne customers and suppliers to minimize the use of materials and processes that impact the environment while maintaining product quality and competitive pricing.
- Making environmental concerns, energy and raw material conservation a priority when evaluating new and existing operations and products or when making decisions regarding land use, process changes, materials purchases, and business acquisitions.

Environmental Remediation (ER) is responsible for remedial actions to clean up historical chemical contamination and for providing radiological support for the D&D of radiological contamination at all Rocketdyne facilities. ER's responsibilities include:

- Compliance with all federal, state and local regulations pertaining to environmental remediation.
- Remediation of historical chemically and radiologically contaminated Rocketdyne sites to achieve closure or permit release for use without radiological restrictions.
- Compliance with all federal, state and local regulations pertaining to occupational and environmental (ionizing) radiation protection.
- Provision of health physics oversight of D&D and radioactive waste management activities.
- Performance of final surveys of D&D'ed buildings and facilities to demonstrate acceptability for release for unrestricted use.
- Response to employee and public concerns regarding environmental remediation activities and the impact of these activities on the health and safety of the community.

4.2 ENVIRONMENTAL MONITORING PROGRAM

The purpose of the environmental monitoring program is to detect and measure releases of hazardous and radioactive materials and identify other undesirable impacts on the environment. It includes remediation efforts to correct or improve contaminated conditions at the site and prevent offsite effects. For this purpose, the environment is sampled and monitored, and effluents are analyzed. A goal of this program is to demonstrate compliance with applicable regulations. Environmental restoration activities at the SSFL include a thorough review of past programs and historical practices to identify, characterize, and correct all areas of potential concern. The key regulations governing the monitoring program are DOE Orders 5400.1 and 5400.5 (Refs. 10 and 11). Additional guidance is drawn from NRC and California regulations and licenses, and appropriate standards.

The basic policy for control of radiological and chemical materials requires that adequate containment of such materials be provided through engineering controls, that facility effluent releases be controlled to federal and state standards, and that external radiation levels be reduced to as low as reasonably achievable (ALARA) through rigid operational controls. The environmental monitoring program provides a measure of the effectiveness of these operational procedures and of the engineering safeguards incorporated into facility designs.

4.2.1 Radiological Monitoring

The radiological monitoring program involves measurements of radioactivity in air, soil, water, and vegetation, and environmental and facility radiation, as appropriate to the changing conditions at the site.

Samples of particulate matter in facility ventilation exhausts and the ambient air are collected by means of filters and vacuum pumps. Facility atmospheric effluent sample filters and ambient air sample filters for 1996 were composited from each sampler for radiochemistry analysis by DataChem Laboratories. Gamma-spectrometry analyses of samples such as soil, water, and ambient air sample filters confirm that the major radionuclides present are normally those of the naturally occurring thorium and uranium decay chains, plus other natural radionuclides such as the primordial K-40, and Be-7 produced by cosmic ray interactions in the atmosphere.

In addition to environmental monitoring, workplace air and atmospheric effluents are continuously monitored or sampled, as appropriate. This directly measures the effectiveness of engineering controls and allows remedial action to be taken before a significant release of radioactivity could occur.

4.2.2 Non-Radiological Monitoring

Extensive monitoring programs for chemical contaminants in air, soil, surface water, and groundwater are in effect to assure that the existing environmental conditions do not pose a threat to the public welfare or environment. Soils contaminated by petroleum products are remediated whenever underground fuel tanks are removed. Extensive soil sampling is performed under the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) and other site-specific remedial programs. Groundwater is extensively monitored for chemical contaminants through sampling at 232 onsite and offsite wells. Groundwater analyses are conducted by Groundwater Resources Consultants, Inc. (GRC) following approved EPA methods. Equipment installed in an extensive groundwater remediation program has the capacity to remove solvents from contaminated groundwater at a throughput of one million gallons per day. This system returns purified water to the surface water collection ponds.

All surface water discharges are monitored as specified in the existing National Pollutant Discharge Elimination System (NPDES) permit. In addition, all sources of emissions are monitored as required by the Ventura County Air Pollution Control District (VCAPCD). Asbestos control is conducted under the requirements of Titles 29, 40, and 49 of the Code of Federal Regulations (CFR), in addition to any state or local regulations that apply to any specific asbestos abatement program.

In addition to this environmental monitoring and restoration program, current operational procedures reflect Rocketdyne's commitment to a clean and safe environment. For example, solvents and oils are collected and recycled, rather than being discarded. A comprehensive training and employee awareness program is in place. All employees working with hazardous materials are required to attend a course on hazardous materials waste management. Environmental bulletins are printed in the internal Rocketdyne newspaper to promote environmental awareness among all employees.

4.3 ENVIRONMENTAL TRAINING

Rocketdyne conducts training and development programs as an investment in human resources to meet both organizational and individual goals. These programs are aimed toward improving employee performance, assuring employee proficiency, preventing obsolescence in employee capability, and preparing employees for changing technology requirements and for possible advancement.

The People & Communications Department is responsible for the development and administration of formal training and development programs. Line managers are responsible for individual employee development through formal training, work assignments, coaching, counseling, and performance evaluation. Line managers and employees are jointly responsible for defining and implementing individual training development goals and plans, including On the Job Training.

The Rocketdyne Technical Skills Department currently maintains a listing of approximately 700 courses available for Rocketdyne personnel. Of these, approximately 90 relate to environment, health, and safety, with approximately 40 relating to environmental protection and remediation. Specialized training programs on new technological developments and changes in regulations are provided, as needed, to assure effective environmental protection.

Also, informal discussions about waste minimization and management occur at hazardous waste coordinator's meetings. Additional offsite courses are also encouraged.

4.4 WASTE MINIMIZATION AND POLLUTION PREVENTION

4.4.1 Program Planning and Development

A Waste Minimization and Pollution Prevention Awareness Plan developed in accordance with DOE Order 5400.1 (Ref. 18) has been in place since December 1993. The plan was updated (Ref. 19) during 1996 to include DOE's guidelines for waste minimization during ER activities. This plan serves as a guidance document for all waste generators at ETEC. The plan emphasizes ETEC's proactive policy of waste minimization and pollution prevention, and outlines goals, processes, and waste minimization techniques to be considered for all waste streams generated at ETEC. The plan requires that waste minimization assessments of all major restoration projects be performed.

The majority of waste currently generated at ETEC is attributable to environmental management activities related to environmental restoration of surplus facilities and clean up of contaminated sites from previous programs. Small amounts of hazardous waste are also generated as a result of ongoing test operations. The key components of waste generated at ETEC are:

- Low-level radioactive waste (LLW), mixed, hazardous, and non-hazardous wastes from decontamination and decommissioning (D&D) operations.
- Sodium hydroxide and scrap metals resulting from the treatment of sodium contaminated metal components at a RCRA permitted facility. The sodium contaminated components are from D&D operations and ongoing test operations at ETEC.
- Motor/turbine oils from ongoing test operations.
- Demineralizer regeneration effluent water.
- High salinity cooling tower basin water.
- Solvents and paints.

In general, the measures used to promote waste minimization at ETEC are:

- Using comprehensive segregation and screening procedures to minimize mixed wastes by separating LLW and hazardous wastes.
- Using survey and decontamination processes to release concrete and steel for potential recycling/reuse
- Removal of bulk sodium from facility drain tanks for recycling/reuse.

- Conversion of residual sodium in piping and components to high grade sodium hydroxide for commercial use
- Sampling, analyzing, and filtering oils to extend their useful life and reduce oil consumption.
- Reusing containers.
- Linking of a chemical/material exchange system with the purchasing system to reduce purchases of hazardous materials.
- Reducing non-hazardous waste disposal through process changes and recycling.

Waste minimization is accomplished by first assessing the waste, identifying waste minimization options, and finally conducting technical and economic evaluations to determine the best approach.

The following ETEC Procedures supplement the Waste Minimization Plan.

- ETEC Procedure 1-20, Environmental Protection Program
- ETEC Procedure 2-11, Construction Management
- ETEC Procedure 2-28, Non-Department of Energy Funded Work
- ETEC Procedure 2-30, Management of Real Property Maintenance Program
- ETEC Procedure 2-44, ETEC Self-Assessment Program

4.4.2 Training and Awareness Programs

The ETEC Waste Minimization and Pollution Prevention Awareness Program includes (1) orientation programs and refreshers, (2) specialized training, and (3) incentive awards and recognition. New ETEC employees attend an orientation program that describes waste generation, treatment, disposal, minimization, and pollution prevention. Orientation presentations are designed to increase pollution prevention and waste minimization awareness and to motivate employees. Also, employees attend periodic refresher training.

Employees are reminded about pollution prevention and waste minimization awareness. Posters are placed in work areas to notify employees about environmental issues or practices. Memoranda are circulated about changes in waste management policy, ETEC and Rocketdyne policies or procedures, and technical data relevant to an employee's job assignment. Presentations using visual aids are provided, as needed, to review major changes in environmental issues.

4.4.3 Waste Minimization and Pollution Prevention Activities

The following are some of the significant activities related to waste minimization and pollution prevention.

- Perform sampling, analysis, and filtering of motor/turbine oils prior to servicing. These procedures have greatly extended the life of these oils and saved money particularly when synthetic oils are involved.
- Use of comprehensive segregation and screening procedure of RA materials resulting in the salvage of usable non-radioactive scrap metal.
- A chemical/material exchange system is currently linked to the purchasing system and prevents the unnecessary purchase of hazardous materials.
- All hazardous waste containers in acceptable condition are reused. Similar hazardous wastes are combined during pickup runs.
- Use of spray nozzles for rinsing operations at the HWMF resulting in reducing the amount of water and hence generation of sodium hydroxide waste.
- Empty product drums returned to the vendor for reuse when practical.
- Approximately 80% of the white paper (20 metric tons) and aluminum cans (16 metric tons) are recycled as a result of increased environmental awareness.
- Use of a compactor to reduce the volume of soft low level radioactive waste
- A user of bulk sodium (Callery Chemical) was identified and supplied with 22,140 gallons of bulk sodium from two excessed sodium facilities and several tanks.
- Approximately 4,500 gallons of residual sodium in tanks and piping systems was converted into commercial grade sodium hydroxide using a Water Vapor Nitrogen process. This resulted in avoiding generation of approximately 15,000 gallons of hazardous waste.
- Approximately 6.5 tons of clean recyclable stainless steel and 31 tons of carbon steel resulted from cleaning tanks and piping
- Implementation of the waste minimization assessment for the D&D of the Hot Lab (T020) resulted in the reduction of 20,500 cubic feet of low level radioactive waste (by decontamination and survey). This has resulted in cost savings of over $600,000.

4.4.4 Tracking and Reporting System

ETEC and Rocketdyne track various categories of materials from procurement to waste disposal. Wastes are tracked by various Rocketdyne and ETEC departments. Radioactive and mixed wastes are characterized by the generator, shipped to the Radioactive Materials Handling

Facility (RMHF), and logged and temporarily stored at the RMHF. Documents that accompany the wastes are verified for accuracy and completeness, and filed at the RMHF by Environmental Management personnel. Hazardous waste tracking and verification procedures (from generator to final offsite disposal) are followed by the Rocketdyne Environmental Protection Department. Rocketdyne is responsible for all non-hazardous and sanitary waste operations at the SSFL.

Relevant reports include:

- EPA's Biennial Hazardous Waste Report
- DOE's Annual Waste Minimization Report
- DOE's Affirmative Procurement Report
- "Source Reduction Evaluation Review and Plan" and "Hazardous Waste Management Performance Report," both of which are required by the "Source Reduction and Hazardous Waste Management Review Act (SB14)"

5. ENVIRONMENTAL RADIOLOGICAL MONITORING

Radiological monitoring of the environment at SSFL began before the first nuclear facilities were established in 1956. The program has continued with modifications to suit the changing operations. The selection of monitoring locations was based on several site-specific parameters such as topography, meteorology, hydrology, and the location of nuclear facilities. The prevailing wind direction for the SSFL site is generally from the north and northwest, with some seasonal diurnal shifting to the southeast quadrant. Most rainfall runoff at the SSFL site flows through several natural watercourses and drainage channels and is collected in two large-capacity retention ponds. This water may be discharged offsite into Bell Canyon to the south or it may be reused for industrial purposes.

Gross alpha and beta measurements of air filter samples are used for screening purposes to quickly identify any unusual release, and to permit a long-term historical record of radioactivity in the environment. For surface water and groundwater, these measurements also permit direct comparison with the screening limits, gross alpha and gross beta, established by EPA for suppliers of drinking water. These gross radioactivity limits provide for more detailed analysis if exceeded. Ventilation exhaust and ambient air samples are counted for gross alpha and beta radioactivity and are also analyzed for specific radionuclides. Detailed analyses of these samples permit more accurate estimates of the potential offsite dose for the air pathway. The following discussion presents a brief summary of pathway dose analysis results for SSFL and De Soto for 1996. Ambient air and exhaust effluent gross alpha/beta measurements are also presented graphically in Section 5.5.1 (Figure 5-4).

Direct radiation is monitored by the use of a large number of thermoluminescent dosimeters (TLDs) mounted on facility fencelines and along the site boundary. To permit the most accurate measurement of low levels of ambient radiation, 18 of these are very sensitive "sapphire" TLDs. These TLDs are complemented by TLDs installed by the State of California Department of Health Services Radiologic Health Branch (DHS/RHB) for independent surveillance. Additional standard TLDs are located around and throughout the facilities.

5.1 DOE FACILITIES AT SSFL (AREA IV)

The RMHF, Hot Lab, and T059 have continuous effluent monitoring capability. In 1996, effluent was monitored only for the RMHF and the Hot Lab, since there was no radiological work in T059 during the year. The decontamination of several buildings was completed. Building T005 was released for unrestricted use by the DHS/RHB. T064 was released for demolition by the DOE. T023 was released for unrestricted use by DOE. ORISE conducted a satisfactory confirmatory survey of T012. T024 is inactive with no effluent, and thus does not require effluent monitoring. Airborne releases from the RMHF are detailed in Table 5-1, sheet 1, and are shown to be below the Derived Concentration Guides (DCGs) of DOE Order 5400.5 (Ref. 20). Airborne and direct radiation doses from the RMHF are detailed in Table 5-9 and are shown to be below the dose limits of DOE Order 5400.5 and EPA NESHAPs limits of

40 CFR 61, Subpart H. Key results are discussed below. Airborne and direct radiation doses from the Hot Lab are detailed in Table 5-9 and are shown to be below the dose limits of DOE Order 5400.5, NRC 10 CFR 20, and the State of California CCR 17, and EPA NESHAPs limits of 40 CFR 61, Subpart I. Key results are discussed below.

At the site boundary-line location nearest to the RMHF, the external annual exposure from direct radiation is estimated to correspond to an average annual dose of approximately 31 mrem above natural background (equivalent to 3.5 μR/hr). An annual dose of 0.00028 mrem is similarly calculated for the nearest residence. These values are below the DOE long-term limit of 100 mrem/yr as specified in DOE Order 5400.5 "Radiation Protection of the Public and the Environment." State and NRC regulations impose the same limits for licensed operations.

These estimated doses were determined by extrapolating the measured annual doses from various area dosimeters in place around the facility. Details on these calculations are given in Section 5.6. The boundary-line exposure is a conservative estimate of a hypothetical potential dose, in that the rugged terrain at the site boundary nearest the RMHF and the Hot Lab precludes anything more than the possible rare and temporary presence of any person at that location. For the nearest residence, radiation attenuation by the air reduces direct radiation to levels indistinguishable from normal background. In addition, intervening irregular rock formations and hills completely shield offsite locations from the radiation sources. Essentially only natural background radiation inherent to the residence location would actually be present.

Airborne dose calculations were performed to demonstrate compliance with the NESHAPs standard. At the location of the hypothetical Maximally Exposed Individual, the effective dose equivalent from DOE facility exhausts during 1996 (RMHF and Hot Lab for the last calendar quarter) was 4.6×10^{-6} mrem. The EPA limit for a DOE site is 10 mrem/yr, as specified in 40 CFR 61, Subpart H. Potential releases from these facilities are so low that, even assuming absence of HEPA filters, estimated doses would be below the level requiring continuous monitoring. However, continuous monitoring is still being performed as a best management practice.

In addition to the above point sources, analyses were performed to determine the maximum estimated individual dose due to potential releases from "area" sources. The only area sources considered for 1996 are the T064 sideyard and adjacent areas, and the RMHF pond (Sump 614), which was dry during part of 1996 and so was subject to possible resuspension of sediment by the wind. The RMHF northslope has been considered to be an occasional source in prior years but is now fully covered by native vegetation, and thus no windborne resuspension of radioactively contaminated soil can occur.

The estimated dose to the hypothetical maximum exposed individual due to potential releases from the diffuse area sources only is 1.28×10^{-4} mrem for 1996. Since releases from the area sources were too small and diffuse to permit accurate measurements, potential releases were estimated using the same method used in the RESRAD computer program (ANL/ES-160), for calculation of airborne radioactivity due to resuspension of soil by the wind. These estimated releases were used as input in the CAP88-PC program to perform the area source dose assessments. Releases from these sources have not been detected by onsite continuous ambient air sampling.

5.2 NRC LICENSED FACILITY AT SSFL (AREA IV)—HOT LAB

The NRC license for the Hot Lab was terminated on September 27, 1996. Interpretation of the monitoring results for the Hot Lab has been apportioned to NRC and DOE according to the fraction of the year under the jurisdiction of each agency. Airborne releases from the Hot Lab are detailed in Table 5-1, sheet 2, and are shown to be below the maximum permissible concentrations (MPCs) of 10 CFR 20.1301 (Ref. 22) and State of California, CCR Title 17, Section 30269 (Ref. 23). Airborne and direct radiation doses at the site boundary are detailed in Table 5-16 and are shown to be less than the NRC dose limits of 10 CFR 20.105 and the State of California limits, CCR Title 17, Section 30253.

Calculations of the direct radiation dose at the nearest site boundary and at the nearest residence were negative, indicating that there was no measurable radiation exposure above natural background due to operations at the Hot Lab. Airborne effluent is a factor of 10^6 less than the isotopic MPCs of the NRC and State of California. Dose to the hypothetical maximally exposed individual from airborne effluent from the Hot Lab for the entire year is 1.7×10^{-6} mrem/yr, and, though not applicable to NRC licensed facilities, this is far below the EPA NESHAPs limit of 10 mrem/yr from 40 CFR 61, Subpart H. Even in the absence of HEPA filters the dose from the Hot Lab would still be below the level requiring continuous monitoring; however, continuous monitoring is still being performed as a best management practice. Compliance with 40 CFR 61, Subpart I, applicable to licensed facilities, was demonstrated by using the COMPLY code at the simplest level.

Removal of the facility stack and ventilation exhaust system was evaluated and shown to not require an EPA permit for new construction or modification.

5.3 STATE OF CALIFORNIA LICENSED FACILITY AT DE SOTO—BUILDING 104

Airborne releases from Building 104 at the De Soto facility are detailed in Table 5-1, sheet 3, and are shown to be below the MPCs of State of California, CCR Title 17, Section 30253. Airborne and direct radiation doses at the site boundary are detailed in Table 5-17 and are shown to be less than the dose limits of State of California, CCR Title 17, Section 30253. (This facility was operated for DOE under a State of California license.)

Direct radiation measurements at De Soto were indistinguishable from background measurements, both onsite and offsite. Therefore, no dose above natural background occurred offsite. Airborne effluent from Building 104 was a factor of 10^5 less than the isotopic MPCs for the State of California. Dose to the hypothetical maximally exposed individual from airborne effluent was 9.5×10^{-6} mrem/yr, which is less than the EPA NESHAPs limit of 10 mrem/yr from 40 CFR 61, Subpart H, for DOE facilities. Compliance with 40 CFR 61, Subpart I, applicable to licensed facilities, was demonstrated by using the COMPLY code at the simplest level.

5.4 EFFLUENT MONITORING

Workplace ventilation is provided in all areas where unencapsulated or unpackaged radioactive material is handled, such as in the Hot Lab decontamination project and in the decontamination and packaging rooms at RMHF (where equipment is decontaminated and radioactive waste is repackaged). This assures protection of the workers from inhalation of airborne radioactive material and prevents the spread of radioactive contamination into the adjacent clean areas. The ventilation exhaust is passed through HEPA filters before being discharged to the atmosphere, to prevent the release of airborne radioactivity. The filtered air generally contains lower levels of long-lived radioactivity than does ambient air from naturally occurring radionuclides in the atmosphere. Essentially all short-lived radioactivity in the air is caused by natural beryllium-7 and the naturally present radon daughters, which dominate the airborne activity.

The ventilation exhaust is sampled to measure the effluent radioactivity. Data from this sampling is used to demonstrate compliance with NRC, State RHB, DOE, and EPA standards (NESHAPs). The U.S. EPA regulates airborne releases of radioactivity from DOE facilities under 40 CFR 61, Subpart H, and from licensed facilities under 40 CFR 61, Subpart I.

The only potential release of effluent radioactivity to uncontrolled areas is by way of filtered discharge of ventilation exhaust from the RMHF, the Hot Lab, T059, and Building 104, and occasional diffuse area sources. No contaminated liquids are discharged to uncontrolled areas. No activities involving radioactive materials were conducted in T059 during 1996. The only diffuse area sources considered significant for 1996 are a temporarily dry runoff collection sump for the RMHF and the slightly contaminated soil to the east of Building T064. Brush has been cleared from this area to permit further survey work.

Effluents that may contain radioactive material are released at the Rocketdyne Propulsion & Power facilities as the result of operations performed under contract to DOE, under NRC Special Nuclear Materials License SNM-21, and under the State of California Radioactive Material License 0015-70. The specific facilities are identified as the RMHF, T059, and the Hot Lab at SSFL, and Building 104 at the De Soto complex.

The level of radioactivity contained in all atmospheric effluents is reduced to the lowest practical value by passing the effluents through certified HEPA filters. The effluents are sampled for particulate radioactive materials by means of continuously operating stack exhaust samplers at the point of release. In addition, stack monitors installed at the Hot Lab and the RMHF provide automatic alarm capability in the event of the release of particulate activity. The HEPA filters used for filtering atmospheric effluents are at least 99.97% efficient for particles 0.3 μm in diameter.

In the tables that follow, the radionuclide-specific results that were negative, zero, or "not detected" have been omitted. In showing gross alpha and beta data, the occasional negative values are included to permit a complete and balanced view of the results. Omission of the negative values would significantly bias the presentation. Censoring of the results by substituting zero for negative values would produce a misleading impression of environmental conditions, and an incorrect estimate of the average values.

The average concentration and total radioactivity, as gross alpha and gross beta activity, in atmospheric effluents to uncontrolled areas from the RMHF, the Hot Lab, and De Soto 104 are shown in Table 5-1. The total shows that no significant quantities of radioactivity were released in 1996. The gross alpha and gross beta counts are done shortly after the weekly stack sample is collected, to permit identification of any unusual release. These results include the naturally occurring radionuclides present in air, Be-7, K-40, and Po-210. Detailed analyses are performed on the entire sets of filter samples at the end of the year, to provide the greatest analytical sensitivity.

The isotopic composition of the radioactivity deposited on the nuclear facility exhaust air sampling filters, composited for the year, is also presented in Table 5-1. Gamma-emitting radionuclides were measured by using a high-resolution gamma spectrometer. All others were measured by using specific chemical separations followed by alpha or beta counting. Radionuclides that were reported as less than the method detection level are shown as "not detected" (ND). The relatively large amount of Po-210 collected on the Hot Lab filter is due to use of unfiltered bypass (ambient) air taken into the main exhaust system from the outside, which contains naturally occurring elements from the U-238 decay chain in the environment. The K-40 is due to the presence of this radionuclide in natural potassium of the airborne dust in the ambient air. Be-7 had decayed below the detection level by the time of the analysis. Materials used in operations conducted at the SSFL and De Soto sites are responsible for the fission/activation product radioactivity.

For each radionuclide detected, the laboratory calculates a lower limit of detection (LLD). This is the lowest activity that would be identified as "radioactive" with 95% confidence. "Radioactive" is specified as an analytical result that is above 95% of the distribution of background results. This LLD refers to the specific sample form analyzed, in this case a composite of filters. For the purpose of comparing effluent releases, the laboratory LLD for the composited filters was converted to an equivalent annual release and is shown in the table as the release LLD.

The radioactivity results are also shown in Table 5-2, for comparison with ambient air. The effectiveness of the air cleaning systems is evident from the fact that the atmospheric effluents are less radioactive than is the ambient air with respect to the ambient air radionuclides K-40, and Po-210.

Exhaust samples are counted for gross alpha and beta activity after allowing decay of the short-lived airborne radioactivity, on a weekly basis. Composited samples are analyzed in detail at the end of the year to determine the individual radionuclide concentrations. The results of these latter analyses for the RMHF, the Hot Lab, and De Soto are also shown in Table 5-2.

The concentrations in the effluent at the exhaust stack for each facility are compared with appropriate limits for exposure of the public. The isotopic limits for DOE facilities are Derived Concentration Guides (DCGs) for exposure of the public for the most restrictive form of the radionuclide as specified in DOE Order 5400.5. Isotopic effluent limits for facilities with State of California- and NRC-licensed activities are Maximum Permissible Concentrations (MPCs) for release to an unrestricted area for the most restrictive form of the radionuclide as specified in 10 CFR 20, Appendix B.

The most restrictive MPC (from CCR 17 or 10 CFR 20) or DCG for each radionuclide is shown in Column 2 in Table 5-2. (The natural radionuclide K-40 is so uniformly present, and so rarely present in an enriched form, that no MPC or DCG has been developed for it.) These values refer to the permissible concentrations allowed by the State of California (and the NRC) and the DOE for continuous exposure of the public. Note that, in all cases, for the exhaust air, the observed concentrations are far below the MPC and DCG. Many results are so low (close to zero) that the measurements are dominated by analytical and background variations, with the result that negative and inconsistent values are frequently produced. Furthermore, dilution and dispersion occur before the material reaches an unrestricted area, reducing the concentration in the public area.

Table 5-1. Atmospheric Effluents to Uncontrolled Areas (Sheet 1 of 3)

SSFL/RMHF - 1996

Effluent volume (m3)	222,699,362
Lower Limit of Detection, LLD	
Gross alpha (µCi/mL)	6.0E-16
Gross beta (µCi/mL)	6.0E-16
Air volume sampled (m3)	25,128
Annual average concentration in effluent	
Gross alpha (µCi/mL)	ND
Gross beta (µCi/mL)	1.3E-14
Maximum observed concentration	
Gross alpha (µCi/mL)	5.4E-16
Gross beta (µCi/mL)	7.4E-14
Activity releases (µCi)	
Gross alpha	ND
Gross beta	2.859

Radionuclide-Specific Data

Radionuclide	Half-Life (yr)	Activity Detected (pCi)	Annual Release (µCi)	Analysis LLD (pCi)	Release LLD (µCi)	Average Exhaust Concentration (µCi/mL)	DAC (µCi/mL)
H-3	12.34	NA	20.00000			8.98E-14	1.0E-07
Be-7	0.146	ND		101.000	0.895		natural
K-40	1,260,000,000	37.180	0.32951	101.000	0.895	1.48E-15	natural
Co-60	5.26	62.000	0.54948	10.600	0.094	2.47E-15	8.0E-11
Sr-90	27.7	16.870	0.14951	2.055	0.018	6.71E-16	9.0E-12
Cs-137	30.0	330.668	2.93058	13.100	0.116	1.32E-14	4.0E-10
Po-210	0.38	1.461	0.01295	0.814	0.007	5.82E-17	natural
Th-228	1.9131	0.040	0.00035	0.614	0.005	1.57E-18	4.0E-14
Th-230	80,000	0.019	0.00017	0.578	0.005	7.72E-19	4.0E-14
Th-232	14,100,000,000	ND		0.561	0.005		7.0E-15
U-234	247,000	ND		0.572	0.005		9.0E-14
U-235	710,000	ND		0.484	0.004		1.0E-13
U-238	4,510,000,000	ND		0.319	0.003		1.0E-13
Pu-238	86.4	0.087	0.00078	0.411	0.004	3.48E-18	3.0E-14
Pu-239/240	24,390/6,580	0.502	0.00445	0.340	0.003	2.00E-17	2.0E-14
Pu-241	15.16	ND		94.800	0.840		1.0E-12
Am-241	433	ND		0.520	0.005		2.0E-14

Naturally occurring radionuclides are included for information. These activities have not been used in dose estimates.

Derived Air Concentration (DAC) for exposure of the public, for the most restrictive form of radionuclide as specified in DOE Order 5400.5 (2/8/90)

ND = Not Detected, NA=Not Analyzed

Table 5-1. Atmospheric Effluents to Uncontrolled Areas (Sheet 2 of 3)

SSFL/Hot Lab - 1996	
Effluent volume (m3)	301,274,937
Lower Limit of Detection, LLD	
Gross alpha (µCi/mL)	8.0E-16
Gross beta (µCi/mL)	8.0E-16
Air volume sampled (m3)	32,796
Annual average concentration in effluent	
Gross alpha (µCi/mL)	9.6E-16
Gross beta (µCi/mL)	1.4E-14
Maximum observed concentration	
Gross alpha (µCi/mL)	8.8E-15
Gross beta (µCi/mL)	9.6E-14
Activity releases (µCi)	
Gross alpha	0.290
Gross beta	4.181

Radionuclide-Specific Data

Radionuclide	Half-Life (yr)	Activity Detected (pCi)	Annual Release (µCi)	Analysis LLD (pCi)	Release LLD (µCi)	Average Exhaust Concentration (µCi/mL)	MPC (µCi/mL)
Be-7	0.146	ND		96.000	0.882		natural
K-40	1,260,000,000	37.080	0.34063	83.000	0.762	1.13E-15	natural
Co-60	5.26	7.200	0.06614	10.500	0.096	2.20E-16	5.0E-11
Sr-90	27.7	21.290	0.19558	2.195	0.020	6.49E-16	6.0E-12
Cs-137	30.0	118.108	1.08498	11.200	0.103	3.60E-15	2.0E-10
Po-210	0.38	55.459	0.50946	0.297	0.003	1.69E-15	natural
Th-228	1.9131	ND		0.995	0.009		2.0E-14
Th-230	80,000	0.492	0.00452	0.786	0.007	1.50E-17	2.0E-14
Th-232	14,100,000,000	ND		0.714	0.007		4.0E-15
U-234	247,000	0.028	0.00026	0.585	0.005	8.48E-19	5.0E-14
U-235	710,000	ND		0.378	0.003		6.0E-14
U-238	4,510,000,000	ND		0.500	0.005		6.0E-14
Pu-238	86.4	0.040	0.00037	0.681	0.006	1.23E-18	2.0E-14
Pu-239/240	24,390/6,580	ND		0.790	0.007		2.0E-14
Pu-241	15.16	ND		97.300	0.894		8.0E-13
Am-241	433	ND		0.585	0.005		2.0E-14

Naturally occurring radionuclides are included for information. These activities have not been used in dose estimates.

Derived Air Concentration (DAC) for exposure of the public, for the most restrictive form of radionuclide as specified in DOE Order 5400.5 (2/8/90)

ND = Not Detected, NA=Not Analyzed

Table 5-1. Atmospheric Effluents to Uncontrolled Areas (Sheet 3 of 3)

De Soto 104 - 1996	
Effluent volume (m3)	126,329,759
Lower Limit of Detection, LLD	
Gross alpha (µCi/mL)	8.0E-16
Gross beta (µCi/mL)	2.0E-15
Air volume sampled (m3)	16.082
Annual average concentration in effluent	
Gross alpha (µCi/mL)	5.8E-17
Gross beta (µCi/mL)	8.9E-16
Maximum observed concentration	
Gross alpha (µCi/mL)	4.5E-16
Gross beta (µCi/mL)	1.9E-15
Activity releases (µCi)	
Gross alpha	0.007
Gross beta	0.112

Radionuclide-Specific Data

Radionuclide	Half-Life (yr)	Activity Detected (pCi)	Annual Release (µCi)	Analysis LLD (pCi)	Release LLD (µCi)	Average Exhaust Concentration (µCi/mL)	MPC (µCi/mL)
Be-7	0.146	ND		92.000	0.723		natural
K-40	1,260,000,000	14.640	0.11500	88.000	0.691	9.10E-16	natural
Co-60	5.26	ND		10.500	0.082		5.0E-11
Sr-90	27.7	1.424	0.01119	2.210	0.017	8.85E-17	6.0E-12
Cs-137	30.0	2.636	0.02071	13.000	0.102	1.64E-16	2.0E-10
Po-210	0.38	2.842	0.02232	0.291	0.002	1.77E-16	natural
Th-228	1.9131	ND		0.910	0.007		2.0E-14
Th-230	80,000	0.332	0.00261	0.839	0.007	2.07E-17	2.0E-14
Th-232	14,100,000,000	0.074	0.00058	0.442	0.003	4.61E-18	4.0E-15
U-234	247,000	ND		0.760	0.006		5.0E-14
U-235	710,000	ND		0.660	0.005		6.0E-14
U-238	4,510,000,000	ND		0.486	0.004		6.0E-14
Pu-238	86.4	ND		0.626	0.005		2.0E-14
Pu-239/240	24,390/6,580	ND		0.459	0.004		2.0E-14
Pu-241	15.16	ND		95.200	0.748		8.0E-13
Am-241	433	0.148	0.00116	0.799	0.006	9.19E-18	2.0E-14

Naturally occurring radionuclides are included for information. These activities have not been used in dose estimates.

Derived Air Concentration (DAC) for exposure of the public, for the most restrictive form of radionuclide as specified in DOE Order 5400.5 (2/8/90)

ND = Not Detected. NA = Not Analyzed

Table 5-2. Filtered and Ambient Air Radioactivity Concentrations - 1996

		Activity Concentration (µCi/mL)											
		Exhaust				Ambient						Averages	
Radionuclide	Maximum Permissible Concentration	RMHF	Hot Lab	DS104	T059	RMHF	RMHF Pond	Hot Lab	T100 (7 day)	T886	DS104	Exhaust	Ambient
H-3	100,000,000	9.0E-14										9.0E-14	
Be-7	natural												
K-40	natural	1.5E-15	1.1E-15	9.1E-16								1.2E-15	
Co-60	50,000	2.5E-15	2.2E-16									1.3E-15	
Sr-90	6,000	6.7E-16	6.5E-16	8.9E-17							1.9E-17	4.7E-16	1.9E-17
Cs-137	200,000	1.3E-14	3.6E-15	1.6E-16		4.9E-17		6.6E-17	4.0E-16	4.6E-16	0.0E+00	5.6E-15	2.4E-16
Po-210	natural	5.8E-17	1.7E-15	1.8E-16		6.5E-15	8.0E-15	6.4E-15	7.1E-15	7.8E-15	8.2E-15	6.4E-16	7.3E-15
Th-228	20	1.6E-18										1.6E-18	
Th-230	20	7.7E-19	1.5E-17	2.1E-17								1.2E-17	
Th-232	4			4.6E-18								4.6E-18	
U-234	50		8.5E-19						9.1E-17			8.5E-19	9.1E-17
U-235	60								6.5E-17				6.5E-17
U-238	60								1.0E-16				1.0E-16
Pu-238	20	3.5E-18	1.2E-18									2.4E-18	
Pu-239/240	20	2.0E-17							2.8E-17			2.0E-17	2.8E-17
Pu-241	800												
Am-241	20			9.2E-18			2.6E-17	1.3E-17	2.1E-17			9.2E-18	2.0E-17
Gross Alpha	20		9.6E-16	5.8E-17		2.4E-15	2.9E-15	2.8E-15	1.5E-15	3.2E-15	3.1E-15	5.1E-16	2.6E-15
Gross Beta	10,000	1.3E-14	1.4E-14	8.9E-16		1.8E-14	2.2E-14	2.1E-14	2.2E-14	2.3E-14	2.1E-14	9.2E-15	2.1E-14

The downwind concentration of radioactive material emissions to the atmosphere during 1996 from the two SSFL exhaust stacks has been calculated with the CAP88-PC computer code using representative input data including wind speed, directional frequency, and stability (using meteorological data developed for the SSFL site by the NRC and Argonne National Laboratory [ANL]) plus facility-specific data such as stack heights and exhaust air velocity.

The radioactivity concentrations at the site boundary location nearest to each release point and at the nearest residence for each nuclear facility are shown in Table 5-3. Table 5-3 shows the non-natural radioactivity concentrations at the nearest boundary and residence locations. These concentrations were estimated by use of CAP88-PC and specific radionuclide releases for each facility, for the direction in which the concentrations are the greatest. While the site boundary is only 118 meters from the RMHF, the maximum ground level concentration occurs at a distance of 325 meters. Therefore, the concentration for the RMHF is calculated for this distance.

Table 5-3. Annual Average Radioactivity Concentrations of Atmospheric Effluents - 1996

Facility	Annual Release (µCi)	Distance (m) and Direction to		Downwind Concentration (µCi/mL)	
		Boundary	Residence	Boundary	Residence
DS 104	3.26	187 E	315 S	3.00E-20	1.70E-20
Hot Lab	2.12	309 NW	2,987 NW	4.50E-19	4.70E-20
RMHF	21.6	325 NW	2,867 NW	2.27E-18	2.49E-19

5.5 ENVIRONMENTAL SAMPLING

5.5.1 Air

Ambient air sampling is performed continuously at De Soto and SSFL with air samplers operating on 24-hour sampling cycles. (These samplers were modified at the end of the year to function on a 7-day cycle. This will improve the sensitivity for activity with a loss in the daily resolution provided by the 24-hour samplers. This is appropriate and consistent with the very low levels of radioactivity in the ambient air, and the lack of opportunity for significant facility releases.) Monitoring locations currently in use are shown in Figures 5-1 and 5-2 and listed in Table 5-4. Airborne particulate radioactivity is collected on glass fiber (Type A/E) filters that are automatically changed daily at the end of each sampling period (midnight). The samples are counted for gross alpha and beta radiation following a minimum 120-hour decay period to allow for decay of short-lived radon and thoron daughters. The volume of a typical daily ambient air sample is approximately 28 m^3, similar to the natural breathing rate of people, 23 m^3 per day.

Daily ambient air samples are counted for gross alpha and beta radiation with a low-background thin-window gas-flow proportional-counting system. The system is capable of simultaneously counting both alpha and beta radiation. The sample-detector configuration provides a nearly hemispherical (2π) geometry. The thin-window detector is continually purged with argon/methane counting gas. A preset time mode of operation is used for counting all samples.

Counting system efficiencies are determined routinely with Tc-99 and Th-230 standard sources. The activities of the standard sources are traceable to the National Institute of Standards and Technology (NIST).

Filter samples for each ambient air sampling location are composited annually and analyzed for isotopic-specific activity. The results of the sample analyses are shown in Table 5-2 with the effluent results for comparison. As is the case with effluent air samples, the observed ambient air radionuclide concentrations were far below the MPC. The variability in the measurements was dominated by weather effects, and by analytical and background variations.

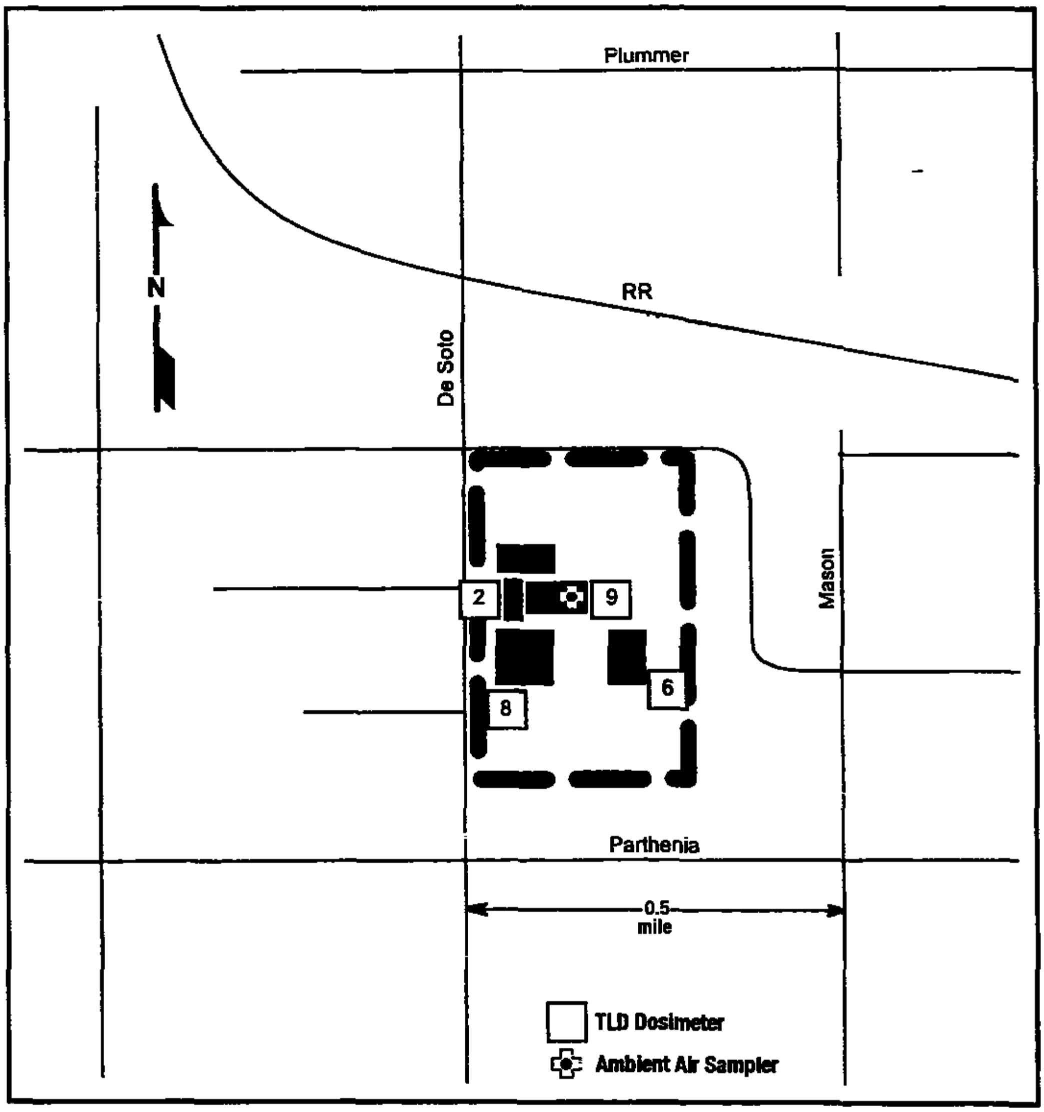

Figure 5-1. Map of De Soto Site Monitoring Stations

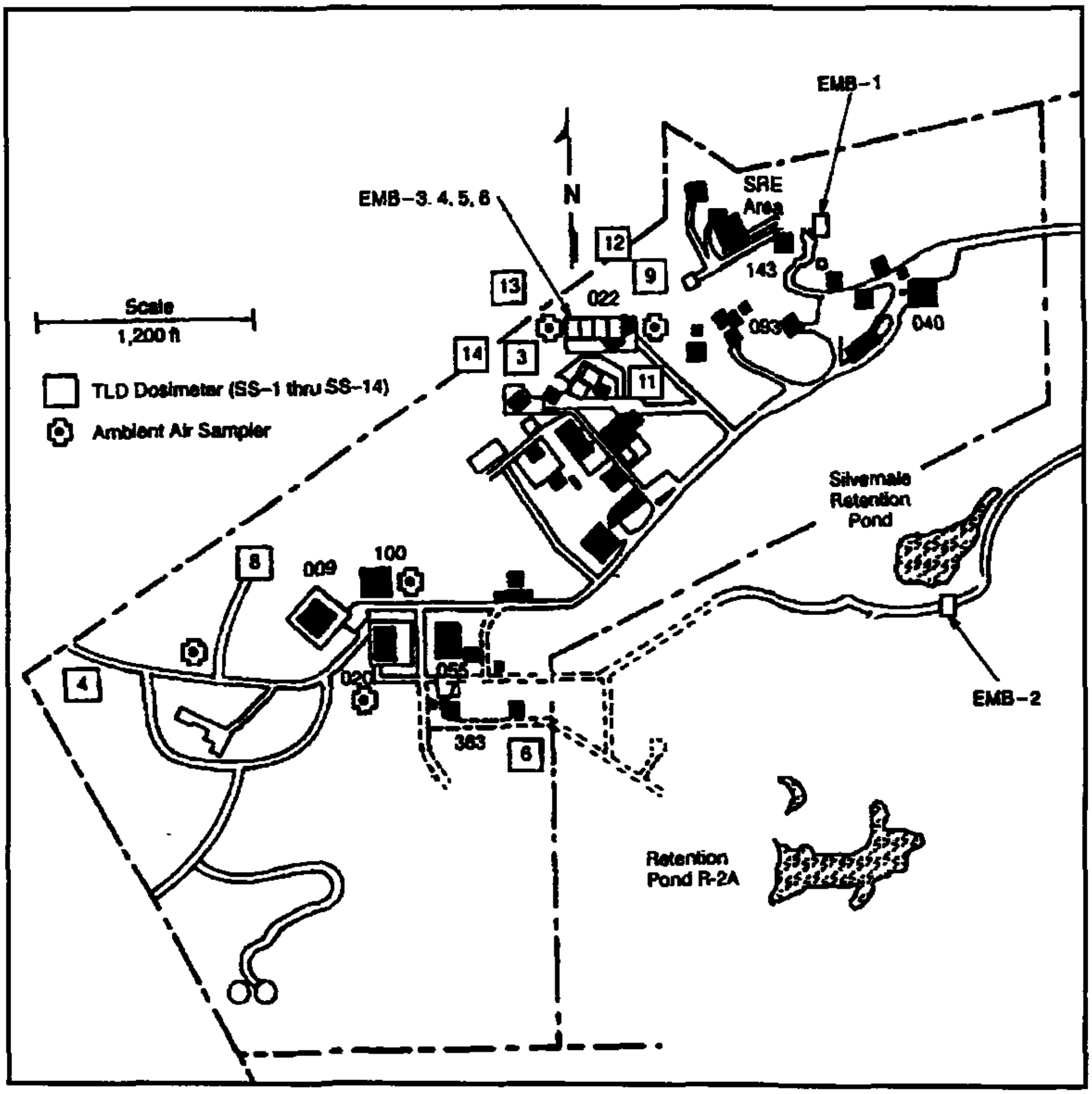

Figure 5-2. Map of Santa Susana Field Laboratory Site Sampling Stations

Table 5-4. Sampling Location Description

Station	Location	Frequency of Sampling
Ambient Air Sampler Locations		
A-1	De Soto Site, Building 104 roof	(D)
A-2	SSFL Site, T020, southwest side	(D)
A-3	SSFL Site, T034, at main gate	(D)
A-4	SSFL Site, T886, Former Sodium Disposal Facility	(D)
A-5	SSFL Site, RMHF Pond, north side	(D)
A-6	SSFL Site, T100, east side - 7-day sampler	(W)
Onsite - De Soto - Ambient Radiation Dosimeter Locations		
DS-2	De Soto Site, northwest corner of Building 101	(Q)
DS-6	De Soto Site, east boundary, southeast corner of Building 105	(Q)
DS-8	De Soto Site, Guard Post 4, southwest corner of Building 101	(Q)
DS-9	De Soto Site, southeast of Building 104	(Q)
Onsite - SSFL - Ambient Radiation Dosimeter Locations		
SS-3 (CA)	SSFL Site, Electric Substation 719 on boundary fence	(Q)
SS-4 (CA)	SSFL Site, west boundary on H Street	(Q)
SS-6 (CA)	SSFL Site, northeast corner of T353	(Q)
SS-7 (CA)	SSFL Site, T363, north side	(Q)
SS-8 (CA)	SSFL Site, Former Sodium Disposal Facility north boundary	(Q)
SS-9 (CA)	SSFL Site, RMHF northeast boundary at T133	(Q)
SS-11 (CA)	SSFL Site, T036, east side	(Q)
SS-12 (CA)	SSFL Site, RMHF northwest property line boundary	(Q)
SS-13 (CA)	SSFL Site, RMHF northwest property line boundary	(Q)
SS-14 (CA)	SSFL Site, RMHF northwest property line boundary	(Q)
EMB-1 (CA)	SSFL Site, SRE area north of T003	(Q)
EMB-2 (CA)	SSFL Site, south of Silvernale retention pond, off Test Area Road	(Q)
EMB-3(CA)	SSFL Site, northeast fence of RMHF	(Q)
EMB-4(CA)	SSFL Site, RMHF north central fenceline	(Q)
EMB-5 (CA)	SSFL Site, RMHF northwest fenceline	(Q)
EMB-6 (CA)	SSFL Site, RMHF T075 north fenceline	(Q)
Offsite Ambient Radiation Dosimeter Locations		
OS-1 (CA)	Offsite, Chatsworth	(Q)
OS-5	Offsite, Thousand Oaks	(Q)
BKG-11	Background Location, West Hills	(Q)
BKG-12	Background Location, Somis	(Q)
BKG-13	Background Location, Hollywood	(Q)
BKG-14	Background Location, Northridge	(Q)
BKG-15	Background Location, Simi Valley (west)	(Q)
BKG-16	Background Location, Moorpark	(Q)
BKG-17	Background Location, Simi Valley (east)	(Q)
BKG-19	Background Location, Burbank	(Q)
BKG-20	Background Location, Lancaster	(Q)
BKG-21	Background Location, Quartz Hill	(Q)
BKG-22	Background Location, Saugus	(Q)
BKG-23	Background Location, Calabasas	(Q)

Codes:		**Locations:**	
A	Air Sampler Station	DS	De Soto
D	Daily Sample	SS	SSFL
W	Weekly Sample	OS	Offsite
Q	Quarterly Sample	BKG	Background
CA	State Confirmatory Location		

It should be emphasized that these measurements determine only the long-lived particulate radioactivity in the air and, therefore, do not show radon (Rn-222) and most of its daughter radionuclides. Polonium-210 is a long-lived daughter and is detected by these analyses. It is assumed to be in equilibrium with its parent, Pb-210, whose relatively long half-life (22.3 years) provides an essentially constant level of Po-210 in the samples. Because of these effects, the ambient air, the air that is being breathed, is actually about four times as radioactive as implied in this table. Since most short-lived particulate radioactivity is removed from the exhaust air by the HEPA filters, these effects are not significant in the filtered effluent.

Because the alpha and beta activity are counted relatively soon after collection, most natural Be-7 is detected, elevating the apparent beta activity. (Be-7 decays by electron-capture and emits a gamma-ray in 10% of the decays. This gamma-ray is weakly detected as beta activity.) The naturally occurring radionuclides, Po-210 and Ra-226 and -228, also contribute to the activity detected on the stack exhaust filter samples, particularly at the Hot Lab, where some unfiltered outside air is brought into the exhaust system after the HEPA filters. A more complete list of the results from the gross alpha and gross beta counting of the ambient air samples is shown in Table 5-5.

Guide values for SSFL site ambient air are based on the effluent concentration limits in 10 CFR 20 Appendix B (for licensed operations) and DOE Order 5400.5 for the DOE operations. The guide value for alpha activity is 2×10^{-14} µCi/mL (Pu-239) due to contamination remaining from work with unencapsulated plutonium (the NRC value is 6×10^{-14} µCi/mL). The appropriate value for beta activity is 6×10^{-12} µCi/mL (Sr-90) due to the presence of Sr-90 in fission product contamination from previous work with irradiated nuclear fuel at the SSFL site (the DOE value is 9×10^{-12} µCi/mL). The appropriate guide value for De Soto ambient air alpha activity is 5×10^{-14} µCi/mL (U-234) due to prior (licensed) work with unencapsulated enriched uranium. The appropriate guide value for beta activity is for Co-60, 5×10^{-11} µCi/mL since it is the most restrictive limit for any beta-emitting radionuclide recently in use at De Soto.

Figure 5-3 is a graph of the weekly averaged long-lived alpha and beta ambient air radioactivity concentrations for De Soto and SSFL during 1996 as indicated by the gross alpha and gross beta counting. Generally, the ambient airborne radioactivity was relatively constant during 1996, and showed no significant disturbances. Heavy rain at the end of January, in February, November, and December, suppressed the natural airborne radioactivity.

Table 5-5. Ambient Air Radioactivity Data - 1996

Area	Activity	Number of Samples	Gross Radioactivity Concentrations (μCi/mL) Annual Average Value and Dispersion	Maximum Value[a] and Date Observed	Average Percent of Guide[b]
De Soto Building 104	Alpha	332	(3.1±2.7)E-15	12.3E-15 (8/20)	6.2
	Beta		(21.3±13.2)E-15	81.0E-15 (11/02)	0.04
SSFL Area IV Hot Lab	Alpha	339	(2.8 ± 2.7)E-15	12.7E-15 (7/31)	14
	Beta		(20.9 ± 14.4)E-15	88.5E-15 (1/08)	0.35
SSFL Area IV RMHF	Alpha	353	(2.4 ± 2.6)E-15	10.3E-15 7/21)	12
	Beta		(17.5 ± 13.0)E-15	84.3E-15 (9/27)	0.19
SSFL Area IV T886	Alpha	318	(3.2 ± 3.0)E-15	12.3E-15 (7/26)	16
	Beta		(22.6 ± 15.3)E-15	70.6E-15 (1/07)	0.38
SSFL Area IV RMHF Pond	Alpha	353	(2.9 ±2.6)E-15	10.8E-15 (1/08)	14.5
	Beta		(21.9 ± 13.5)E-15	67.7E-15 (4/29)	0.24

[a]Maximum value observed for single sample.

[b]*Guide De Soto Site: 5E-14 μCi/mL alpha, 5E-11 μCi/mL beta; CCR 17.*
SSFL site: 2E-14 μCi/mL alpha, 6E-12 μCi/mL beta; 10 CFR 20 Appendix B, CCR 17, and 2E-14 μCi/mL alpha, 9E-12 μCi/mL beta, DOE Order 5400.5 (02/08/90).

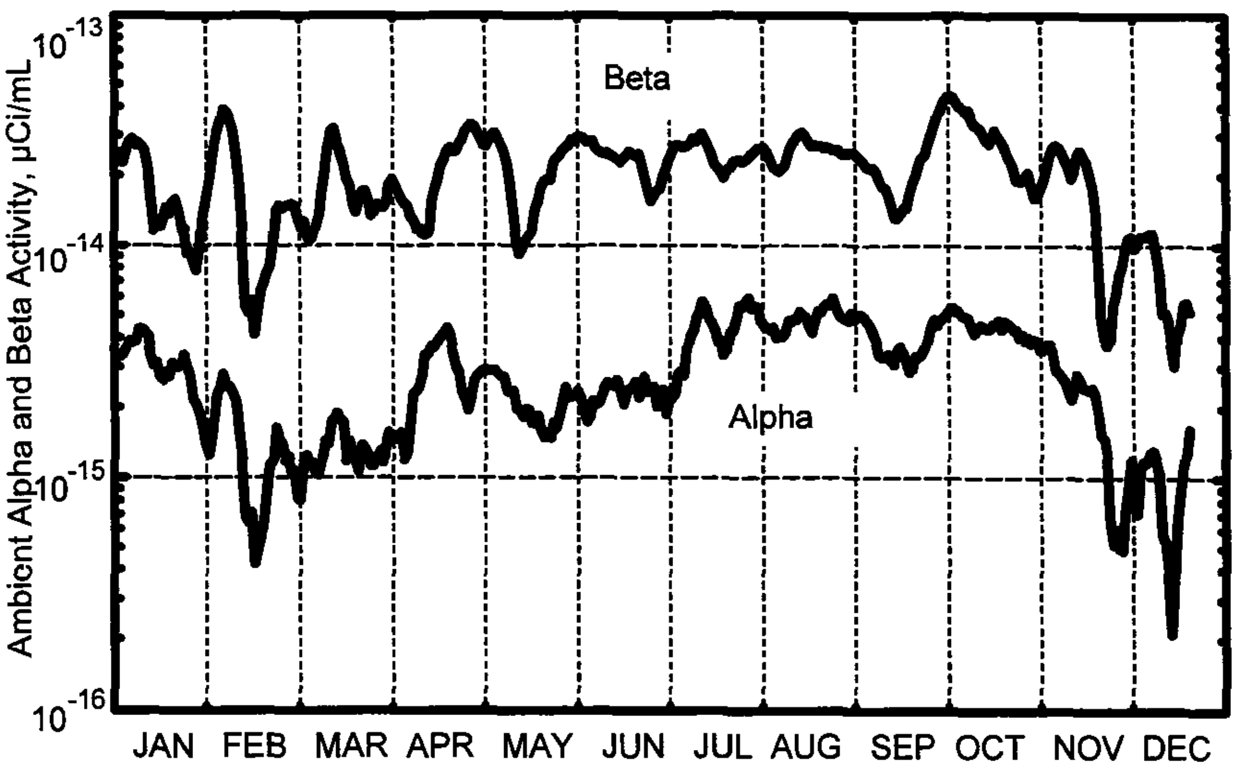

Figure 5-3. Seven-Day Smoothed Airborne Radioactivity at the De Soto and Santa Susana Field Laboratory Sites - 1996

The daily data were mathematically smoothed in a moving weekly average for the year. The activity detected in ambient air is attributed to naturally occurring radioactive materials. Radionuclides detected by gross alpha and beta analysis of air samples collected during 1996 include K-40 plus several naturally occurring radionuclides from the uranium and thorium series.

A further comparison of ambient air and facility exhaust radioactivity is presented in Figure 5-4.

The gross alpha and the gross beta concentrations for the ambient weekly samples are compared with the stack sample results for the Hot Lab, the RMHF, and Building 104 at De Soto, which are also on a weekly cycle. Gaps in the plots are due to negative analytical values resulting from air samples showing less activity than the analytical background.

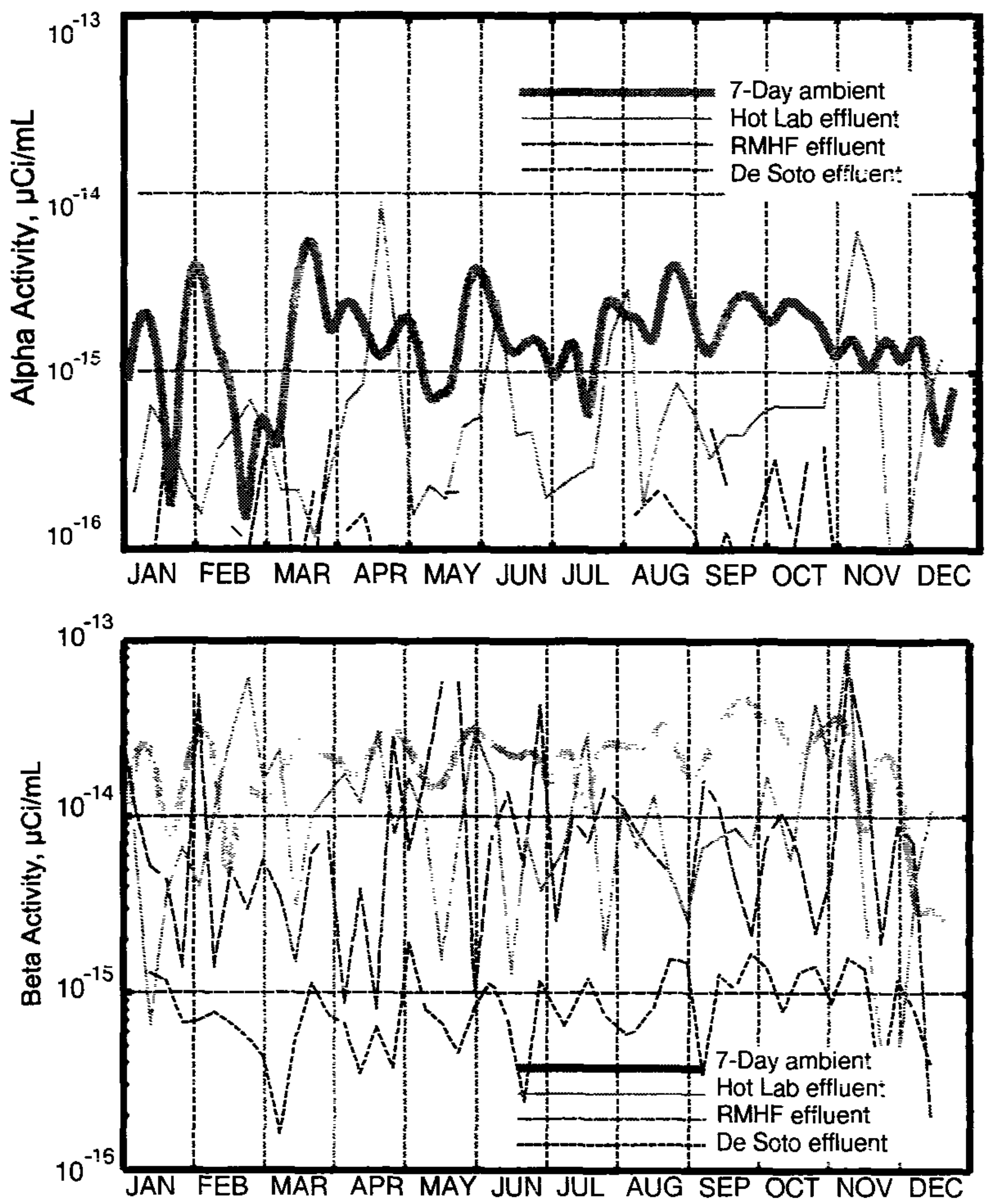

Figure 5-4. Filtered Exhaust and Ambient Air Radioactivity Concentration

5.5.2 Groundwater

Many wells in and around the site are used to monitor the condition of the groundwater in the unconsolidated surface alluvium and the underlying Chatsworth Formation. The locations of these wells are shown in Figure 6-2. While the primary purpose of these wells is to determine concentrations of chemicals that had been discharged to the ground during rocket engine testing, they also serve to monitor for chemicals or radioactivity released by DOE operations. Water samples from these wells are periodically analyzed for radioactivity. The summary results for 1996 are shown in Table 5-6. The regulatory limits for radioactivity in water from drinking water suppliers have been assigned to groundwater by the State of California as a water-quality goal, and are applied here. Numerical limits for radionuclides not specifically listed by the State for drinking water were derived from the EPA generic dose limit of 4 mrem/year by use of Dose Conversion Factors from RESRAD version 5.61. Except for several instances for gross alpha (26 to 53 pCi/L), the monitored groundwater satisfies the goal. The gross alpha limit exceedences resulted from the presence of higher levels of naturally occurring uranium.

Groundwater is extracted from a French drain around a basement area of Building T059 to prevent any inflow or outflow of groundwater into a part of the building currently undergoing remediation. During 1996, this water was released to the surface drainage water collection system. Samples were analyzed by gamma spectrometry. The results of these analyses showed no detectable activity for the remaining activation nuclides possible from T059. In no sample was any activity detected that indicated the possibility of contamination of this water.

Laboratory analyses were performed for tritium in water from 34 groundwater monitoring wells and 5 offsite wells. Of the 58 analyses performed, only 13 (for 7 onsite wells) were above the detection limit of 200 pCi/L. The maximum result, 4,250 pCi/L, is far below the EPA and California limits for drinking water suppliers of 20,000 pCi/L. The maximum tritium levels were observed in Well RD-34A, with values of 4,250 ± 470 pCi/L on 8/18/96, and 4,020 ± 420 pCi/L on 2/19/96, and Well RD-28, with values of 450 ± 170 pCi/L on 8/20/96, and 430 ± 190 pCi/L on 2/6/96. Well RD-34A is located offsite near the RMHF in Area IV. Well RD-28 is located near T059. RD-24, also near T059 showed 400 ± 190 pCi/L (2/17/96) and 320 ± 160 pCi/L (8/7/96). RD-27, downslope from T886, showed 450 ± 180 pCi/L (8/18/96) and 430 ± 210 pCi/L (2/16/96). RD-34B showed 448 ± 21 pCi/L (2/19/96, by electrolytic enrichment) and 330 ± 160 pCi/L (8/18/96). Other wells indicating some detectable level of tritium were RD-23 and RD-54A. The average detected tritium in the 7 wells was about 900 pCi/L. Excluding the one well with the highest H-3 content (RD-34A), the average was 351 pCi/L. The history of tritium concentration in water from Well RD-34A is shown in Figure 5-5. Full scale on this plot is 20,000 pCi/L, the allowable limit for suppliers of drinking water. The drop from an initial detection of about 7000 pCi/L to an average of around 3000 pCi/L may reflect the effect of pumping water out of a limited reservoir, with dilution by incoming water. None of the offsite wells showed the presence of tritium. This occurrence of tritium in groundwater appears to have resulted from unintended production of tritium in soil surrounding the reactor test vessel in

Building T010, shown as S8ER (T010) in Figure 2-5. Saturation of the surrounding ground by water drift from the nearby cooling tower mobilized the tritium, which then migrates to the wells. The cooling tower has not been operated since October 1995. Occasional other leakage may supply water to this area.

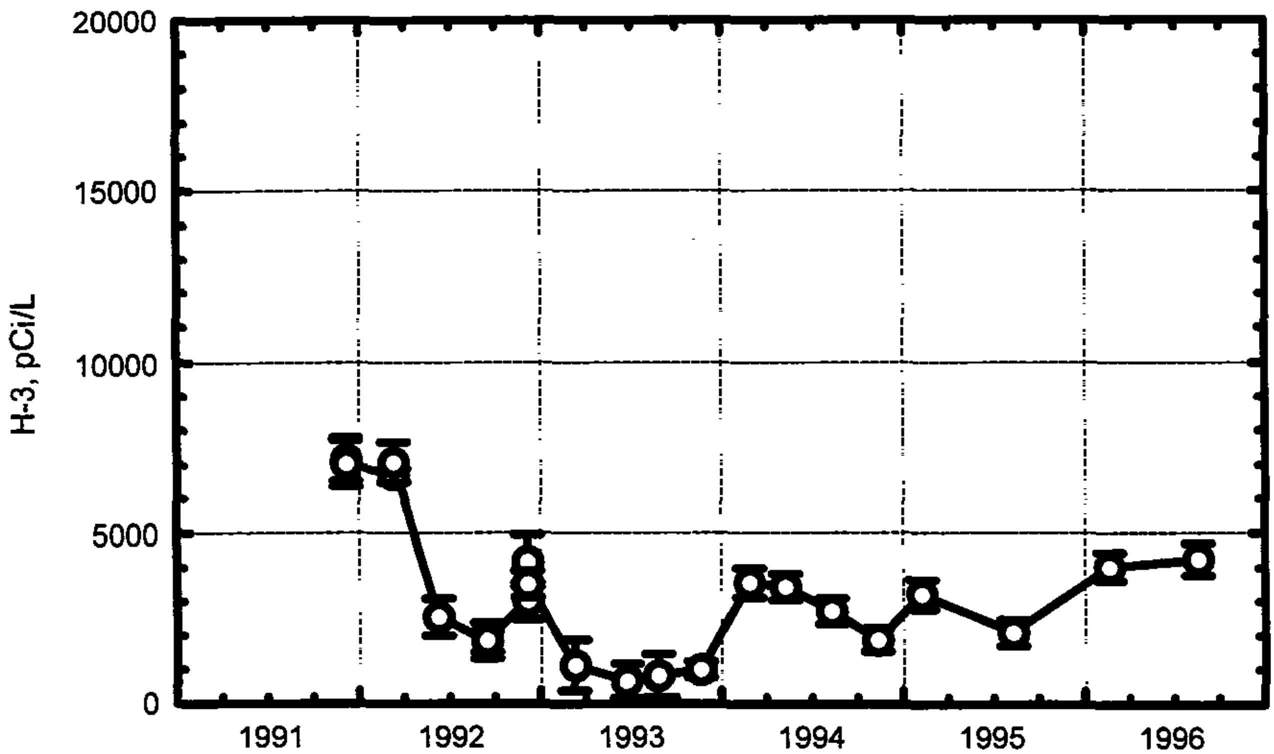

Figure 5-5 Tritium Concentration in Water From Well RD-34A

Table 5-6. Radioactivity in Groundwater at SSFL - 1996

	Activity (pCi/L)									
	H-3	Cs-137	Th-228	Th-230	Th-232	U-234	U-235	U-238	Gross Alpha	Gross Beta
Water Suppliers MCL	20,000[a]	110	6.8	10	2.0	20 - Total Uranium			15[a]	50[a]
Maximum	4250	ND	-0.07	-0.027	0.013	11.5	0.89	10.8	53.0	33.7
Mean	197	ND	-0.07	-0.027	0.013	6.9	0.5	6.4	7.5	6.6
Minimum	-290	ND	-0.07	-0.027	0.013	3.7	0.207	2.9	-0.7	1.5
Number of analyses[b]	64 (49)	(64)	1 (1)	1 (1)	1 (1)	3	3	3	64 (13)	64 (6)

[a]From 40 CFR 141 and EPA limit of 4 mrem/yr (see text).

[b]Numbers in parentheses represent the number of analyses reported as less than the detectable limit. The mean has been calculated from all reported values. ND = not detected.

5.5.3 Surface Water and Domestic Water Supply

Most of Area IV slopes toward the southeast, and rainfall runoff is collected by a series of drainage channels and accumulates in pond R-2A. Water from this pond is eventually released to Bell Creek under the NPDES permit. Water from pond R-2A is also used for cooling the rocket engine test stand flame buckets where much of the cooling water evaporates. Some of Area IV slopes to the northwest, and a small amount of rainfall drains toward the northwest ravines, which lead into Meier Canyon. To permit sampling this runoff, five catch basins were installed in 1989 near the site boundary to accumulate runoff.

Average radioactivity concentrations in these catch basin samples are summarized in Table 5-7. For radioactivity, the maximum contaminant limits (MCL) applicable to suppliers of drinking water (Title 22, Chapter 15, Article 5, Section 64443, of the California Code of Regulations) are imposed on releases from the two southern controlled discharge points (Outfalls 001 and 002) and the five northwest slope runoff channels (Outfalls 003, 004, 005, 006, and 007). Although not required if gross alpha does not exceed 5 pCi/L, the specific analyses for Ra-226 + Ra-228 were generally performed.

In none of the runoff events did any radiological analysis indicate an exceedance of these limits. Most results were below the detection capability of the analysis.

Table 5-7. NPDES Discharge Radioactivity Data for Northwest Slope Monitoring - 1996

	Activity (pCi/L)					
	H-3	Sr-90	Ra-226+ R-228	Gross Alpha	Gross Beta	Uranium
Water Suppliers MCL	20,000	8	5	15	50	20
Maximum	300	1.0	1.7	8.0	12.3	NA
Mean	56	0.3	0.3	1.5	4.2	NA
Minimum	-60	-0.1	0.0	0.0	0.5	NA
Number of Analyses[a]	35 (29)	35 (27)	35 (30)	35 (16)	35 (3)	

[a]Numbers in parentheses represent the number of analyses reported as less than the detectable limit.

Domestic water in this area is supplied by a variety of municipal and regional organizations, including the Los Angeles Department of Water and Power, the Metropolitan Water District of Southern California, several Ventura County Waterworks Districts, and the Oxnard Public Works Department. Most of the water is imported from distant sources, such as Owens Valley, the Feather River, and the Colorado River. Some water, for Oxnard and Moorpark, comes from local groundwater wells. The local water is blended with imported water and treated to assure purity and safety. Water is transported in open aqueducts and enclosed pipelines and is stored in open reservoirs and underground settling basins. The State of California requires that these suppliers routinely monitor their water for many potentially hazardous materials (and less significant aesthetic quality factors, as well) and report the results of this monitoring to their customers on an annual basis. Tests for radioactivity are relatively limited, and are performed over an extended period of time, so not all parameters are reported in any one year. The results reported by local water suppliers during 1996 are shown in Table 5-8 and represent the averages of results of analysis of water supplied from the Metropolitan Water District (MWD), LADWP, Burbank, and the Ventura County Waterworks (District 1). The MWD is by far the largest supplier of locally consumed potable water.

Table 5-8. Domestic Water Supplies Radioactivity Data

	Activity (pCi/L)					
	H-3	Sr-90	Ra-226+ R-228	Gross Alpha	Gross Beta	Uranium
Water Suppliers MCL	20,000	8	5	15	50	20
Maximum	4473	2.0	2.9	15.5	10.3	15
Mean	713	ND	0.96	4.46	5.11	4.37
Minimum	ND	ND	ND	ND	ND	ND
Number of reports[a]	21 (18)	21 (20)	21 (6)	21 (0)	21 (10)	21 (10)

[a]Numbers in parentheses represent the number of report entries listed as not analyzed, not detected, or not reported.

Comparison of the radioactivity concentrations in groundwater at SSFL from Table 5-7 with that of the local public supply water (Table 5-8) shows no significant differences in either the alpha or beta activity. In general, the water at SSFL is slightly less radioactive than the local drinking water.

5.5.4 Rock and Soil

The radioactivity in native rock and soil serves as an indicator of any spread of contamination outside the operating facilities and other known areas of radioactive contamination. Soil radioactivity is due to various naturally occurring radionuclides present in the environment and to radioactive fallout of dispersed nuclear weapons materials. Naturally occurring radionuclides include K-40 and the uranium and thorium series (including radon and daughters). The radionuclide composition of local area surface soil has been determined to be predominantly K-40, natural thorium, and natural uranium, both in secular equilibrium with daughter nuclides. Radioactivity in nuclear weapons test fallout consists primarily of the fission-produced Sr-90 and Cs-137, as well as Pu-239.

Soil was sampled by the DHS/RHB at the T886 Former Sodium Disposal Facility as part of the verification that this area has been suitably decontaminated. These analyses showed minor amounts of Cs-137, below the global fallout concentration, and no Sr-90. No other contaminants were detected. Extensive sampling was also conducted at the T064 Side Yard and adjacent area as part of the preliminary scoping work before remediation.

Building T064 served as a storage and transfer facility for unirradiated nuclear fuel materials. The fenced-in yard was occasionally used for temporary secure storage of other items. One stored item consisted of a shipping cask contaminated with Cs-137 in water. The water leaked onto the asphalt paving about 1962 and drained into the adjacent soil. This contamination has been addressed in successive campaigns, each aiming for lower limits of residual activity. The building itself was demolished in 1997, and cleanup of the soil is continuing.

A large number of soil samples were taken in the T064 area to provide information on the size of the area to be remediated. The locations of these samples are shown in Figure 5-6. Only gamma spectrometry was performed on these samples, and so only the gamma emitting radionuclides are identified for these locations. A cumulative probability plot of the 1996 results is shown in Figure 5-7. This plot clearly shows the departure from the background distribution of fallout Cs-137, at about the 50% point on the Cumulative Probability scale. While most of the area is below the allowable contamination limit, 9.2 pCi/g Cs-137 as shown by the "UL" line, it is intended to remove as much contaminated soil as is practical, so as to minimize the residual radioactivity. In addition, four samples were taken from excavated soil and analyzed by DataChem Labs by gamma spectrometry, alpha spectrometry, and radiochemistry for Sr-90. The results of these analyses are shown in combination in Table 5-9.

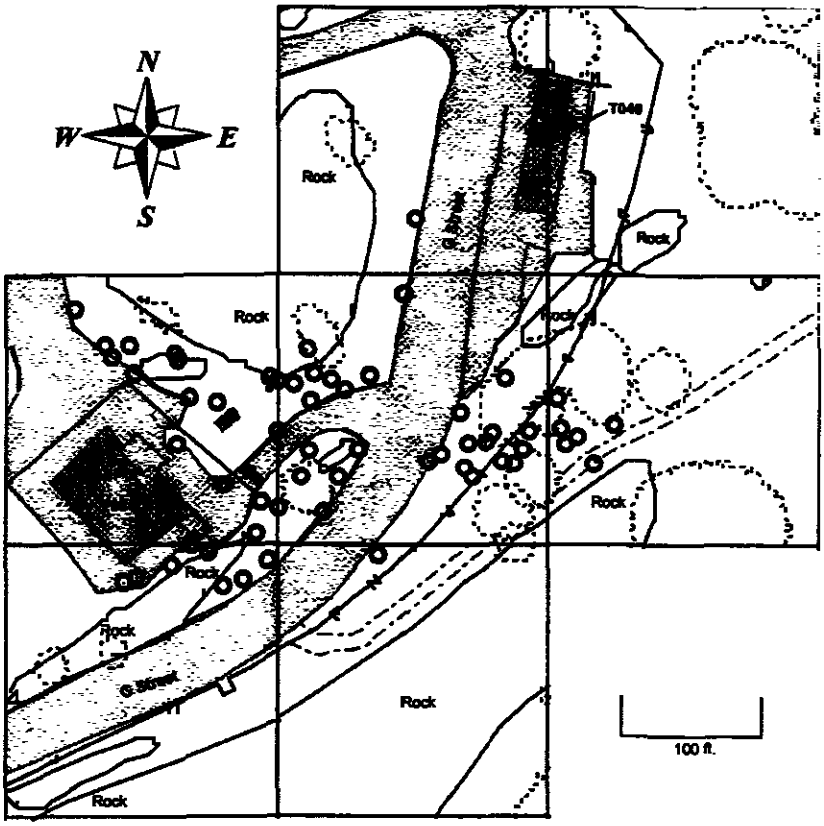

Figure 5-6. Sample Locations for T064 Soil Survey

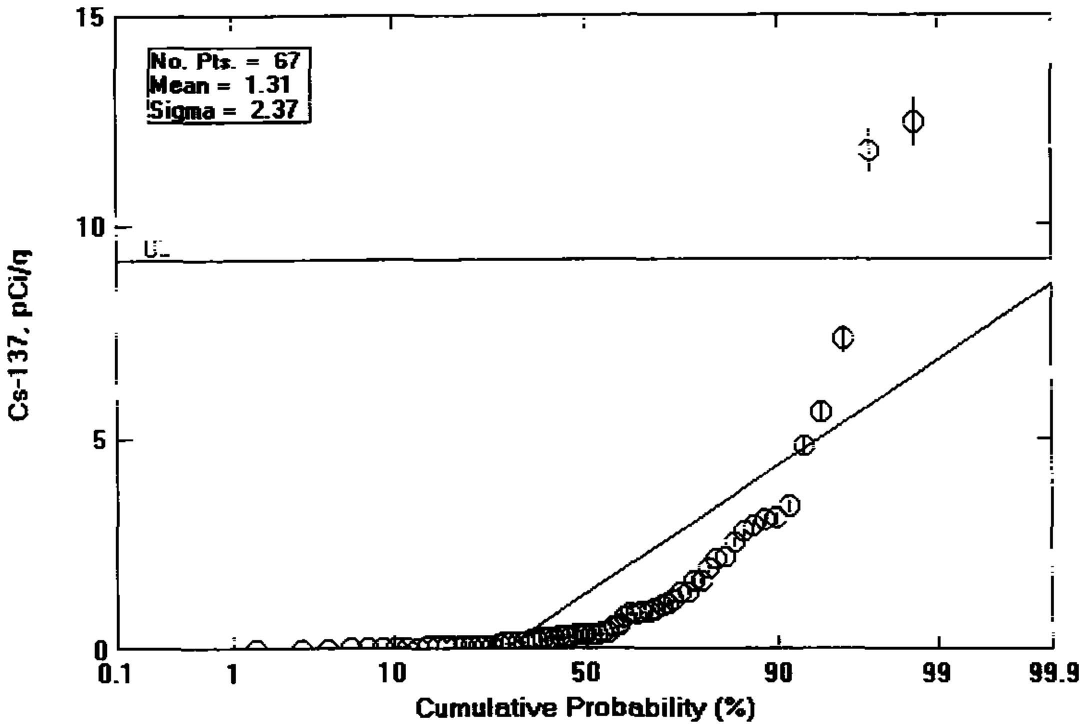

Figure 5-7. Probability distribution of Cs-137 activity in soil samples from the T064 areas.

Table 5-9. T064 Areas Soil Radioactivity Data - 1996

	Activity (pCi/g)[a]											
	H-3	Be-7	K-40	Sr-90	Cs-137	Ti-208	Pb-210	Pb-212	Bi-212	Pb-214	Bi-214	Ra-224
Allowable Soil Limit	31,900	natural	27.6	36.0	9.20	chain	chain	chain	chain	chain	chain	chain
Maximum	NM	ND	19.35	NM	12.44	0.56	4.70	1.93	4.59	1.21	1.15	1.81
Mean	NM	ND	17.69	NM	1.30	0.35	0.84	1.19	0.96	0.78	0.72	1.26
Minimum	NM	ND	15.58	NM	0.02	0.28	0.42	1.00	0.56	0.62	0.59	0.83
Number of analyses[b]	NM	68(68)	68(0)	NM	68(1)	68(0)	68(14)	68(1)	68(29)	68(0)	68(0)	68(0)
	Activity (pCi/g)[a]											
	Ra-226	Ac-228	Th-227	Th-228	Th-230	Th-232	Th-234	U-234	U-235	U-238	Pu-238	Pu-239
Allowable Soil Limit	5 and 15	chain	chain	chain	chain	5 and 15	chain	30.0	30.0	35.0	37.2	33.9
Maximum	1.49	1.60	1.22	4.38	5.79	8.88	1.79	9.86	0.23	2.54	NM	NM
Mean	0.97	0.98	0.28	4.12	5.79	6.38	0.84	6.70	0.05	1.82	NM	NM
Minimum	0.64	0.79	0.10	3.78	5.79	3.87	0.51	4.80	0.02	1.03	NM	NM
Number of analyses[b]	68(5)	68(0)	68(60)	68(65)	68(67)	68(2)	68(0)	68(54)	68(1)	68(64)	NM	NM

[a]NM = Not Measured.
[b]Numbers in parentheses represent the number of analyses reported as less than the detectable limit.

5.5.5 Vegetation

Three samples of vegetation were collected in 1996, in conjunction with remediation actions. Two samples were of cypress trees planted near the Hot Lab. These were qualitatively scanned for detectable activity and only small amounts of natural thorium and uranium daughters were found in one. No activity was detected in the other. In the third sample, sumac from the contaminated area next to the T064 Side Yard, small amounts of natural radioactivity were found.

5.5.6 Wildlife

No animal samples were collected in 1996.

5.5.7 Ambient Radiation

During the later years of the nuclear programs at Atomics International and Rocketdyne, from 1974 through 1989, the ambient radiation monitoring program used rather complicated bulb-type dosimeters (CaF_2:Mn). This was justified by the amount of nuclear materials handled in the operations at SSFL and De Soto, and by the low levels of radiation in the environment. At the termination of all nuclear work in 1989, such a program was no longer needed, and efforts were directed toward simplifying the program. This was done initially by using the same dosimeters (LiF) that were well established in use for personnel monitoring in radiation work. While these dosimeters are well suited to measuring exposures in the range of interest for compliance with occupational radiation regulations (doses "above background"), they are somewhat insensitive for environmental measurements since the resolution in terms of dose uses increments of 10 mrem per quarter. Using these dosimeters demonstrated that environmental exposures did not reach regulatory limits, but provided limited information on the actual exposure rates present around the facilities and in the neighboring environment.

The State RHB provides packages containing calcium sulfate ($CaSO_4$) dosimeters for independent monitoring of radiation levels at SSFL and in the surrounding area. These dosimeters are placed at specific locations along with the Rocketdyne TLDs. The State dosimeters are returned to the Radiologic Health Branch (RHB) for evaluation. Data for these TLDs, which were placed at various Rocketdyne dosimeter locations both onsite and offsite, are also shown in Table 5-10 for 1996 and in Table 5-11 for 1995. During this time, the program operated state-wide by the DHS/RHB was being modified and significantly improved, so that lack of suitable comparisons at the site and background locations became increasingly noticeable.

In addition to the LiF TLDs discussed above, Rocketdyne began deploying, in the last quarter of 1995, environmental TLDs that utilize an aluminum oxide ("sapphire") chip. These TLDs are capable of determining doses in increments of 0.1 mrem (compared to 10 mrem for the LiF-based badges previously used). In addition, the aluminum oxide badge reporting is much more detailed, providing both gross and corrected readings for the locations. Proper use of the control badges supplied with these dosimeters allows elimination of the natural and transportation exposure that occurs before, during, and after the deployment of the environmental dosimeters to measure the ambient radiation. This permits accurate determination of the net exposure received while the environmental TLDs are in the field, exposed to the ambient radiation. In various intercomparisons, aluminum-oxide-based dosimeters have been shown to be among the most accurate dosimeters available in measuring environmental exposure rates.

Test badges were positioned starting in the second and third quarters of 1995. In the fourth quarter of 1995, aluminum oxide TLDs were co-located at all perimeter locations indicated in Table 5-11. Problems in adequately shielding the control TLDs led to incorrectly high reported values for ambient radiation levels during 1995 and 1996. Investigation showed that the only significant difference between the DHS/RHB and the Rocketdyne results was a systematic offset resulting from the uncorrected exposure beyond the period intended for measuring the ambient radiation. The original reported values have been adjusted to bring them into overall agreement with the results reported by the DHS/RHB for matching locations. The results for 1996 are shown in Table 5-10. Corrected results for 1995 are shown in Table 5-11. These values for ambient radiation exposure during 1995 replace those reported in the Annual Site Environmental Report for that year (RI/RD96-140). The annual-average exposure rates for the co-located DHS/RHB and Rocketdyne dosimeters (corrected) are compared in Figure 5-7. The measurements for 1995 are shown as open squares, while those for 1996 are shown as open circles. The ideal comparison, where both sets of measurements yield exactly the same values, is shown as the dashed line.

Except for dosimeter locations SS-9, -11, -12, and -13, Tables 5-10 and 5-11 show that radiation exposures and equivalent annual exposure rates monitored onsite are nearly identical to levels monitored at the offsite locations. These data reflect natural background radiation from cosmic radiation, radionuclides in the soil, and radon and thoron in the atmosphere. Radiation doses measured at locations SS-9, -11, -12, and -13, are slightly higher, and are reflective of normal operations at the RMHF, which involve handling and shipment of radioactive material.

The natural background radiation level as measured by the offsite dosimeters is approximately 84 mrem/yr. At the SSFL the local background is approximately 102 mrem/yr, based on the data from dosimeters SS-3, -4, -6, -7, -8, and -11, shown in Table 5-10. At De Soto, the local background is approximately 91 mrem/yr. The small variability observed in these values is attributed to differences in elevation and geologic conditions at the various sites. The altitude range for the dosimeter locations is from approximately 260 m (850 ft) above sea level (ASL) at the De Soto facility and the offsite locations to a maximum of approximately 580 m (1,900 ft) ASL at SSFL.

Analysis of the results demonstrates that compliance was achieved with the annual limits of the NRC, the State of California Department of Health Services (DHS), and the U.S. Department of Energy (DOE); the limit being 100 mrem/yr for total dose, above natural background, to the maximally exposed individual.

The reported dosimeter exposures for 1995 and 1996 were, therefore, corrected by using the averages of the DHS/RHB values for co-located dosimeters, to eliminate this systematic offset. The corrected values for 1996 are shown in Table 5-10. Revised values for 1995 are shown in Table 5-11. These values for ambient radiation exposure during 1995 replace those reported in the Annual Site

Table 5-10. De Soto and SSFL Ambient Radiation Dosimetry Data - 1996

1996		RD Quarterly Exposure (mrem)				Annual Exposure	Annual Average Exposure Rate(μR/h)	
TLD-Locations		Q-1	Q-2	Q-3	Q-4	(mrem)	Rocketdyne	State DHS
DeSoto	DS-2	13.8	22.6	18.5	24.3	79.2	9.0	--
	DS-6	28.4	25.5	22.0	25.0	100.9	11.5	--
	DS-8	17.7	21.6	21.1	25.4	85.8	9.8	--
	DS-9	20.1	27.9	24.4	27.5	99.9	11.4	--
Mean values		**20.0**	**24.4**	**21.5**	**25.5**	**91.4**	**10.4**	--
SSFL	SS-3	20.5	19.4	20.0	28.0	87.9	10.0	9.4
	SS-4	18.2	29.3	22.3	31.8	101.6	11.6	12.1
	SS-6	19.9	28.7	23.5	29.2	101.3	11.6	12.4
	SS-7	20.7	26.8	26.3	30.2	104.0	11.9	11.8
	SS-8	20.4	27.4	27.3	36.0	111.1	12.7	12.4
	SS-9	22.8	34.2	27.0	32.1	116.1	13.2	13.5
	SS-11	24.2	31.8	25.1	--	108.1	12.3	12.5
	SS-12	31.8	41.7	32.9	40.0	146.5	16.7	16.5
	SS-13	29.9	39.5	30.9	38.3	138.6	15.8	15.3
	SS-14	24.0	30.2	27.6	33.4	115.3	13.2	13.5
	EMB-1							12.2
	EMB-2							12.4
Mean values		**23.2**	**30.9**	**26.3**	**33.2**	**113.0**	**12.9**	**12.8**
Offsite	OS-1	17.0	25.4	22.2	25.5	90.2	10.3	10.6
	OS-5	14.4	21.1	16.6	19.8	71.9	8.2	--
	BKG-11	17.0	22.6	19.2	24.8	83.6	9.5	--
	BKG-12	17.9	23.7	22.4	27.5	91.5	10.4	--
	BKG-13	12.3	15.3	16.8	18.0	62.4	7.1	--
	BKG-14	17.9	21.6	17.1	23.5	80.1	9.1	--
	BKG-15	15.3	20.1	20.7	28.8	84.9	9.7	--
	BKG-16	23.0	24.8	20.9	28.8	97.5	11.1	--
	BKG-17	17.6	21.2	20.3	29.7	88.8	10.1	--
	BKG-18	20.0	20.0	21.3	28.8	90.1	10.3	--
	BKG-19	15.1	20.9	19.0	25.1	80.1	9.1	--
	BKG-20	19.3	24.0	20.7	23.5	87.5	10.0	--
	BKG-21	16.6	21.3	16.8	21.5	76.2	8.7	--
	BKG-22	19.0	23.7	22.2	33.8	98.7	11.3	--
Mean values		**17.3**	**21.8**	**19.7**	**25.6**	**84.5**	**9.6**	--
Note: Includes natural background radiation of approximately 84 - 116 mrem per year (see text).								

Table 5-11. De Soto and SSFL Ambient Radiation Dosimetry Data - 1995

1995		RD Quarterly Exposure (mrem)				Annual Exposure	Annual Average Exposure Rate(μR/h)	
TLD-Locations		Q-1	Q-2	Q-3	Q-4	(mrem)	Rocketdyne	State DHS
DeSoto	DS-2	26.3	26.3	21.3	28.5	102.5	11.7	--
	DS-6	26.3	26.3	21.5	25.5	99.7	11.4	--
	DS-8	26.3	26.3	23.5	28.3	104.5	11.9	--
	DS-9	26.3	26.3	25.6	29.1	107.4	12.2	--
Mean values		**26.3**	**26.3**	**23.0**	**27.8**	**103.5**	**11.8**	--
SSFL	SS-3	26.3	26.3	20.7	25.7	99.1	11.3	10.2
	SS-4	26.3	26.3	24.2	43.6	120.5	13.7	12.7
	SS-6	26.3	26.3	21.5	35.4	109.6	12.5	12.9
	SS-7	26.3	26.3	24.6	30.4	107.7	12.3	11.7
	SS-8	26.3	26.3	24.6	32.8	110.1	12.6	13.3
	SS-9	36.7	26.3	26.8	36.5	126.3	14.4	13.9
	SS-11	26.3	26.3	25.1	34.6	112.4	12.8	13.0
	SS-12	31.2	26.5	38.0	59.7	155.4	17.7	17.3
	SS-13	27.9	21.9	35.1	41.0	125.9	14.4	14.5
	SS-14	26.3	26.3	22.1	41.9	116.7	13.3	13.5
	EMB-1	26.3	26.3	26.3	26.3	105.4	12.0	12.6
	EMB-2	26.3	26.3	26.3	26.3	105.4	12.0	12.9
Mean values		**27.7**	**26.0**	**26.3**	**36.2**	**116.2**	**13.3**	**13.2**
Offsite	OS-1	21.3	20.0	22.8	28.4	92.5	10.5	11.5
	OS-5	18.0	14.4	18.3	27.9	78.6	9.0	--
	BKG-11	--	--	--	27.8	111.2	12.7	--
	BKG-12	--	--	--	26.2	104.8	11.9	--
	BKG-13	--	--	--	20.5	82.0	9.3	--
	BKG-14	--	--	--	25.9	103.6	11.8	--
	BKG-15	--	--	--	23.1	92.4	10.5	--
	BKG-16	--	--	--	24.4	97.6	11.1	--
	BKG-17	--	--	--	29.6	118.4	13.5	--
	BKG-19	--	--	--	25.1	100.4	11.4	--
	BKG-20	--	--	--	25.2	100.8	11.5	--
	BKG-21	--	--	--	22.2	88.8	10.1	--
	BKG-22	--	--	--	32.8	131.2	15.0	--
	BKG-23	--	--	--	29.8	119.2	13.6	--
Mean values		**19.6**	**17.2**	**20.5**	**26.3**	**101.5**	**11.6**	**11.5**

Note: Includes natural background radiation of approximately 102 - 116 mrem per year (see text).

Environmental Report for that year, RI/RD96-140. The annual-average exposure rates for the co-located DHS/RHB and Rocketdyne dosimeters (corrected) are compared in Figure 5-8. The measurements for 1995 are shown as open squares, while those for 1996 are shown as open circles. The ideal comparison, where both sets of measurements yield exactly the same values, is shown as the dashed line.

These results, for both years, show a range of natural background, spanning approximately 20 mrem per year, depending on location. The offsite values, covering a wide spectrum of locales, average slightly less than the De Soto results. The SSFL results, due to the significantly higher elevation, and differences in geology, show a slightly higher average. This average is also affected by inclusion of dosimeters at SS-9, -11, -12, -13, and -14, which receive exposure from the RMHF.

Starting in the second half of 1997, the control dosimeters at SSFL are being stored in a special low-background shield that should eliminate the previous difficulties in comparing the Rocketdyne measurements with the DHS/RHB.

To summarize, there are some inconsistencies in the TLD measurements of ambient radiation at Rocketdyne during the past few years. These inconsistencies are due in part to (1) the use of three different types of dosimeters in different years, (2) inconsistent reporting of gross and/or net dose by the dosimeter processor, and (3) inconsistent use of the control dosimeters for eliminating irrelevant doses, such as received during transit and storage. As a result, the exposure rate reported by Rocketdyne in three years (1990, 1992, 1993) was less than that reported by the RHB by 30-40%. In other years, agreement with the RHB values has been relatively good, within ±10%, as shown in Table 5-12.

The average exposure rate at SSFL, as measured by the RHB, has been very consistent at 13±1 μR/hr over the past 8 years. Both RHB and Rocketdyne results have shown an average difference between the SSFL and the offsite exposure rates of 2-3 μR/hr (Table 5-13) or 21-27 mrem per year (Table 5-14).

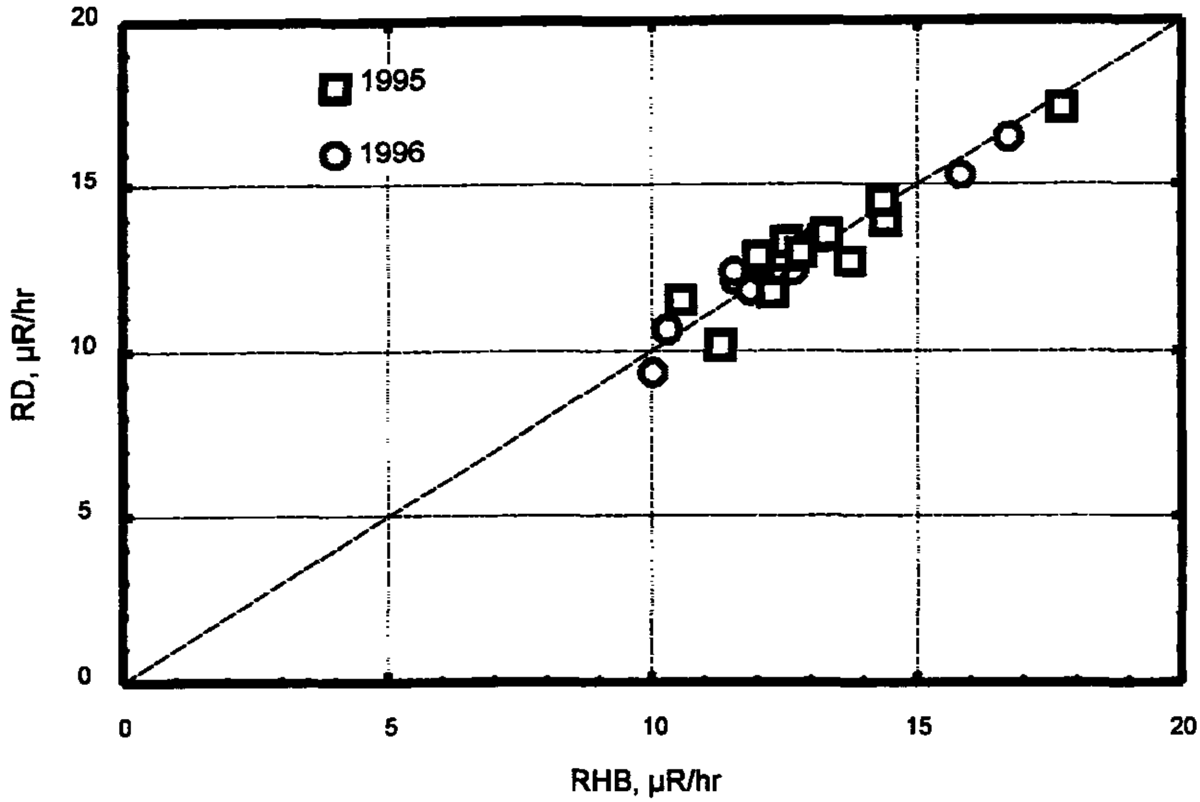

Figure 5-8. Comparison of results for co-located dosimeters for 1995 and 1996

Table 5-12. Comparison of TLD Radiation Exposures

	Mean Offsite Exposure Rate			Mean SSFL Exposure Rate*			Dosimeter Type	
	RD (µR/hr)	RHB (µR/hr)	Ratio (RD/RHB)	RD (µR/hr)	RHB (µR/hr)	Ratio (RD/RHB)	RD	RHB
1989	10	11	0.91	12	12	0.95	CaF_2:Mn	$CaSO_4$
1990	7	8	0.93	7	15	0.50	LiF	$CaSO_4$
1991	8	8	0.95	12	13	0.92	LiF	$CaSO_4$
1992	7	10	0.70	8	13	0.63	LiF	$CaSO_4$
1993	5	9	0.63	7	11	0.67	LiF	$CaSO_4$
1994	11	11	0.97	15	13	1.16	LiF	$CaSO_4$
1995	12	12	1.01	13	13	1.01	LiF, Al_2O_3	$CaSO_4$
1996	10	11	0.91	13	13	1.01	Al_2O_3	$CaSO_4$
Average	9	10	0.88	11	13	0.85		
Std Dev	2	1	0.14	3	1	0.23		

* includes three locations known to have elevated exposure from RMHF

Table 5-13. Comparison of TLD Radiation Exposure Rate (μR/hr)

	RD			RHB			Dosimeter Type	
	Mean SSFL* (μR/hr)	Mean Offsite (μR/hr)	Difference (μR/hr)	Mean SSFL* (μR/hr)	Mean Offsite (μR/hr)	Difference (μR/hr)	RD	RHB
1989	11.8	9.6	2.2	12.4	10.5	1.9	CaF_2:Mn	$CaSO_4$
1990	7.2	7.4	-0.2	14.5	8.0	6.5	LiF	$CaSO_4$
1991	12.3	8.0	4.3	13.4	8.4	5.0	LiF	$CaSO_4$
1992	7.9	7.1	0.8	12.6	10.1	2.5	LiF	$CaSO_4$
1993	7.4	5.4	2.0	11.1	8.6	2.5	LiF	$CaSO_4$
1994	15.4	11.0	4.4	13.3	11.3	2.0	LiF	$CaSO_4$
1995	13.3	11.6	1.7	13.2	11.5	1.7	LiF, Al_2O_3	$CaSO_4$
1996	12.9	9.6	3.3	12.8	10.6	2.2	Al_2O_3	$CaSO_4$
Average	11.0	8.7	2.3	12.9	9.9	3.0		
Std Dev	3.1	2.1	1.6	1.0	1.4	1.7		

* Includes three locations known to have elevated exposure from RMHF

Table 5-14. Comparison of TLD Annual Radiation Exposures (mrem/y)

	RD			RHB			Dosimeter Type	
	Mean SSFL* (mrem/y)	Mean Offsite (mrem/y)	Difference (mrem/y)	Mean SSFL* (mrem/y)	Mean Offsite (mrem/y)	Difference (mrem/y)	RD	RHB
1989	103	84	19	109	92	17	CaF_2:Mn	$CaSO_4$
1990	63	65	-2	127	70	57	LiF	$CaSO_4$
1991	108	70	38	117	74	44	LiF	$CaSO_4$
1992	69	62	7	110	88	22	LiF	$CaSO_4$
1993	65	47	18	97	75	22	LiF	$CaSO_4$
1994	135	96	39	117	99	18	LiF	$CaSO_4$
1995	117	102	15	116	101	15	LiF, Al_2O_3	$CaSO_4$
1996	113	84	29	112	93	19	Al_2O_3	$CaSO_4$
Average	97	76	20	113	87	27		
Std Dev	27	18	14	9	12	15		

* Includes three locations known to have elevated exposure from RMHF

5.5.8 Determination of Natural Background

The extensive measurements conducted as part of the Area IV characterization survey, and the measurements in the earlier, Multimedia offsite surveys performed by McLaren/Hart (Refs. 26 and 27), in cooperation with EPA and DHS/RHB, provide an unusual opportunity to define the background radioactivity and radiation exposure of this area. The "natural" radioactivity in the environment includes tritium from cosmic-ray production and nuclear weapons tests, potassium in the rocks and soil, Sr-90 and Cs-137 from global fallout, and several members of the decay chains of naturally occurring thorium and uranium. These radionuclides in and on the ground, and in the air, and the natural radiation from space, contribute to the natural background exposure rate. Since determination of the impact of nuclear operations, such as those conducted in the past at SSFL, is done in reference to natural background, it is important to have a well-established measure of that background. A statistical interpretation tool, cumulative probability plotting, is used to assure that only data values that belong with the majority of the set are included. This tool has the advantage that it requires no further statistical or mathematical treatment, it only requires that the reader be able to recognize a straight line. Data that fall along a straight line belong in the set, those that don't, don't. In some cases, it is necessary to exclude some of the lowest measured values to achieve the straight-line distribution. In some cases it is necessary to exclude some highest values. In the one case, depleted soil may affect the results, in the other possible low-level contamination or anomalous accumulation may produce a misleading concentration. In either case, slight errors introduced by sampling or analysis may produce an abnormal value. The plotting allows detection of these effects, and the plot demonstrates their elimination.

Review of data for the Area IV survey report showed that significant differences existed between the Simi Hills region containing SSFL and four of the offsite locations identified for comparative background measurements. These four locations were situated in the Tapia Park and Wildwood Park areas, and differed significantly from SSFL in terms of the radionuclide content of the soil. This soil difference was readily apparent in the exposure rate readings in those locations, and was confirmed specifically by laboratory analyses.

5.5.8.1 Exposure Rate

The results of the Area IV survey measurements of exposure rate at SSFL are compared with the complete set of offsite measurements in Figure 5-9. (This figure shows the probability of a measurement resulting in a particular value. For example, 50% of the measurements are below about 15 μR/hr, 99.9% are below about 20 μR/hr. A natural distribution of values produces a straight line plot of data points. Localized differences in conditions will produce noticeable departures from this ideal straight line.) In this plot, the 10,479 measurements at SSFL are shown as circles. The offsite measurements are shown as squares. The average value of the exposure rate at SSFL is 14.6 μR/hr. The average of the offsite measurements is 14.5 μR/hr. Not only are these averages essentially the same, it can be clearly seen that the distributions of most of the exposure rate measurements, onsite and offsite, are essentially the same. The only noticeable differences are that the less precise measurements in the offsite surveys produce a stair-stepped appearance to the plot, and the offsite measurements are lower at the low end and higher at the high end. The two lowest blocks of offsite data are from the four locations in which the soil was subsequently shown to be significantly depleted in natural radioactivity. (This comparison uses all the offsite data available, since this review shows that there is no contribution from Rocketdyne operations to the exposure rate at the nearer offsite locations, on the Brandeis-Bardin Institute and the Santa Monica Mountains Conservancy land. Note, however, that the "background dataset" used in the Area IV Survey report (Ref. 17) did not include data for any of those samples taken on the Brandeis-Bardin Institute or the Santa Monica Mountains Conservancy). These instrumental readings show somewhat better agreement for the offsite areas and SSFL than do the TLD results just previously discussed. This is primarily due to the selection of similar geological areas in the SSFL background determination. The offsite TLDs are located in a variety of terrains, specifically residential yards, that differ considerably from the mountainous areas included in the SSFL study.

The radiation exposure rate measurements from the Tapia and Wildwood areas clearly departs from the distribution expected for natural background radiation. Therefore, these measurements should be excluded from any estimate of background radiation in the Simi Hills. It would be as inappropriate to include these exceptionally low values from areas depleted in natural radioactivity as it would be to include elevated readings from a contaminated area. This review attempts to exclude both depressed readings and elevated readings, so as to include only those values resulting from areas that truly represent the average environment of the Simi Hills.

Omitting the low exposure rate values from the comparison produces a much better agreement with the ideal distribution (the straight line) and with the 10,479 measurements made at SSFL. This is shown in Figure 5-10.

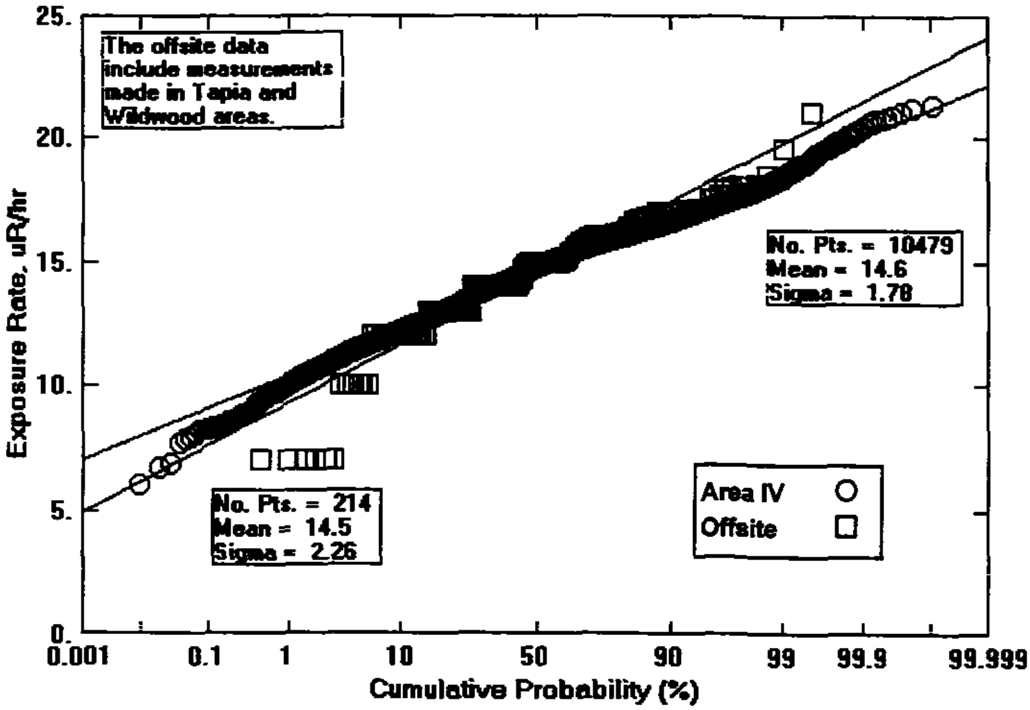

Figure 5-9. Comparison of onsite (Area IV) and offsite (multimedia) exposure rate measurements

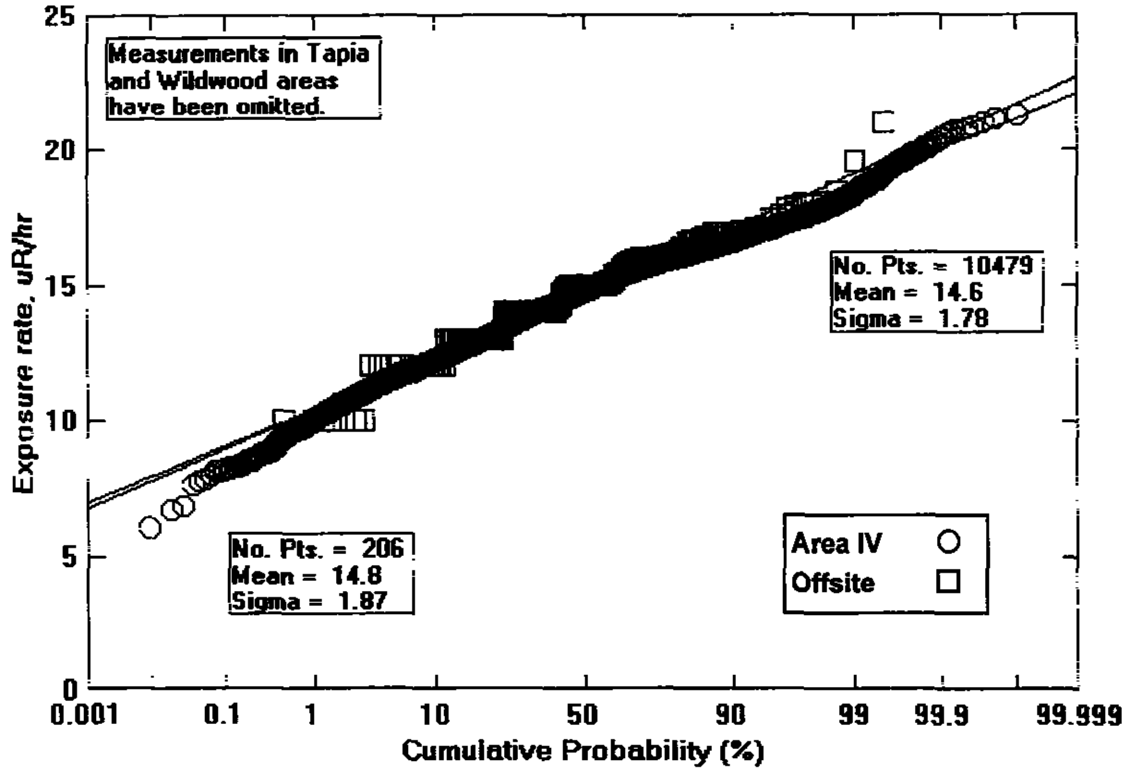

Figure 5-10. Comparison of onsite (Area IV) and offsite (multimedia) exposure rate measurements, omitting the low readings from Tapia and Wildwood areas.

5.5.8.2 Soil Radioactivity

In addition to the exposure rate measurements, 149 soil samples were taken in Area IV, based on uniform random sampling as well as indications of elevated exposure rate. (Since the intent here is to establish valid estimates of background radioactivity in the Simi Hills, this discussion excludes samples taken from three areas that were identified for remediation because of unusually high radioactivity for the local soil or samples, which were suggestive of potential contamination. One area had an unusually high content of natural uranium minerals. The other two are associated with T064, a facility currently in the process of decommissioning. The natural contamination and the T064 areas will be discussed later.) These samples were analyzed by gamma spectrometry, alpha spectrometry, and radiochemistry. These analyses produced results for H-3 (tritium), K-40, Sr-90, Cs-137, Ra-226, Th-228, Th-230, Th-232, U-234, U-235, U-238. All other radionuclides were essentially undetectable.

The problem of the four unsuitable offsite background locations is shown especially well in the results for K-40, a radioactive isotope of potassium, a common element in rocks and soil. The entire set of soil analytical results for K-40 (by gamma spectrometry) is shown in Figure 5-11, again using the same method to display the data as was used for the exposure rate measurements.

(In this plot, the uncertainty in each measurement is shown by the span of the vertical error bars above and below each point.) It is obvious that the lower portion of the data does not match the majority of results. All data in this region, below about 10% cumulative probability came from the two locations at Tapia Park and the two locations at Wildwood Park. These low values are not representative of the other areas from which soil samples were analyzed, and distort the distribution badly. The distribution of data points departs markedly from the mathematical ideal straight line calculated for this set. K-40 is one of the natural radionuclides that contributes to the natural exposure rate, and it is the exceptionally low concentration of this radionuclide that, in part, reduces the exposure rate measurements at Tapia Park and Wildwood Park. In the succeeding discussion, the Tapia and Wildwood data have been uniformly omitted. Those soils are not representative of the Simi Hills.

5.5.8.2.1 Potassium-40

The results of the depleted soil samples have been omitted from the plot shown in Figure 5-12, and the improvement in the plot is obvious. The data points lie along the straight line representing the ideal distribution of K-40 results for the Simi Hills region. Therefore, this distribution may be taken as a representation of natural K-40 in the background. Some soils in this region will have higher or lower concentrations of K-40 than others, but there is a high probability that any measurement will be within 5 pCi/g above or below the average value of 20.5 pCi/g. The close agreement of the points and the straight line assure that there are no soil samples in this set with exceptionally high or low concentrations of this radionuclide. Future soil results that lie within this distribution may be assumed to represent background activity for K-40. Results that fall outside this distribution may warrant further investigation.

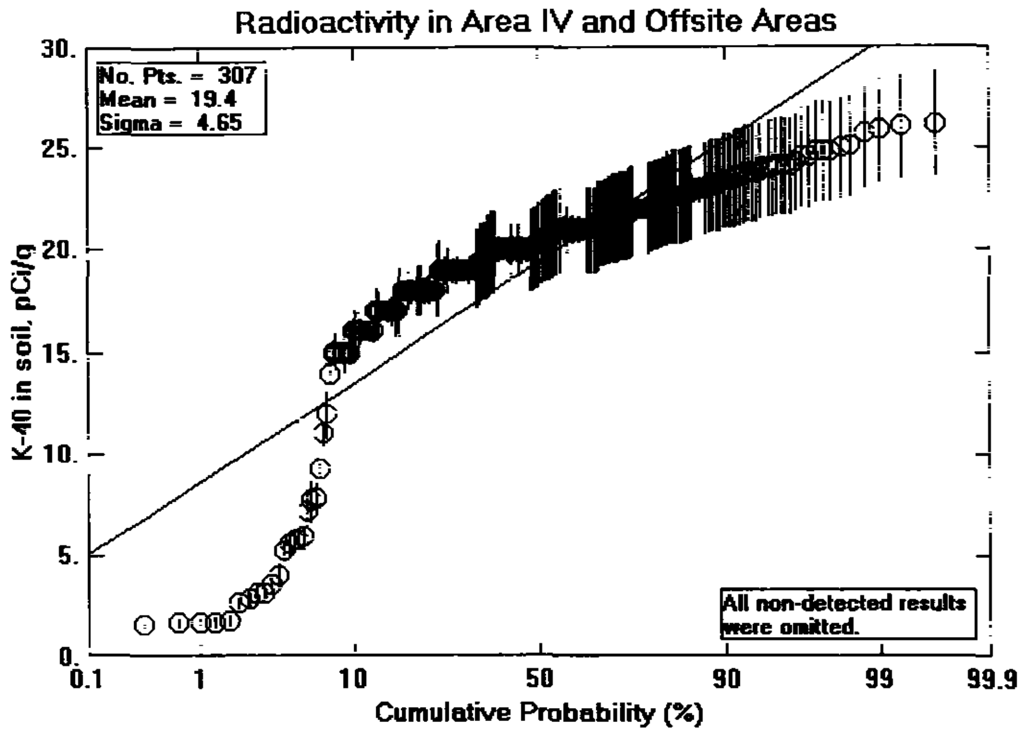

Figure 5-11. K-40 activity in soil samples from the Area IV and multimedia offsite surveys

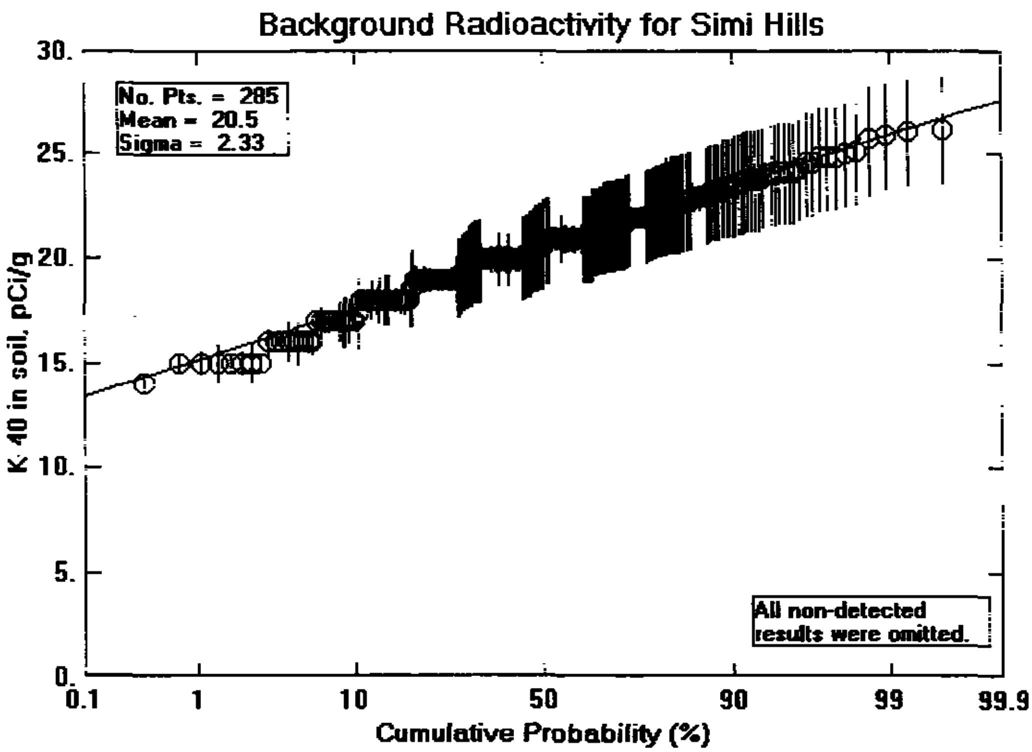

Figure 5-12. K-40 activity in soil samples from the Area IV and multimedia offsite surveys (Tapia and Wildwood samples have been omitted).

5.5.8.2.2 Tritium

Figure 5-13 shows the results for H-3 (tritium) in soil moisture. Since the purpose of this review is to establish a basis for a definition of natural background, several results associated with known contamination by tritium have been omitted from this plot. The moisture in un-irrigated soil, as this natural wilderness is, is essentially the same water as surface water, water that has recently fallen as rain or been deposited as dew. Thus, the plotted results represent the natural concentration of tritium in surface water. The results are clearly dominated by the high variability of this analysis, as indicated by the relatively large error bars for each point, at these low levels of tritium. However, the average of these 170 measurements, 6 pCi/L, is close to that expected for natural, uncontaminated surface water. (For perspective, the allowable limit for tritium in water from drinking water suppliers is 20,000 pCi/L.) As in the case of K-40, future results that fall outside of this distribution might warrant further investigation.

5.5.8.2.3 Strontium-90 and Cesium-137

Since Sr-90 and Cs-137, fission products commonly present together in irradiated nuclear fuel, are the most common of the radioactive contaminants at SSFL, results of background measurements of these two radionuclides are shown together in Figure 5-14. This plot shows the entire set of results from uncontaminated areas at SSFL and from offsite, except for those samples that did not have detectable Sr-90 or Cs-137, and three high values of Cs-137 that were suggestive of possible contamination, and the negative/zero values for Sr-90 and three exceptionally low values. Clearly the points match the ideal straight lines closely, and show no indication of contamination, or depletion. (The careful reader will notice that the Y-axis scale has changed form in this plot. It is now logarithmic, increasing by a factor of 10 at each step. This produces a "log-normal" plot, which clearly provides a better match to the data in some cases. In some cases, the linear form of the distribution provides a better fit to the data, in some cases, the log-normal is best. There is no strong theoretical basis for expecting one to be superior to the other in any particular case, so the best fitting distribution is used here for each radionuclide as appropriate.)

This radioactivity is the result of global fallout from the atmospheric testing of nuclear weapons, and has been present in the environment for over 40 years. The two lines are nearly parallel, showing that overall the ratio of Sr-90 activity to that of Cs-137 is nearly constant. That would be expected for a common source of widespread deposition, such as fallout. This plot shows that the average background concentration of Sr-90 in the Simi Hills region is 0.046 pCi/g, but that values may be found ranging up to about 0.3 pCi/g. Similarly, the average value for Cs-137 is 0.149 pCi/g, but values up to 1 pCi/g may be found, as background. Results above these distributions may suggest contamination. Depending on the actual values, remediation may or may not be required. For perspective, the allowable limit for Sr-90 in soil at SSFL is 36.0 pCi/g, while the limit for Cs-137 is 9.2 pCi/g.

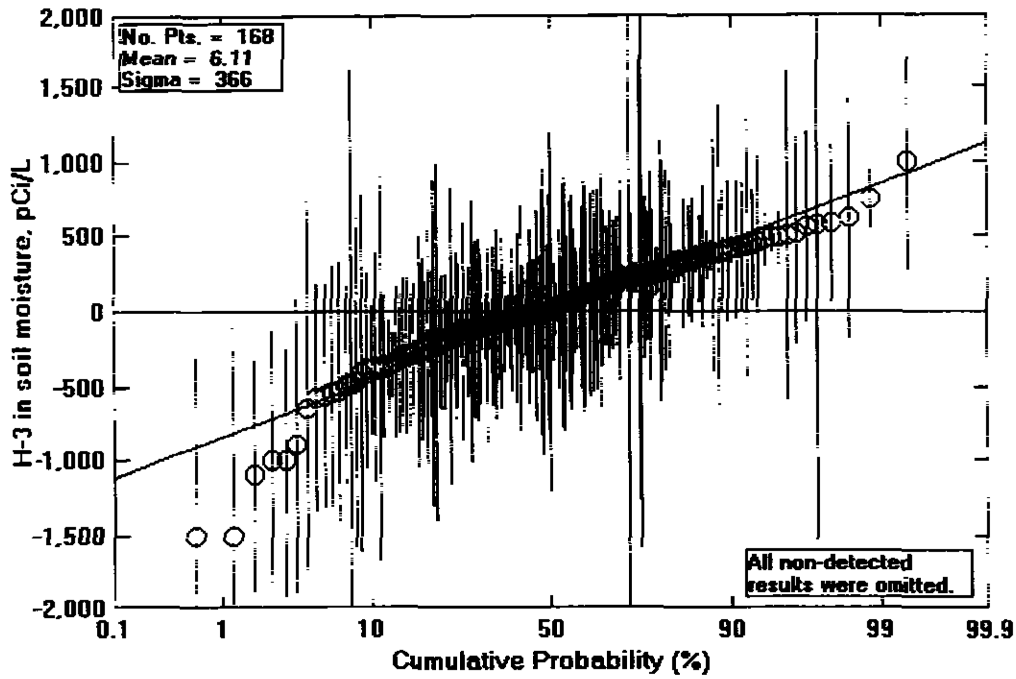

Figure 5-13. H-3 activity in moisture from soil samples from the Area IV and *multimedia offsite* surveys.

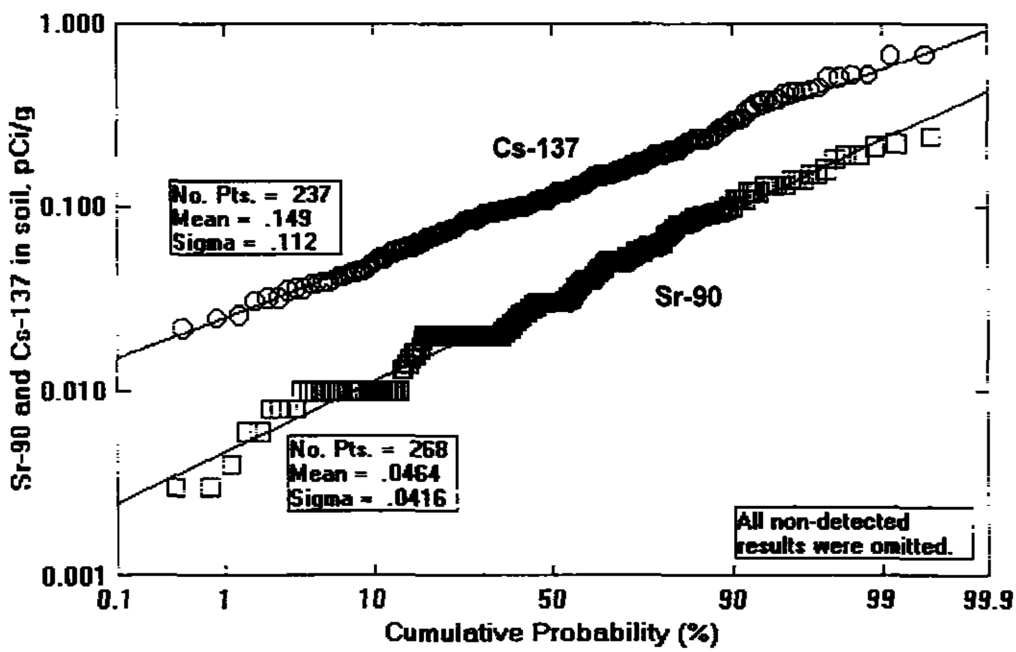

Figure 5-14. Sr-90 and Cs-137 activity in soil samples from the Area IV and multimedia offsite surveys.

5.5.8.2.4 Radium-226

Ra-226, one of the naturally occurring radionuclides in the decay chain of U-238, was measured by using gamma spectrometry. In this analysis, gamma radiation from the U-235 that is naturally present with the U-238, and therefore is associated with the Ra-226, interferes with the quantification of the Ra-226 activity. (A similar interference occurs in analysis of U-235 by gamma spectrometry. This interference becomes insignificant for actual contamination by either Ra-226 or U-235. The interference is avoided for U-235 by using alpha spectrometry.) In those analyses where this interference was not corrected, an adjustment was made by multiplying the reported value and uncertainty by 0.5525. This corrects for the activity of U-235 that was falsely identified as Ra-226. These results are shown in Figure 5-15.

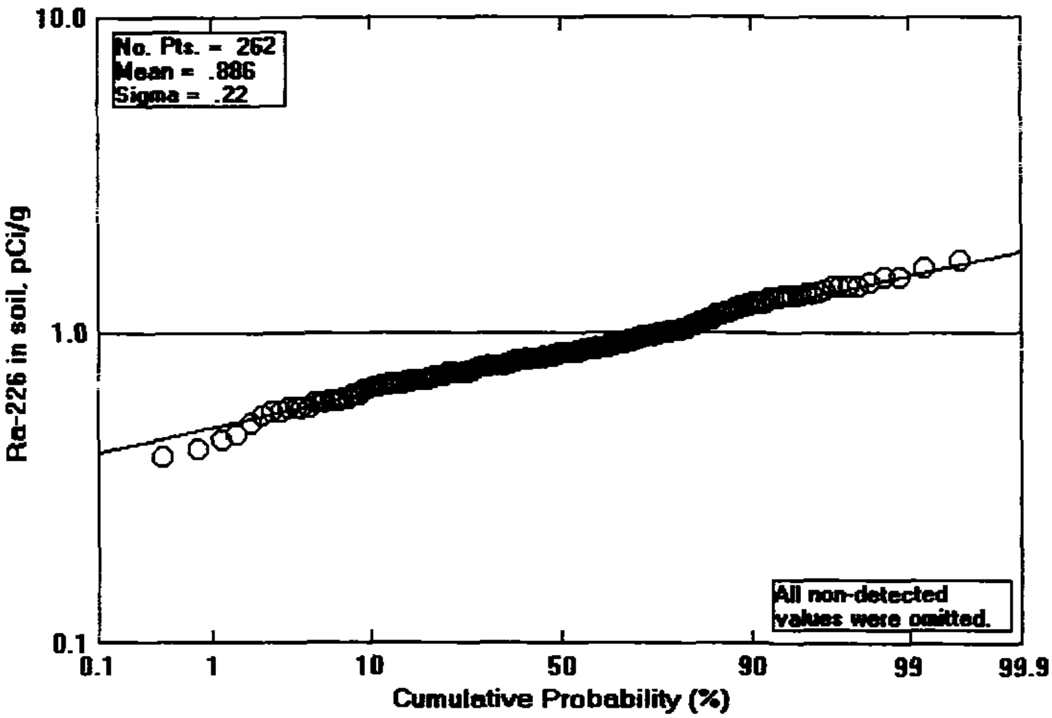

Figure 5-15. Ra-226 activity in soil samples from the Area IV and multimedia offsite surveys.

5.5.8.2.5 Thorium-228, -230, and -232

Th-228 is a daughter of the natural thorium (Th-232) present in the rocks and soil of the Simi Hills. Results for this radionuclide are shown in Figure 5-16.

Th-230 is a long-lived daughter of U-234 and U-238, from the natural uranium that is present in the Simi Hills. The results of analyses for this radionuclide are shown in Figure 5-17.

Th-232 is the single longest-lived radionuclide of natural thorium. Analytical results for this radionuclide are shown in Figure 5-18.

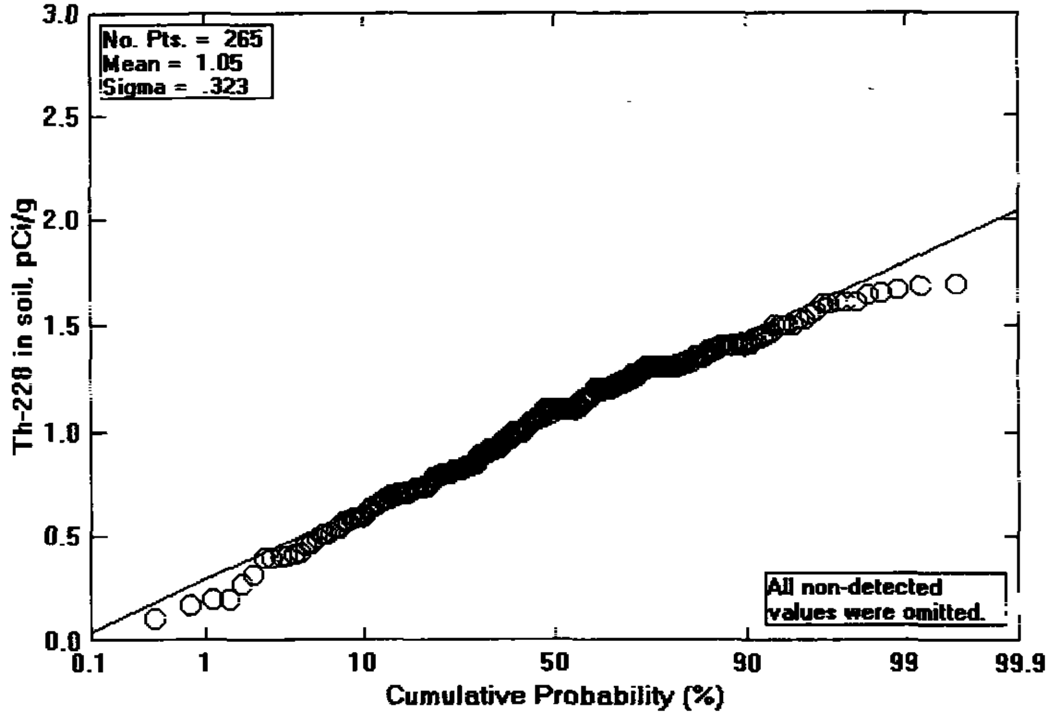

Figure 5-16. Th-228 activity in soil samples from the Area IV and multimedia offsite surveys.

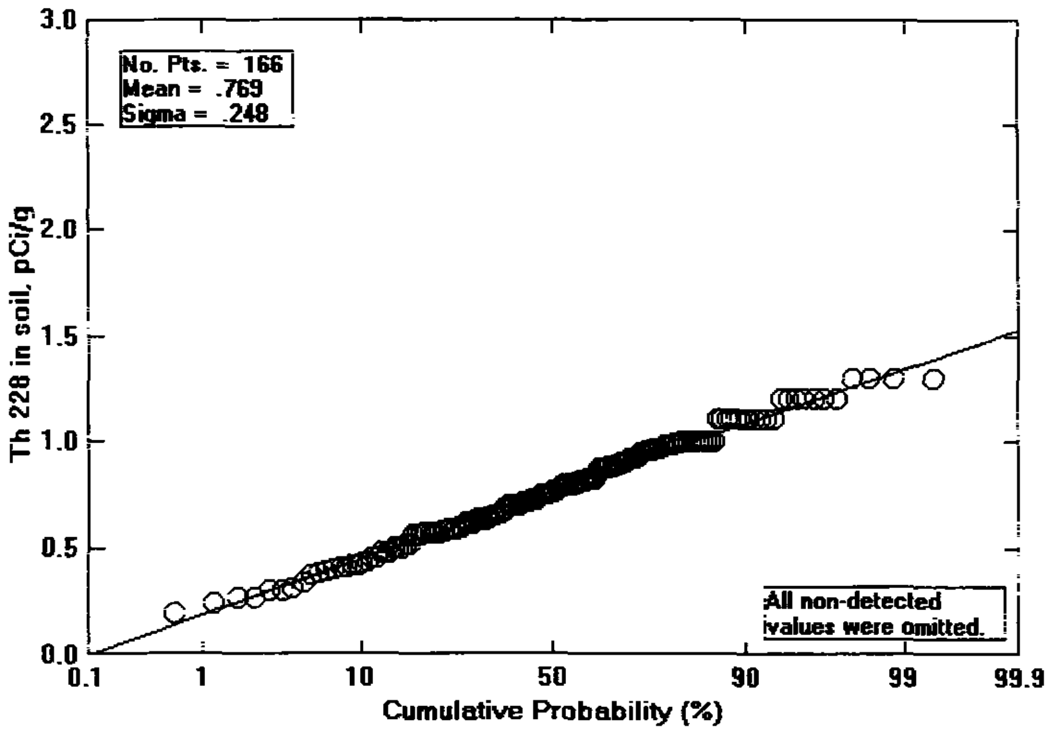

Figure 5-17. Th-230 activity in soil samples from the Area IV and multimedia offsite surveys.

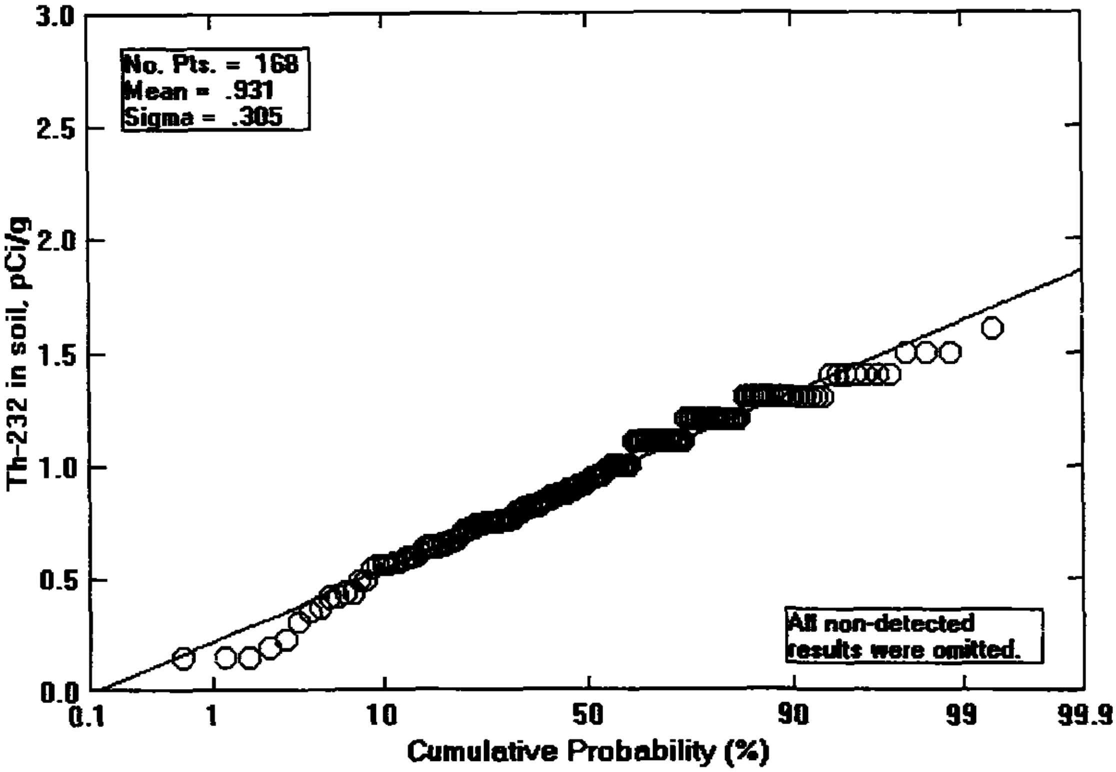

Figure 5-18. Th-232 activity in soil samples from the Area IV and multimedia offsite surveys.

5.5.8.2.6 Uranium

Natural uranium consists of three different isotopes, with well-defined activity ratios. The U-234 activity should match the U-238 activity, although some slight deviations occur in nature. The U-235 should have an activity approximately equal to 4.6 % of the U-238 activity. These activities are compared in Figures 5-19 and 5-20. The U-234 and U-238 activities are shown in the first figure, U-234 as squares and U-238 as circles. The data are nearly identical. The U-235 data are shown with the U-238 data in the next figure. The extremes of the distributions show ratios of 6.1% and 4.5 %, closely spanning the expected value of 4.6%.

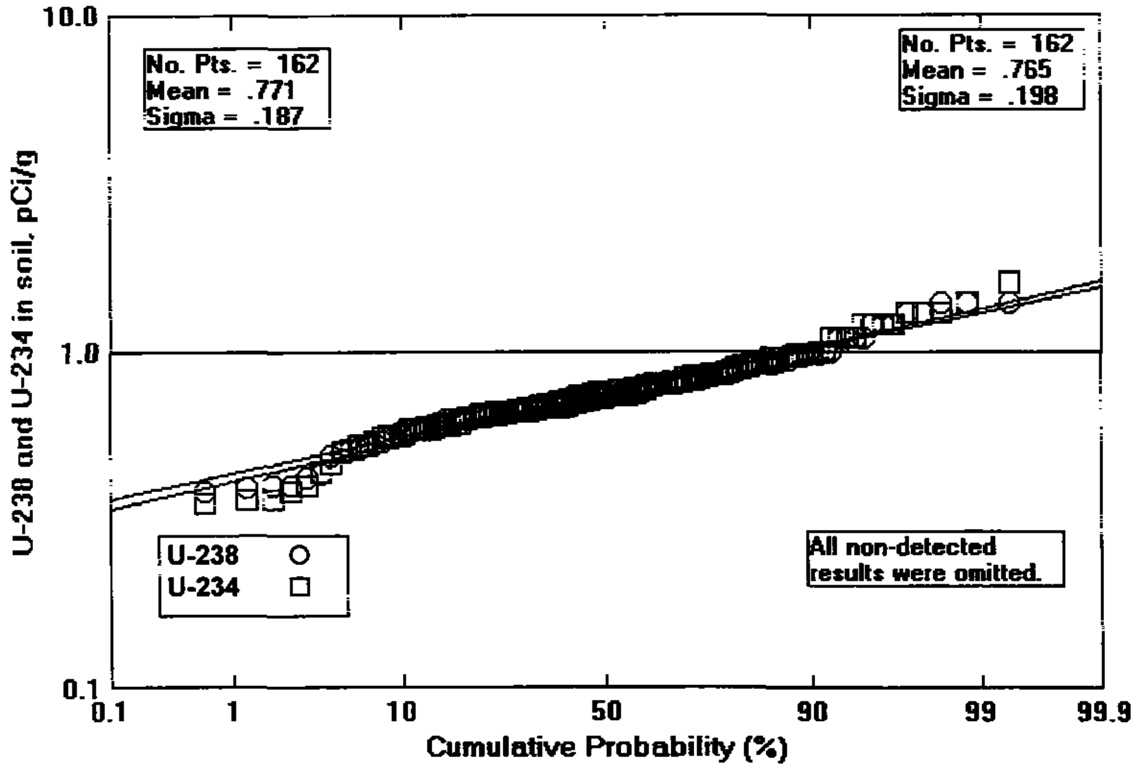

Figure 5-19. U-238 and U-234 activity in soil samples from the Area IV and multimedia offsite surveys.

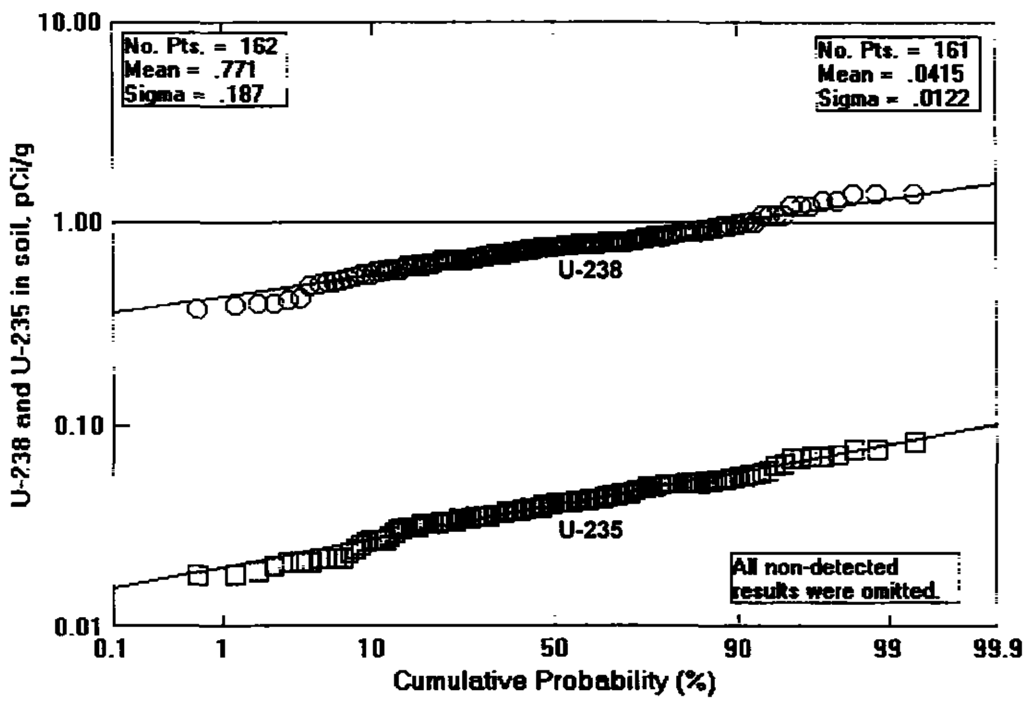

Figure 5-20. U-238 and U-235 activity in soil samples from the Area IV and multimedia offsite surveys.

5.6 ESTIMATION OF PUBLIC RADIATION DOSE

Because so little radioactive material is released from the Rocketdyne facilities, and the radiation exposure is so small compared to natural background, it is not possible to directly measure radiation dose to the public. Hypothetical doses were estimated based on direct measurements at the facilities, extrapolated to occupied areas offsite. The external dose calculations assume that differences in observed TLD readings represent true differences in local exposure. These TLD measurements, which are assumed to represent point sources at the Hot Lab and RMHF, are extrapolated to the boundary and nearest residence using an inverse square distance relation, and accounting for air attenuation of the radiation. The external exposures, above background, are then obtained by subtracting from these extrapolated values an average background exposure obtained from offsite measurements.

Individual Dose

For 1996, the estimated dose at the property line boundary nearest the RMHF was calculated to be 31 mrem/yr above local background (an average exposure rat of 3.5 μR/hr above backgound). Similarly, for the nearest residence, the annual dose estimate for 1996 was calculated to be 0.00028 mrem. For these calculations, the external dose estimate at the boundary was obtained by extrapolation of data from three environmental monitoring TLDs (SS-12, -13, and -14 shown earlier in Table 5-10) located at the RMHF. For the nearest residence dose, data from 14 separate facility TLDs (not listed in Table 5-10) was used for extrapolation. The average annual background used in both calculations was obtained from the fourteen offsite dosimeters adjusted for the somewhat higher background at SSFL, and was 108 mrem. Boundary dose estimates assume 100% occupancy, whereas the actual presence of persons at the boundary is rare or nonexistent. The estimated doses are far below the applicable limits of DOE, NRC, and the State of California.

Except for the nearest boundary line exposure for the RMHF, the estimated offsite doses are extremely low compared to the maximum permissible exposures recommended for the general population in the vicinity of DOE facilities. The effective dose equivalent for any member of the public, for all pathways (combining internal and external dose), shall not exceed 100 mrem/yr (above background) for DOE facilities or for NRC and State of California licensed facilities. As discussed above, the RMHF boundary to the north of the facility received an estimated average "property line" exposure of approximately 31 mrem/yr above the local background. However, this does not constitute a dose to the general public since it lies within an isolated area without direct public access.

Estimates of the internal dose assume a constant unsheltered exposure throughout the year, adjusted for wind direction frequency, and therefore considerably overestimate the actual annual averaged doses near the site. Estimated internal radiation doses due to atmospheric emission of radioactive materials from De Soto and the SSFL nuclear facilities are calculated by use of the EPA program CAP88-PC, and are several orders of magnitude below the radiation standards and are far below doses from internal exposure resulting from natural radioactivity in air. For the air pathway only, for DOE operations, the standard is 10 mrem/yr for committed effective dose equivalent, as established by EPA.

Public exposure to radiation and radioactivity is shown in Table 5-15 through Table 5-17. These tables present the estimated exposures in comparison to the regulatory standards and that received due to natural radioactivity in the environment. Dose values in the tables represent both internal and external exposures.

The general population (person-rem) dose estimates were calculated using CAP88-PC code. This code uses release rate, wind speed, wind direction and frequency, stability fractions, and stack height parameters as input data. Population dose estimates are 6.4×10^{-3} person-rem for the SSFL site and 6.0×10^{-5} person-rem for the De Soto site. The collective effective dose equivalent estimated for potential area sources in 1996 is 5.1×10^{-3} person-rem, included in the SSFL total. Inhalation is the only potential exposure pathway likely to exist. Figure 5-21 shows the arrangement of the census tract boundaries from the 1990 census Figures 5-22 through 5-24 show local population distribution estimates that were determined from the 1990 Federal census by Urban Decision Systems, Inc., and modified by direct observation of nearby residential areas around the SSFL site, and the occupational population at SSFL.

Table 5-15. Public Exposure to Radiation and Radioactivity from DOE Operations at SSFL - 1996

Radioactive Materials Handling Facility (RMHF)
Department of Energy (DOE, Exempt from Licensing)

1.	All pathways	
	a. Maximum estimated external dose to an individual	2.8×10^{-4} mrem/yr
	b. Maximum estimated internal dose to an individual[a]	1.6×10^{-7} mrem/yr
	Total	2.8×10^{-4} mrem/yr
	Limit	100 mrem/yr
	("Radiation Protection of the Public and the Environment" DOE Order 5400.5)	
2.	Air pathway (reported in NESHAPs report)	2.9×10^{-6} mrem/yr
	Limit (40 CFR 61, Subpart H)	10 mrem/yr

[a] Inhalation and ingestion exposure from CAP88-PC calculation of air pathway; NESHAPs report contains only total air pathway exposure.

Table 5-16. Public Exposure to Radiation and Radioactivity from Licensed Operations at SSFL - 1996

Hot Laboratory
U.S. Nuclear Regulatory Commission
Special Nuclear Material License No. SNM-21
State of California
Radioactive Material License No. 0015-70

1.	Direct radiation at boundary	indistinguishable from background
	Limits (10 CFR 20.1301, CCR 17 Section 30253)	100 mrem in 1 yr
2.	Airborne (non-natural radioactivity) effluent at boundary[a]	4.50E-19 µCi/mL
	Limits (10 CFR 20.1302, CCR 17 Section 30253)	2E-14µCi/mL

[a] Use of the EPA computer program, COMPLY, to determine the air pathway dose from the measured radionuclide concentrations for the ventilation exhaust from the Hot Lab at SSFL showed this facility to be in compliance with 40 CFR 61, Subpart I, at Level 1, the simplest, most conservative screening level.

Table 5-17. Public Exposure to Radiation and Radioactivity from Licensed Operations at De Soto - 1996

Applied Nuclear Technology Laboratory (DS104)
State of California
Radioactive Materials License No. 0015-70

1.	Direct radiation at boundary	indistinguishable from background
	Limits (CCR 17 Section 30253)	100 mrem in 1 yr
2.	Airborne (non-natural radioactivity) effluent at boundary[a]	3.0E-20 µCi/mL
	Limit (CCR 17 Section 30253)	2E-14µCi/mL

[a] Use of the EPA computer program, COMPLY, to determine the air pathway dose from the measured radionuclide concentrations for the ventilation exhaust from the Applied Nuclear Technology Laboratories at De Soto showed this facility to be in compliance with 40 CFR 61, Subpart I, at Level 1, the simplest, most conservative screening level.

Population Dose

In spite of the large number of people in the surrounding population, the population dose estimated for Rocketdyne operations is extremely small. For comparison, the dose received by the same population from naturally occurring radiation is approximately 3 million person-rem, approximately 2 billion times greater than that estimated for SSFL operations.

To account for population increases, analytical results using the 1990 census data were multiplied by 1.03. This factor was based on population increases in Los Angeles and Ventura counties since 1990.

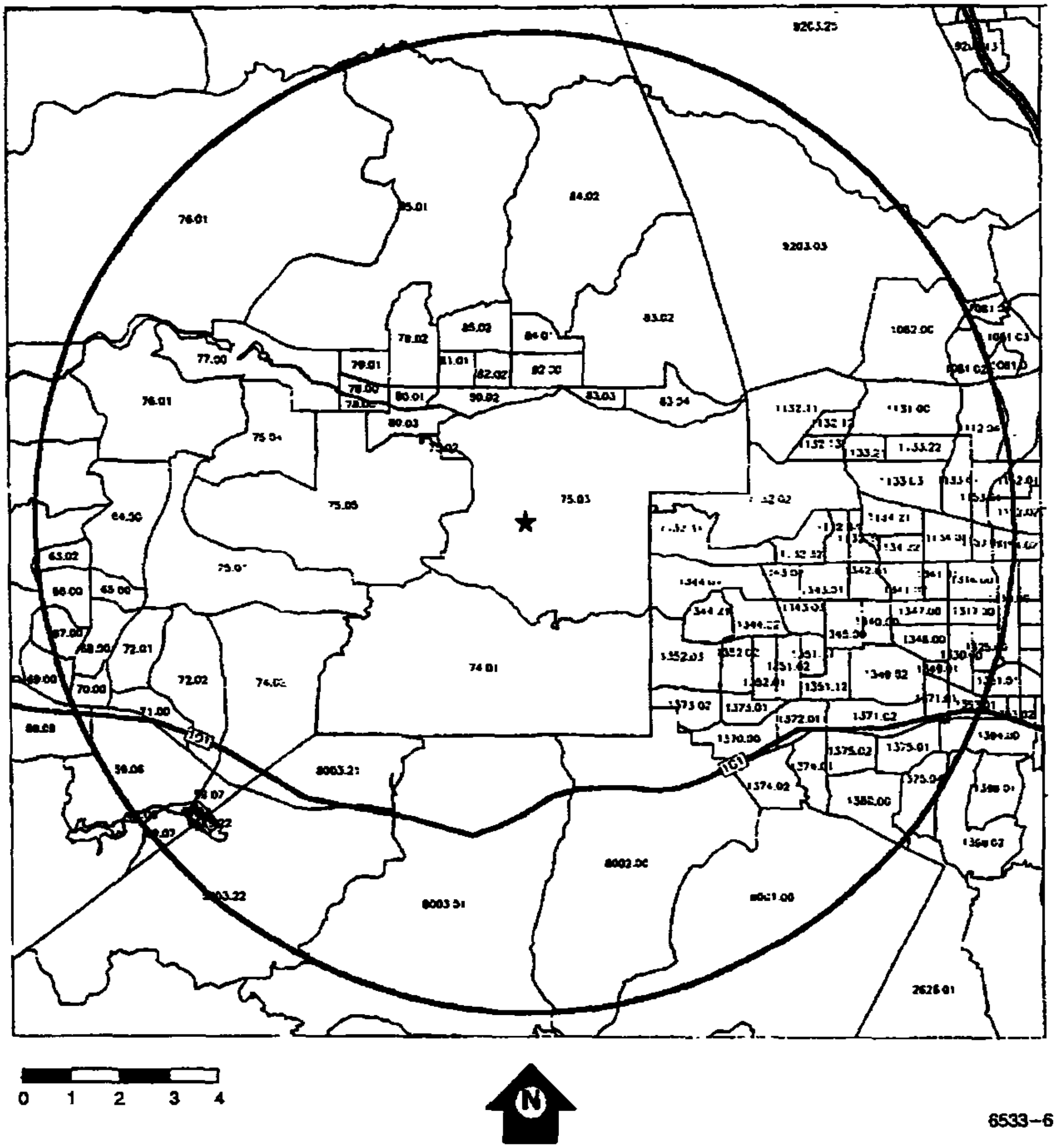

Figure 5-21. Census Tract Boundaries (1990) within 10 miles of SSFL (individual tracts are identified by number)

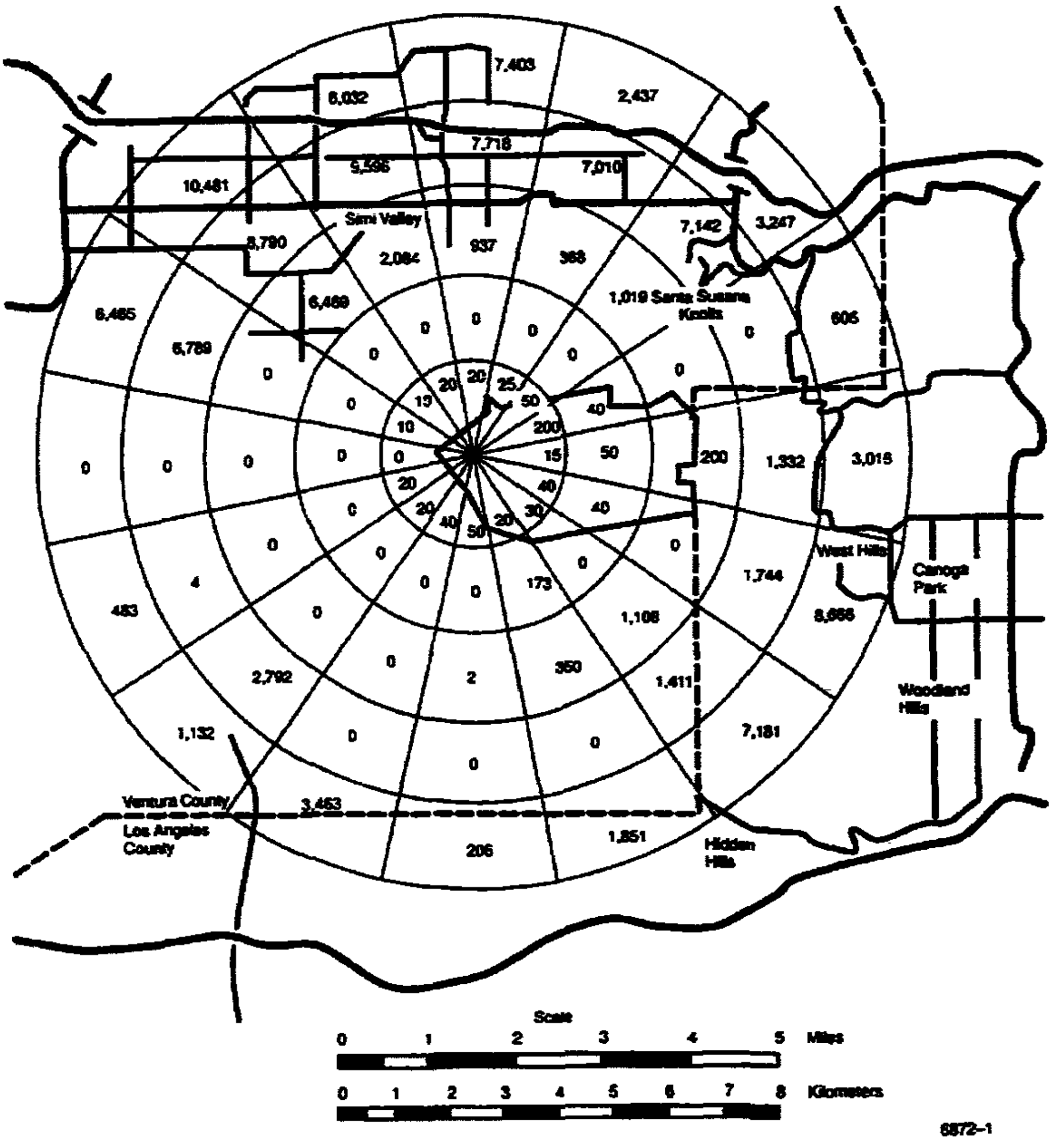

Figure 5-22. SSFL Site-Centered Demography to 8 km (1990), Showing Number of Persons Living in Each Grid (daytime employment for SSFL)

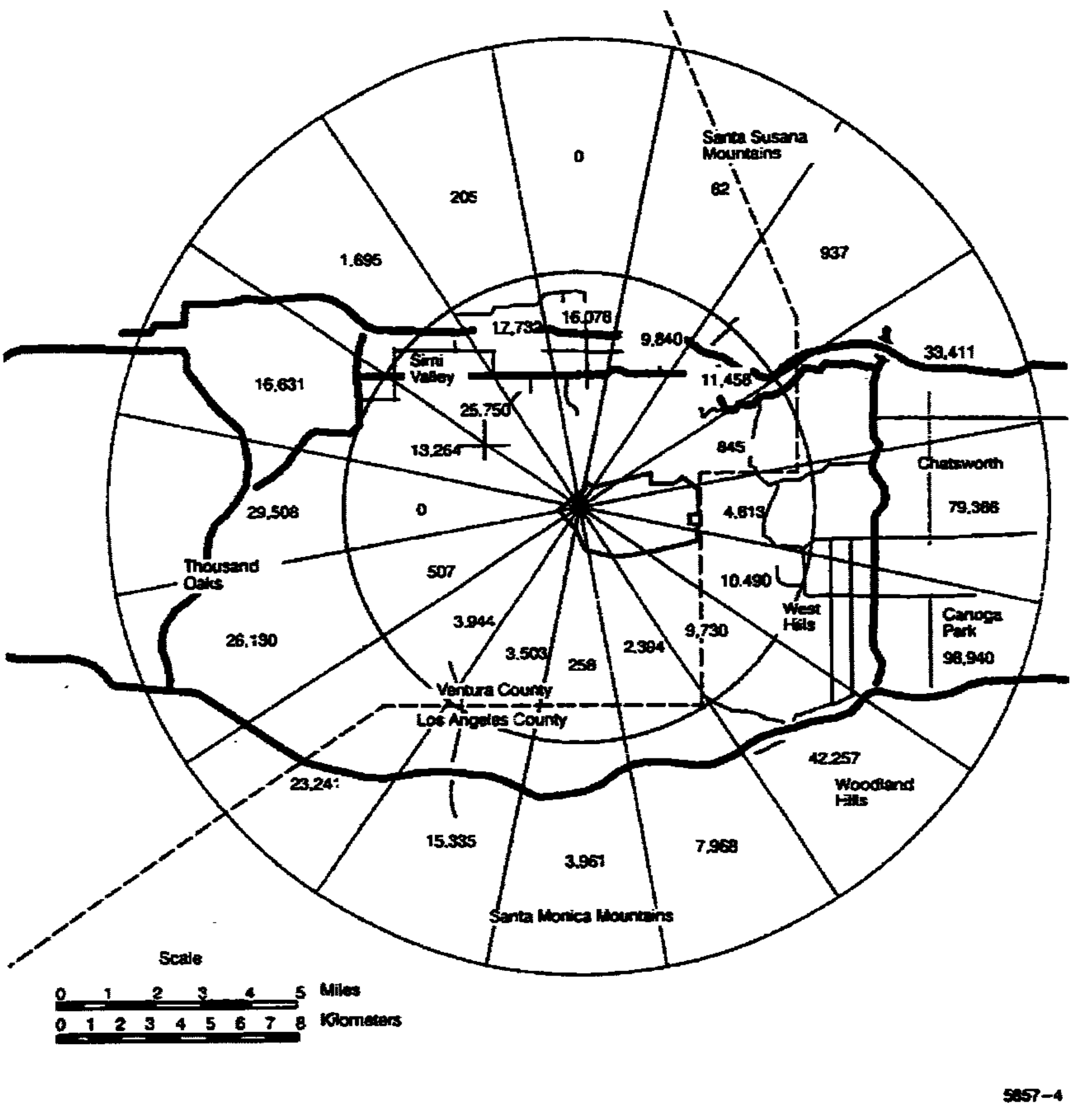

Figure 5-23. SSFL Site-Centered Demography to 16 km (1990), Showing Number of Persons Living in Each Grid

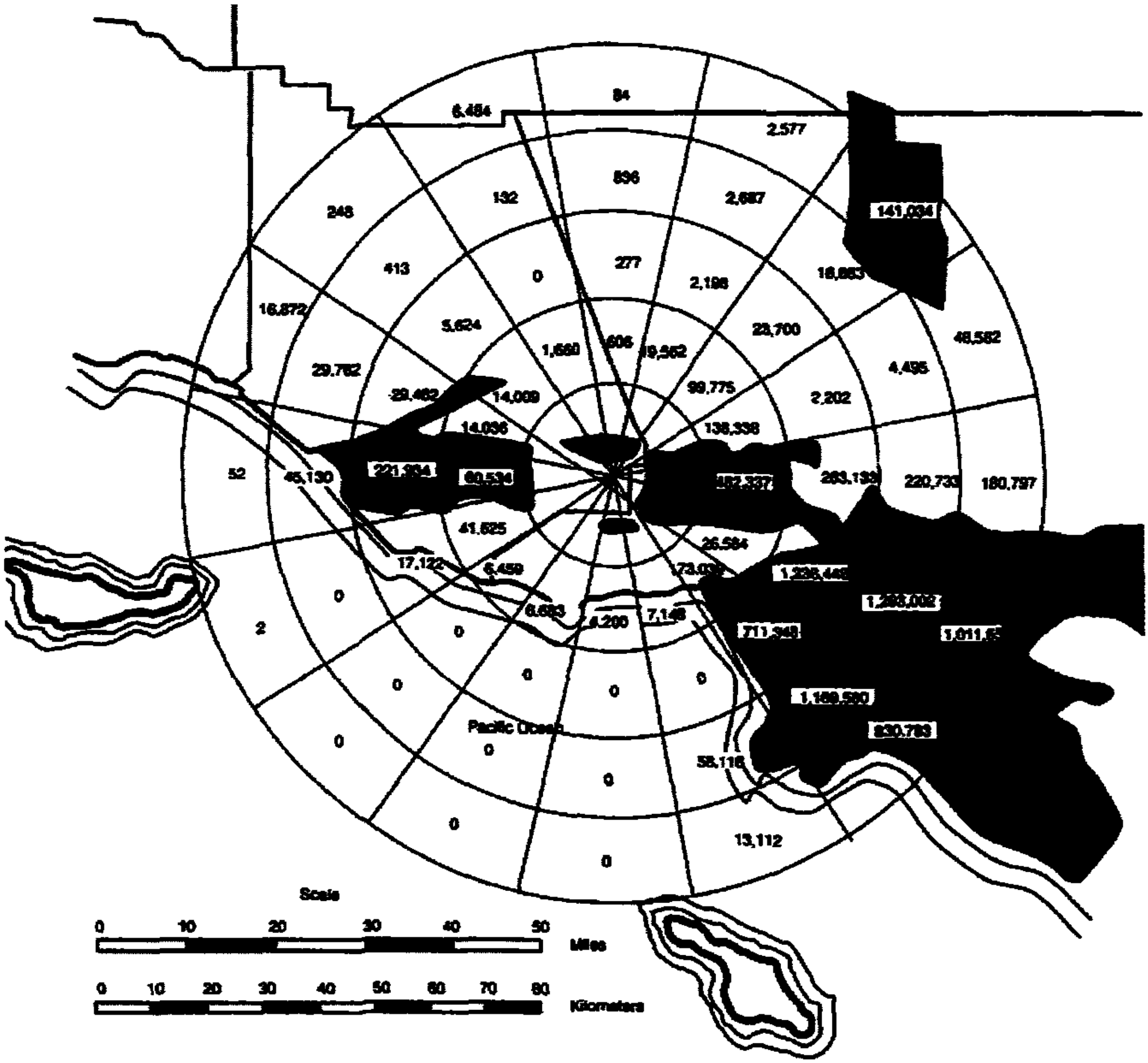

Figure 5-24. SSFL Site-Centered Demography to 80 km (1990), Showing Number of Persons Living in Each Grid (heavily populated areas are shown by shading)

6. ENVIRONMENTAL NON-RADIOLOGICAL MONITORING

Rocketdyne maintains a comprehensive environmental program to ensure compliance with all applicable regulations, to prevent adverse environmental impact, and to restore the quality of the environment from past operations. Petroleum hydrocarbon contaminated soils resulting from underground storage tanks (USTs) have been remediated as tanks are removed. The majority of the storage tanks have been removed. The few remaining USTs contain either sodium or radioactive water and are located within concrete vaults and equipped with automatic leak detection systems. As stated previously, these tanks are exempt from the UST regulations.

An extensive site-wide groundwater remediation program has the capacity for removing solvent contamination from approximately one million gallons of groundwater per day at SSFL. The major groundwater contaminant in Area IV is trichloroethylene (TCE) and its degradation products. Two pilot groundwater extraction system wells have been installed in Area IV and evaluation of their performance is in progress.

The discharge of surface water at SSFL results from collection of rainfall runoff or is due to the nonutilization of treated groundwater and is regulated by the California Regional Water Quality Control Board (CRWQCB) through an NPDES permit. The majority of surface water runoff drains to the south and is collected in the water reclamation/pond system. Discharges from this system are subject to effluent limitations and monitoring requirements as specified in the existing NPDES permit. A small portion of the site within Area IV generates rainfall runoff to five northwest boundary runoff channels where monitoring locations (Figure 6-1) have been established and sampling is conducted in accordance with the northwest slope monitoring program. All discharges are periodically monitored for volatile organics, heavy metals, and applicable radionuclides, in addition to other parameters necessary to assess water quality.

All sources of air emissions at SSFL are subject to the provisions of the Clean Air Act (CAA) as administered through the California Air Resources Board and the Ventura County Air Pollution Control District (VCAPCD). The VCAPCD regulates sources of air emissions and issues permits that contain limits on pollutant levels and conditions of operation.

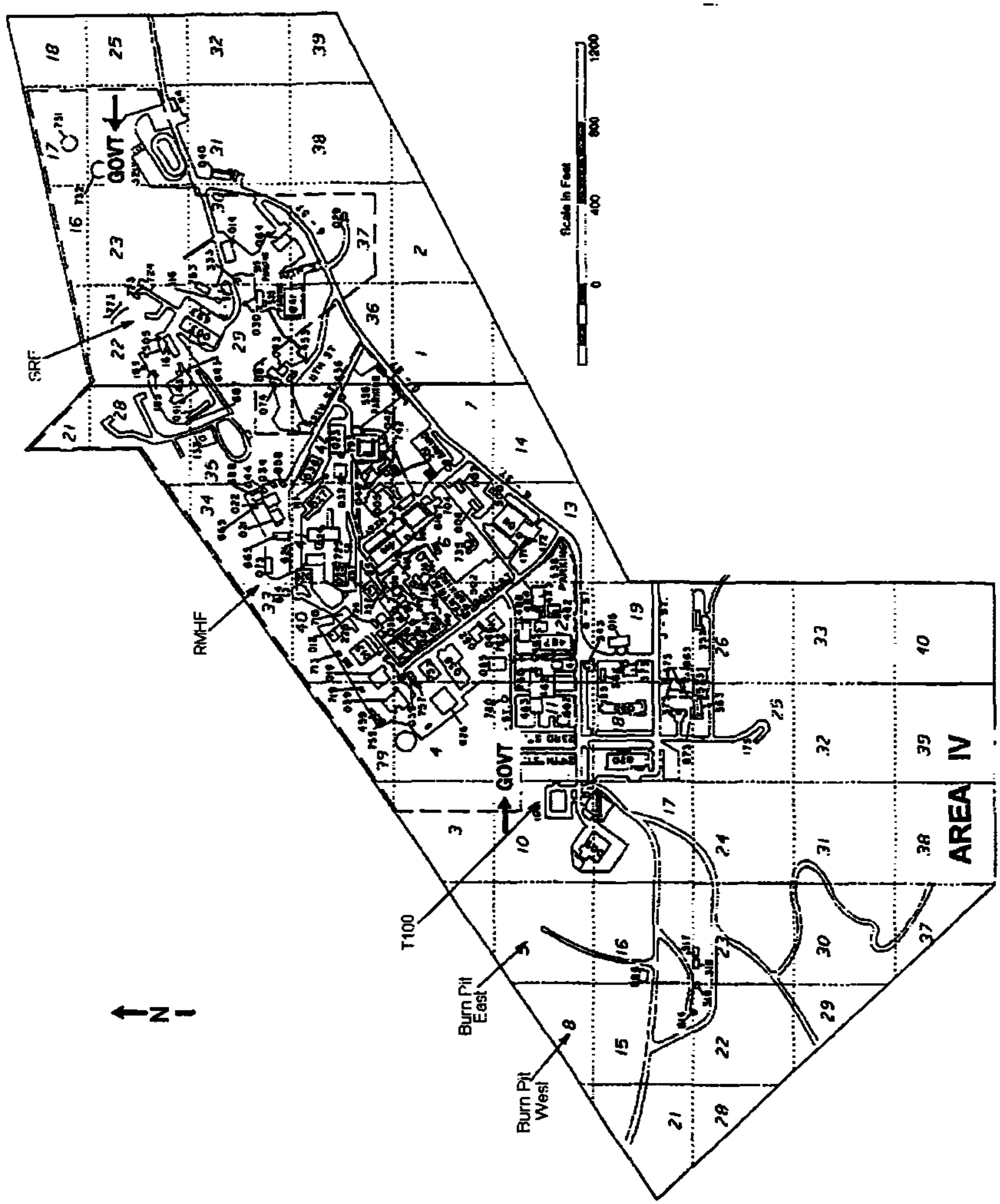

Figure 6-1. Locations of Surface Water Runoff Collectors Along Northwest Boundary of SSFL, Area IV

The specific soil analyses performed are based on site specific requirements according to the activities generating the samples and potential disposition of the soil. A wide variety of analyses are conducted to determine the extent of any potential chemical contamination. All analyses conducted in Area IV at the present time are conducted per appropriate regulations.

The overall annual groundwater monitoring program at SSFL addresses collection and analysis of groundwater samples and measurement of the water levels for the 216 Rocketdyne installed wells onsite and 16 offsite private wells. The locations of these wells within and around DOE areas in Area IV are shown on the map of SSFL in Figure 6-2. Groundwater quality parameters and sampling frequency have been determined based on historical water quality data, location of known or potential sources of groundwater contamination, operational requirements of groundwater extraction and treatment systems and regulatory direction. The groundwater monitoring program includes the following parameters, all analyzed using the appropriate EPA methods: volatile organic constituents, base/neutral and acid extractable organic compounds, petroleum hydrocarbons, and trace metals and common ion constituents. Radiological analyses are performed on groundwater samples from DOE areas in Area IV and offsite.

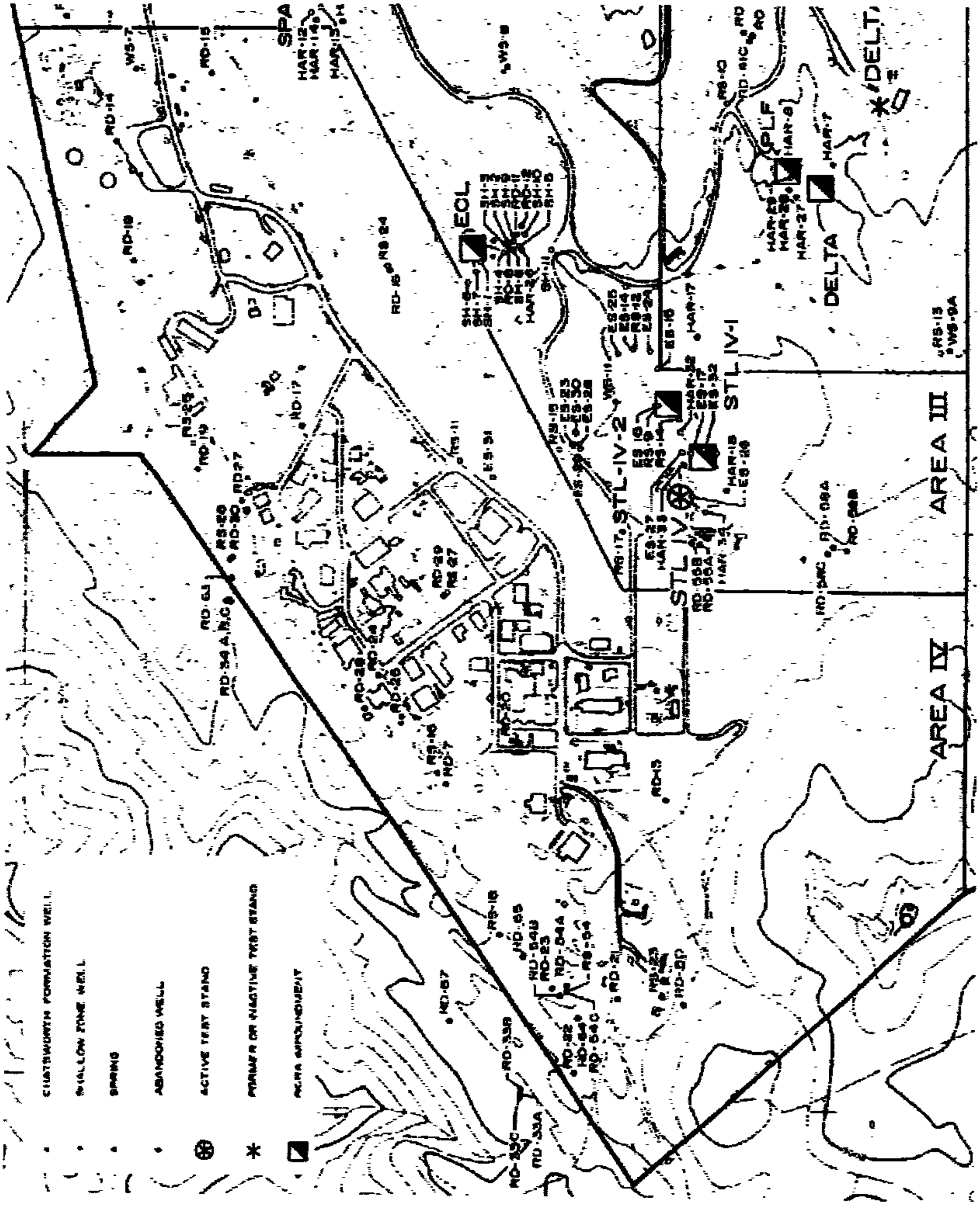

Figure 6-2. Location of Wells Used in Groundwater Management Program

6.1 SURFACE WATER

Rocketdyne has filed a Report of Waste Discharge with the California Regional Water Quality Control Board (CRWQCB) and has been granted a discharge permit pursuant to the National Pollutant Discharge Elimination System (NPDES) and Section 402 of the federal Water Pollution Control Act. The permit to discharge, NPDES No. CA0001309, initially became effective September 27, 1976. The permit was renewed with minor changes effective September 17, 1984 and has since undergone significant modifications subsequent to reissuance on December 7, 1992. The current permit is in effect through November 10, 1997.

The permit allows the discharge of reclaimed wastewater and storm water runoff from water retention ponds into Bell Creek, a tributary to the Los Angeles River, in addition to the discharge of storm water runoff from the northwest slope (Area IV) locations. Discharge along the northwest slope (Outfalls 003 through 007) generally occurs only during and after periods of heavy rainfall. The permit applies the numerical limits for radioactivity in drinking water supplies to drainage through these outfalls. Excess reclaimed water is now discharged on a continuous basis through the R-2A outfall location (Outfall 002).

There is no sanitary sewer discharge from SSFL. Domestic sewage is treated, disinfected, and discharged to the retention ponds. Permit conditions are placed on the operation of the two treatment plants. Area IV sewage is piped directly to the Area III Sewage Treatment Plant (STP III).

Of the two retention ponds at SSFL that discharge via the NPDES permit, only one receives influent from Area IV, and is referred to as Pond R-2A. Influent to the ponds includes tertiary treated domestic sewage, cooling water from various testing operations, and storm water runoff. During periods of discharge from the ponds, grab-type samples are collected for analysis by a California State certified testing laboratory. Analyses include chemical constituents such as heavy metals, volatile organics, base/neutral and acid extractable, and general chemistry in addition to specified radionuclides. Toxicity testing is also conducted in the form of acute and chronic toxicity bioassays.

In November 1989, a storm water runoff program was developed and implemented in Area IV for runoff from the northwest portion of the site. Five monitoring locations were selected that include: the Radioactive Materials Handling Facility watershed (Outfall 003), Sodium Reactor Experiment watershed (Outfall 004), the Former Sodium Disposal Facility (Outfalls 005 and 006), and behind T100 (Outfall 007). Runoff monitoring is currently conducted as set forth by the NPDES permit referenced above. Furthermore, all surface water program activities for the SSFL, including Area IV, have been addressed and incorporated into the current NPDES permit. The SWPPP and the NPDES permits were both prepared in accordance with the current federal and state regulations.

The permit imposes the contaminant limits for drinking water suppliers, relative to radioactivity, and goes far beyond the requirements of the drinking water supplier regulations in requiring much more frequent sampling and analysis. For Outfalls 001 and 002, during periods of discharge, and whenever rainfall is greater than 0.1 inch, no more than one sample per week needs to be obtained. During dry weather flow, minimum sampling frequency for these two outfalls shall be once per month. For discharges from Outfalls 003, 004, 005, 006, and 007, no more than one sample per week need be obtained.

6.2 AIR

There were no requirements for non-radiological air monitoring in 1996.

6.3 GROUNDWATER

A groundwater monitoring program has been in place at the SSFL site since 1984. During the investigation, 232 onsite and offsite wells have been monitored. There are 10 offsite wells near the northwest boundary. The groundwater at SSFL exists in two definable geological situations. One is the loose and consolidated alluvium on bedrock, which is termed the Shallow Zone, the other is the bedrock itself, termed the Chatsworth Formation. Moisture in the alluvium is very seasonal, wet in the rainy season and dry in the summer. Long-term deposits of groundwater, sufficient to recharge the water extraction wells at SSFL, exist in the Chatsworth Formation. The Shallow Zone has 93 wells, and the Chatsworth Formation, the indurated sandstone that constitutes the dominant aquifer underlying the facility, has 139 (including private offsite wells). In Area IV, the Upper Basin at the Former Sodium Disposal Facility (T886) was identified as a potentially chemically contaminated area, and subsurface soil samples were taken at numerous locations. Chemically and radiologically contaminated soils were removed from the T886 site. Further excavation is planned for 1997-1998.

Routine quarterly chemical and radiological monitoring of the wells is conducted according to the monitoring plan submitted to the lead agency for the groundwater program. Quarterly reports are submitted to the regulatory agencies at the end of the first three quarters. An annual report is submitted after the monitoring for the fourth quarter is completed.

Hydrogeologic studies at SSFL describe two groundwater systems at the site: a shallow, unconfined system in the alluvium (surface mantle soils) of the Burro Flats area and along the major drainage channels, and a deeper fracture controlled groundwater system in the Chatsworth Formation sandstone (bedrock). The alluvium is composed of a heterogeneous mixture of gravel, sand, silt, and clay, which are known to have hydraulic conductivities ranging from 0.1 to 100 gal/day/ft^2. Water levels in the alluvium respond to recharge resulting from precipitation and runoff, and may vary considerably between wet and dry periods.

The Chatsworth Formation is composed of well consolidated, massively bedded sandstones with interbedded layers of siltstone and claystone. The formation may be as thick as 6,000 ft at the SSFL site. The regional direction of groundwater flow in the formation is probably radially offsite toward the surrounding lowlands. The permeability of the Chatsworth Formation is very low except along open fractures. Groundwater within fractures occurs mostly under confined conditions.

The hydrogeologic environment at the SSFL site is a dynamic system. The groundwater system is recharged by precipitation migration through fractures and from unlined ponds and drainage channels. Because of the meager rainfall in the area and the relatively large variability in annual precipitation, groundwater recharge is low and may vary greatly from year to year.

Specific pathways of possible transport of contaminant-bearing groundwater along fracture zones are difficult to predict on the basis of the well data. Fracture zones vary widely in frequency and geometry. Water transmitting characteristics also vary from one location to the other as well as from one specific depth to another. Not all fractures are water-bearing. Recharge over the area may also vary over both space and time.

The solvents found in the groundwater include trichloroethylene (TCE) and its family of degradation products. The analyses results of the Area IV wells have been documented in the "Area IV (Phase III) Groundwater Investigation Report" prepared for Rocketdyne by Groundwater Resources Consultants, Inc., in December 1992, as well as in their 1996 Annual Report (Ref. 14).

The bulk of the Area IV shallow groundwater is seasonal and dependent upon rain/natural drainage patterns. The surface water sampling occurs rarely because it is rain-prompted. Documentation of these rainfall events since November 1989 has been submitted to the California RWQCB (Los Angeles area).

Three existing areas of TCE contamination in groundwater in the northwest part of Area IV were monitored in 1996. These areas are shown in Figure 6-3, where areas of suspected contamination exceeding 100 µg/L are shown in black, and areas equal to or above 5 µg/L are shown as cross-hatched. The State action level is 4 µg/L. As indicated in the figure, two of the three areas (at the north and south ends of the northwest boundary) have spread slightly offsite to the northwest. The central occurrence may also extend offsite, however, no data are available because this area is located in inaccessible terrain. The installation of nine new monitor wells in 1993-1994 detected no new offsite plumes of degraded groundwater near Area IV.

The shallow zone well RS-28, one of the two onsite wells within the TCE occurrence associated with the RMHF canyon (the northern occurence), recorded 34 µg/L TCE in May 1996. The other well, a Chatsworth Formation well (RD-30) showed 21 to 29 µg/L TCE in 1996. Both wells were installed in 1989. RD-34A, an offsite Chatsworth Formation well (shallowest well of a three-well cluster constructed in 1991), within the same occurrence showed less than 5.8 to 9.8 µg/L TCE in 1996, compared to 0.4 to 19 µg/L in 1995. RD-63, an extraction well installed in 1994 for the pilot extraction test in the area, recorded 12 to 15 µg/L TCE in 1996.

The Chatsworth Formation well (RD-7), the only well within the central contaminated area (Figure 6-3) southwest of T059, also recorded a TCE concentration of 38 to 51 µg/L in 1996 compared to 47 to 53 µg/L in 1994. Since its construction in 1986, RD-7 generally showed TCE concentrations in the 16 to 53 µg/L range with peaks ranging up to 130 µg/L.

RD-25, located southwest of T059, continued to show perchloroethene (PCE). In 1996, the well showed 27 to 29 µg/L PCE, compared to 32 to 42µg/L PCE in 1995. From 1989 to 1993, the well showed less than 1 to 39 µg/L PCE.

Three wells, a Chatsworth Formation well (RD-54A, shallowest of the three bedrock well cluster constructed in 1993) and two shallow zone wells (RS-18 and RS-54) of the southern contaminated area (Figure 6-3) near T886 at the western end of the site, recorded a significant increasing trend in TCE concentration during 1993 to 1994. TCE in RS-54 decreased from a 1994 range of 2300 to 4500 µg/L to the 1996 range of 2100 to 3200 µg/L. RD-54A, constructed in 1989, showed 360 to 477 µg/L TCE in 1996 compared to 190 to 320 µg/L in 1994. RS-18, mostly dry since its construction in 1985 to 1991, recorded an increase in TCE from 2,700 µg/L in 1993 to 3,200 µg/L in 1994. RS-18 recorded 580 µg/L TCE in 1996. RD-21 and RD-23, two Chatsworth Formation wells installed in 1989 recorded an increase in TCE from 88 to 1,600 µg/L in 1994 to 350 to 2200 µg/L in 1995. In 1996, TCE in these wells ranged from 290 to 840 mg/L. RD-33A, an offsite Chatsworth Formation well (shallowest well of a three-well cluster constructed in 1991) of the occurrence, showed 7.7 to 9.2 µg/L TCE in 1996, compared to 3.0 to 6.3µg/L TCE in 1995.

Figure 6-3. TCE Occurrences in Groundwater at SSFL, Area IV

The Interim Well Construction Plan for the most recent phase of monitor well installation and testing at SSFL started in 1993 and was completed in 1994. The Interim Well Construction Plan was approved by Cal-EPA DTSC in November 1992. Eight new Chatsworth Formation wells were constructed in Area IV and offsite northwest of Area IV with DOE funding. Six of these wells were drilled as two well clusters, each with three wells. One of these two clusters was drilled in the T886 area as required by the T886 closure. The other cluster was located offsite, down gradient and west of the RMHF area. An offsite well was also drilled down gradient of T886. The eighth well was drilled south of T886 near the Burro Flats Fault. In addition to the eight Chatsworth Formation wells, one shallow zone well (RS-54) was also completed in the T886 area. The new wells are designed to characterize the hydrogeology and water quality of known groundwater contamination, horizontally and vertically and in relation to the potential source areas. The drilling for the DOE-funded wells started in May 1993 and was completed in June 1994.

The test at RMHF included installation of an extraction well, and treatment of the extracted water in a portable carbon adsorption treatment unit. Results indicated that groundwater extraction in the test well at RMHF was effective in creating a capture zone for degraded groundwater. The capture zone extended up to 200 ft downgradient of the extraction well. Two new wells were installed for the test at T886. Cyclic pumping of one to three wells was conducted in the test at T886, an area characterized by low yield of groundwater. Extraction resumed at RMHF on an interim basis in mid-1996. Groundwater is treated by liquid-phase carbon adsorption and is released southward to the surface water collection system .

Additional remediation treatment options for Area IV degraded groundwater are under continuing consideration. These include conventional methods such as an air-stripping tower unit or a portable carbon adsorption unit or newly emerging enhanced remediation technology.

In 1995, geophysical and hydrogeologic testing was conducted at RD-7 well and vicinity. The average depth of bedrock at the site was determined to be at approximately 15 feet by a seismic survey. Hydrologic, geologic, and geophysical testing showed the presence of vertical sections in the well with hydraulic conductivity ranging from 0.029 to 0.73 feet per day.

7. ENVIRONMENTAL MONITORING PROGRAM QUALITY CONTROL

This section describes the quality assurance (QA) elements that are incorporated into the Rocketdyne radiological analysis program to ensure that data produced are as meaningful as possible.

The following elements of quality control are used for the Rocketdyne program:

1. Reagent Quality - Certified grade counting gas is used.
2. Laboratory Ventilation - Room air supply is controlled to minimize temperature variance and dust incursion.
3. Laboratory Contamination - Periodic laboratory contamination surveys for fixed and removable surface contamination are performed. Areas are cleaned routinely and decontaminated when necessary.
4. Control Charts - Background and reference source control charts for counting equipment are maintained to evaluate stability and response characteristics.
5. Laboratory Intercomparisons - Rocketdyne participates in the DOE EML-QAP.
6. Calibration Standards - Counting standard radioactivity values are traceable to NIST primary standards.

7.1 PROCEDURES

Procedures followed include those for sample selection; sample collection; packaging, shipping, and handling of samples for offsite analysis; sample preparation and analysis; the use of radioactive reference standards; calibration methods and instrument QA; and data evaluation and reporting.

7.2 RECORDS

Records generally cover the following processes: field sample collection and laboratory identification coding; sample preparation method; radioactivity measurements (counting) of samples, instrument backgrounds, and analytical blanks; and data reduction and verification.

Quality control records for laboratory counting systems include the results of measurements of radioactive check sources, calibration sources, backgrounds, and blanks, as well as a complete record of all maintenance and service.

Records relating to overall laboratory performance include the results of analysis of interlaboratory cross-check samples and other quality control analyses; use of standard (radioactive) reference sources; and calibration of analytical balances.

7.3 QUALITY ASSURANCE

Rocketdyne participates in the DOE Quality Assessment Program (QAP) operated by the Environmental Measurements Laboratory (EML) in New York for radiological analyses. During 1996, two sets of samples were distributed: QAP-XLIV and QAP-XLV (Refs. 15 and 16). In 1994, EML analyzed the QAP historical data for air filter, soil, vegetation, and water samples from 1982 through 1992 to generate representative control limits for the performance evaluation of analytical services. The individual data values reported by the participating laboratories were normalized to the EML reference value, and the normalized values were grouped into percentiles. The middle 70% of all historical reported values (from the 15th to 85th percentile) was established as Acceptable and the next 10% on both sides of the 70%--the 5th to 15th and 85th to 95th percentiles--as acceptable with Warning. Results outside this 90% band were considered Not acceptable.

Results of Rocketdyne (RD), DataChem (DC), and the DHS analyses, and the average for all laboratories, are shown in Figure 7-1 for QAP-XLIV and QAP-XLV. (DHS results for QAP-XLV were not reported in the program documents.) Although these comparisons involve sample types, geometries, and analyses that are not part of the routine procedures at the Rocketdyne laboratory, historical review of the Rocketdyne results and those of the other laboratories has generally shown a similar level of quality. This remains the case for the present results for water samples for QAP-XLIV and QAP-XLV, and for soil and vegetation samples for QAP-XLV. Differences with the other laboratories are noted, however, in the air samples for both QAP-XLIV (30% acceptance) and -XLV (18% acceptance), and in the soil and vegetation samples for QAP-XLIV where all Rocketdyne results were outside the acceptable and acceptable-with-warning boundaries.

The QAP soil and vegetation samples (200 g and 100 g, respectively) are significantly smaller than the typical 600 g sample size used at Rocketdyne for similar analyses. In 1996, Rocketdyne succeeded in modifying the small amounts of soil, vegetation and water samples provided by the EML so that geometric effects had negligible impact on the analytical results. Additional investigation has shown that the lack of acceptable agreement in the air filter analyses is also likely to be due to a sample geometry problem. Note, however, that no quantitative air filter analyses are conducted by Rocketdyne for environmental use. All quantitative environmental air samples for the site are analyzed by outside laboratories. For the present report, soil samples and air and effluent filters were analyzed by DataChem Laboratories (Salt Lake City, Utah). The DataChem air filter results for QAP-XLIV and QAP-XLV were 59% and 29% acceptable, respectively. These values are somewhat below the averages for all laboratories.

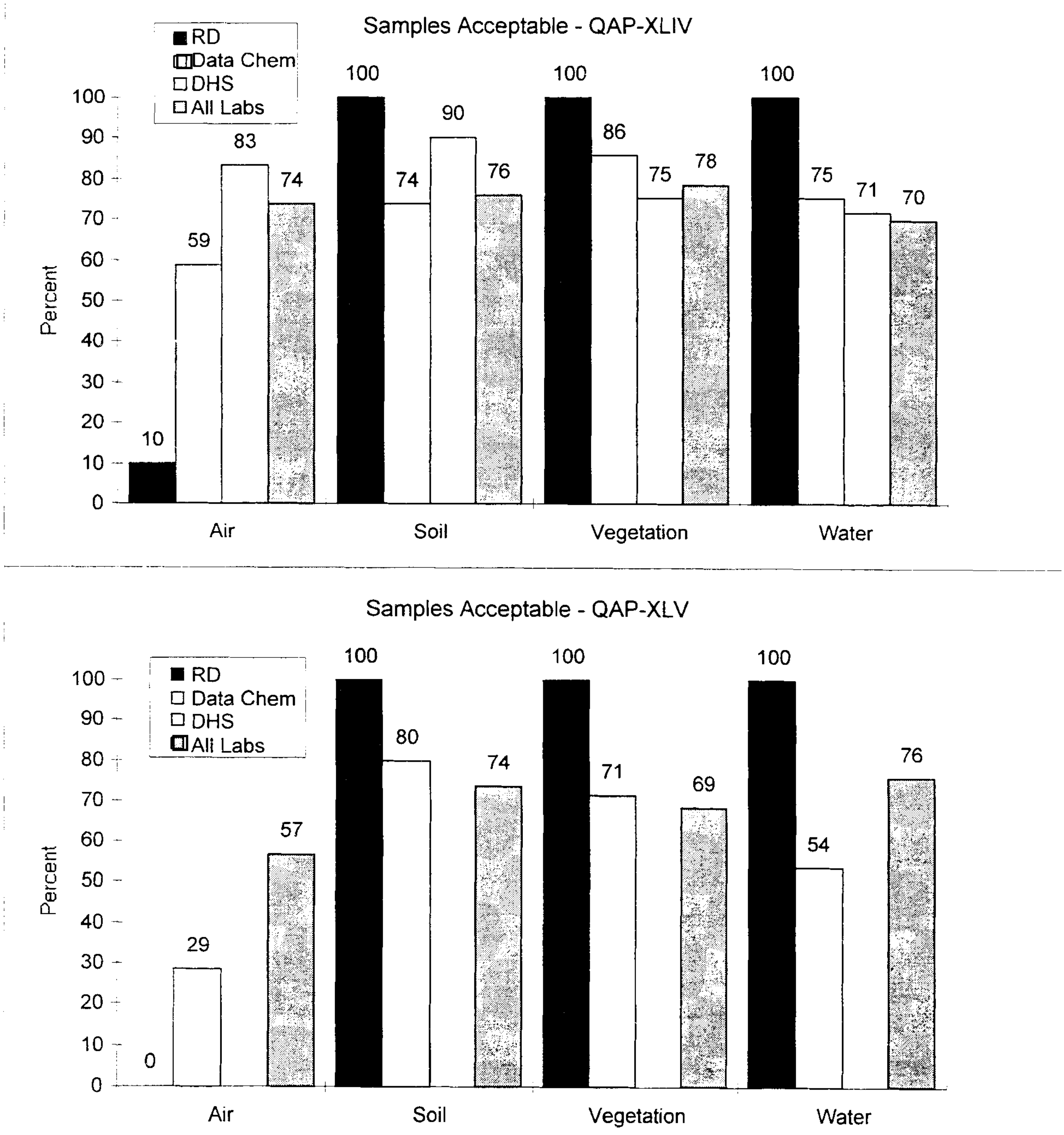

Figure 7-1. Quality Assessment Program Results for QAP-XLIV and QAP-XLV

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APPENDIX A
ACRONYMS

ACM	asbestos-containing materials
ALARA	As Low As Reasonably Achievable
ANL	Argonne National Laboratory
AOC	Areas of Concern
ASL	above sea level
ATIR	Air Toxics Inventory Report
CAA	Clean Air Act
CARB	California Air Resources Board
CCR	California Code of Regulations
CEM	Continuous Emission Monitoring
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
CRO	Community Reuse Organization
CRWQCB	California Regional Water Quality Control Board
CTC	Clemson Technical Center
CWA	Clean Water Act
CX	Categorical Exclusion
D&D	decontamination and decommissioning
DAS	Data Acquisition System
DCG	Derived Concentration Guide
DHS	Department of Health Services
DL	detectable limit
DOE	Department of Energy
DOE-OAK	Department of Energy - Oakland Office
DOE-SF	Department of Energy-San Francisco Office
DTSC	Cal-EPA Department of Toxic Substances Control
EA	Environmental Assessment
EIS	Environmental Impact Statement
EP	Environmental Protection
EML	Environmental Measurements Laboratory
EPA	Environmental Protection Agency
ER	Environmental Remediation

ERPP	Environmental Radiological Protection Plan
ETEC	Energy Technology Engineering Center
FFCA	Federal Facilities Compliance Act
FGR	Flue Gas Recirculation
FONSI	Finding of No Significant Impact
GRC	Groundwater Resources Consultants, Inc. (Tucson, AZ)
HAR	Hydrogeological Assessment Report
HEPA	high-efficiency particulate air
HMET	Hazardous Materials Elimination Team
Hot Lab	Hot Laboratory
HRS	Hazard Ranking System
HSWA	Hazardous and Solid Waste Amendments of 1984
HWMF	Hazardous Waste Management Facility
ICP	Inductively Coupled Plasma
LLD	lower limit of detection
LLTR	Large Leak Test Rig (T059)
MBAS	methylene blue active substances
MCL	Maximum Contamination Level
MGD	million gallons per day
MPC	maximum permissible concentration, air, or water
MSOP	Molten Salt Operation Program
MSTF	Molten Salt Test Facility
MWD	Metropolitan Water District
NA	not analyzed
NASA	National Aeronautics and Space Administration
ND	not detected
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NOD	Notice of Deficiency
NOI	Notice of Intent
NOV	Notice of Violation
NOx	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NS	not specified
NSPS	New Source Performance Standards

ODS	Ozone Depleting Substance
ORISE	Oak Ridge Institute for Science and Education
PAH	polynucleararomatic hydrocarbon
PA/SI	Preliminary Assessment/Site Investigation
PCB	polychlorinated biphenyl
PCE	perchloroethene
QA	quality assurance
QAP	Quality Assessment Program
QC	quality control
QAP	Quality Assessment Plan
R/D	Rocketdyne
R&D	research and development
RCP	Radiological Characterization Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RHB	Radiologic Health Branch
RMHF	Radioactive Materials Handling Facility
RMMA	Radioactive Materials Management Area
ROC	reactive organic compound
ROD	Record of Decision
ROV	Report of Violation
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SBP-1	Sodium Disposal Facility Burn Pit 1
SBP-2	Sodium Disposal Facility Burn Pit 2
SCP	Site Characterization Plan
SCTI	Sodium Component Test Installation
SHEA	Safety, Health, and Environmental Affairs
SNAP	Systems for Nuclear Auxiliary Power
SNM	Special Nuclear Materials
SPCC	Spill Prevention Control and Countermeasure
SPTF	Sodium Pump Test Facility
SRE	Sodium Reactor Experiment
SRI	Stanford Research Institute
SSFL	Santa Susana Field Laboratory

SSME	Space Shuttle Main Engine
SWPPP	Storm Water Pollution Prevention Plan
STL-IV	Systems Test Laboratory, Area IV
STP	Sewage Treatment Plant
SVOC	semi-volatile organic compound
SWMU	Solid Waste Management Unit
TBE	Teledyne Brown Engineering
TCE	trichloroethylene
TLD	thermoluminescent dosimeter
TPCA	Toxic Pits Cleanup Act
TSDF	Treatment, Storage, and Disposal Facility
UCLA	University of California, Los Angeles
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UV	ultraviolet
VCAPCD	Ventura County Air Pollution Control District
VCEHD	Ventura County Environmental Health Division
VCPWA	Ventura County Public Works Agency
VOC	volatile organic compound
WDR	Waste Discharge Requirement

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