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ROCKETDYNE DIVISION ANNUAL SITE ENVIRONMENTAL REPORT SANTA SUSANA FIELD LABORATORY AND DE SOTO SITES 1993

Prepared by the Staffs of
Radiation Protection and Health Physics Services
and
Environmental Protection

21 October 1994

Rockwell Aerospace
Rocketdyne

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1.0 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); testing 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 included development, fabrication, and disassembly of nuclear reactors, reactor fuel, and other radioactive materials, but this work was terminated in 1987. Subsequently, all radiological work has been directed toward decontamination and decommissioning (D&D) of the previously used nuclear facilities and associated site areas.

The 1993 results of radiological monitoring program indicate that there are no significant sources of man–made radioactive material in the vicinity of the Rocketdyne sites. The atmospheric discharge of radioactive materials and direct radiation exposure are the only potential exposure pathways to the general public from Rocketdyne's radiological cleanup operations. All radioactive wastes are processed for subsequent disposal at Department of Energy (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 man–made radioactivity. With the exception of low concentrations of tritium, well below Federal and State drinking water standards, only natural radioactivity has been found in this water.

Radioactivity in the facility ventilation exhausts, and in the environment, is analyzed to assess any impact of the remaining radiological–related operations on the public and the environment. Little radioactivity is dispersed by these operations and very little is released to the environment, due to highly effective filtration systems. Only small amounts of man–made radioactivity are found in the exhaust effluents. With the exception of localized areas of facility and soil contamination, only natural radioactivity can be detected in soil and vegetation samples.

Calculated radiation doses to the public, due to airborne releases and direct radiation, are a factor of 10^3 to 10^6 lower than the applicable limits as well as natural background levels.

The nonradiological monitoring program has increased in recent years, with more extensive sampling of the groundwater at the Santa Susana Field Laboratory (SSFL), and at the De Soto site. Extraction of volatile organic compounds from contaminated groundwater at SSFL is continuing and is effective in reducing remaining contamination levels and in impeding the migration of this contaminated water off–site. Surface discharges of water, after use in rocket–engine testing and other industrial purposes, are analyzed and show only minor exceedances related to turbidity and alkalinity.

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2.0 INTRODUCTION

This annual report discusses environmental monitoring at two manufacturing and test operations sites operated in the Los Angeles area by the Rocketdyne Division of Rockwell International Corporation. These are identified as the Santa Susana Field Laboratory (SSFL) and the De Soto site. These 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 is essentially light industry with some laboratory-scale R&D and has little potential impact on the environment. The SSFL site, because of its large size (2,668 acres), warranted comprehensive monitoring to assure 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.

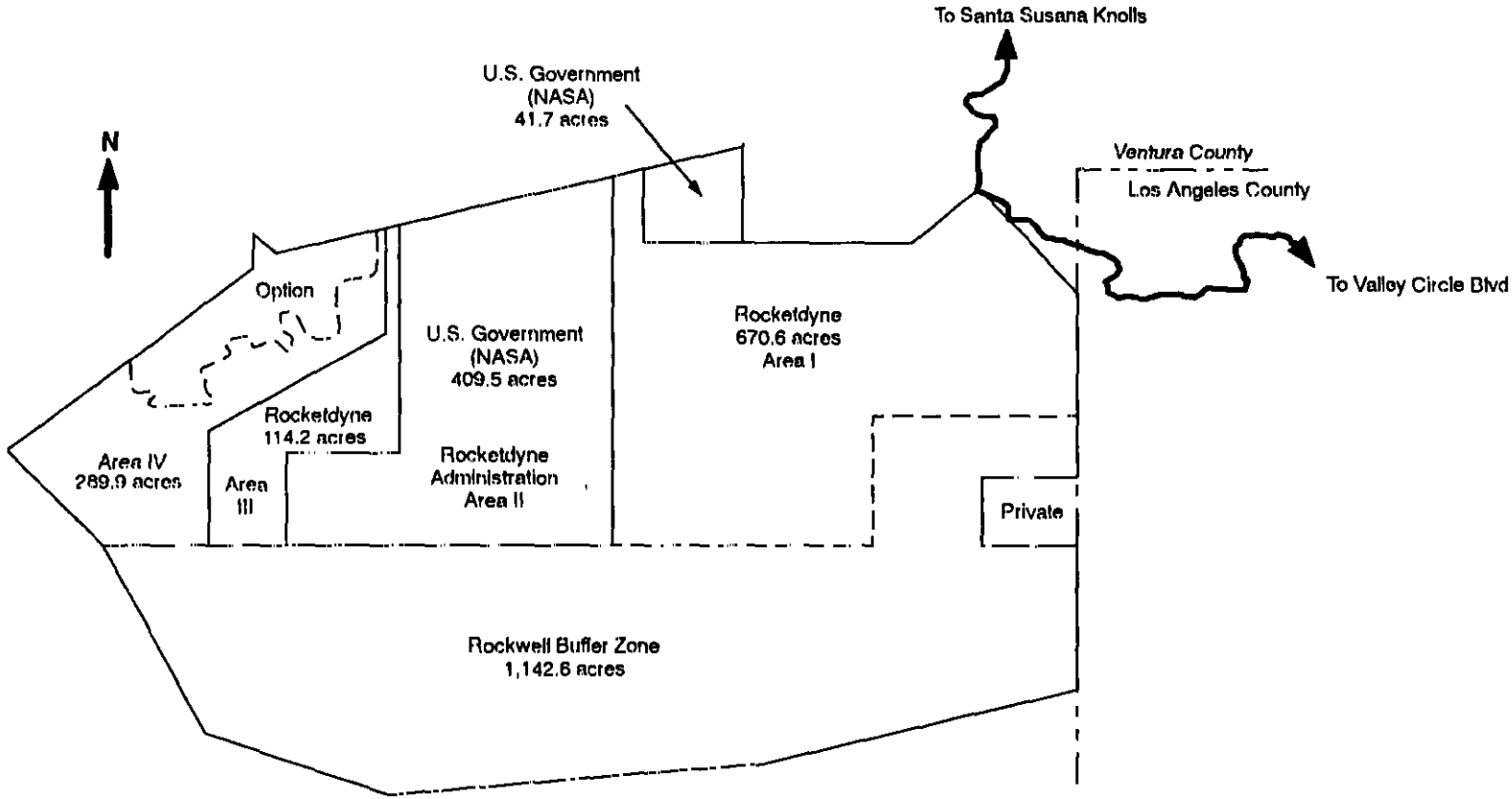
A portion of Area I and all of Area II are owned by the U.S. Government and assigned to the National Aeronautics and Space Administration (NASA). A portion of Area IV is optioned to the Department of Energy (DOE).

The purpose of this report is to present information on environmental and effluent monitoring primarily for the regulatory agencies involved in controlling environmental remediation, i.e., 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 as this is the site of the former nuclear operations. While the major area of interest is radiological, this report also includes a discussion of nonradiological monitoring at SSFL.

Areas I, II, and III have been used for developing and testing rocket engines and propellants, lasers, and other energy technologies since 1954. 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 1987 and subsequent efforts have been directed toward D&D of the former nuclear facilities.

Work in nuclear energy R&D in what has become the Rocketdyne Division of Rockwell International Corporation began 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 over the past 30 years. Most of this work was performed at SSFL and is described in detail in "Nuclear Operations at Rockwell's Santa Susana Field Laboratory—A Factual Perspective" (refer to the bibliography, Appendix B). No work with nuclear materials has been conducted since 1987, and the only work related to these operations during 1993 was the ongoing cleanup and decontamination of the remaining inactive nuclear facilities.

The nuclear operations have been conducted under State and Federal licenses and under contract to DOE and its predecessors. In October 1989, the NRC Special Nuclear Materials License was amended to permit only a minor amount of nuclear material for research purposes. Since then, the license has been further amended to permit only decommissioning operations.



Subdivisions				
Owner	Jurisdiction	Acres		Option
Rockwell	Rocketdyne Area IV	289.9	→	90.26
	Rocketdyne	784.8		
	Rockwell (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	

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Figure 2-1. Santa Susana Field Laboratory Site Arrangement

The location of these sites in relation to nearby communities is shown in Figures 2-2 and 2-3. Undeveloped land surrounds most of the SSFL site. There is occasional cattle grazing on the southern portion and some avocado groves at the northeastern boundary. 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 about 2.3 km (1.4 miles) to the southeast, and the Brandeis-Bardin Institute is 2.9 km (1.8 miles) to the north. A sand and gravel quarry was operated approximately 2.4 km (1.5 miles) to the west but is now deserted.

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.

The release of airborne material at De Soto during the summer would generally be under a shallow inversion layer. Contrary to the situation at De Soto, 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 airflow 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.

Surrounding the De Soto complex is light manufacturing, other commercial establishments, apartment buildings, and single-family houses. With the exception of the Pacific Ocean about 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 (Figure 2-4) 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 which typifies mountain areas of recent geological age. Elevations of the site vary from 500 to 700 m (1,650

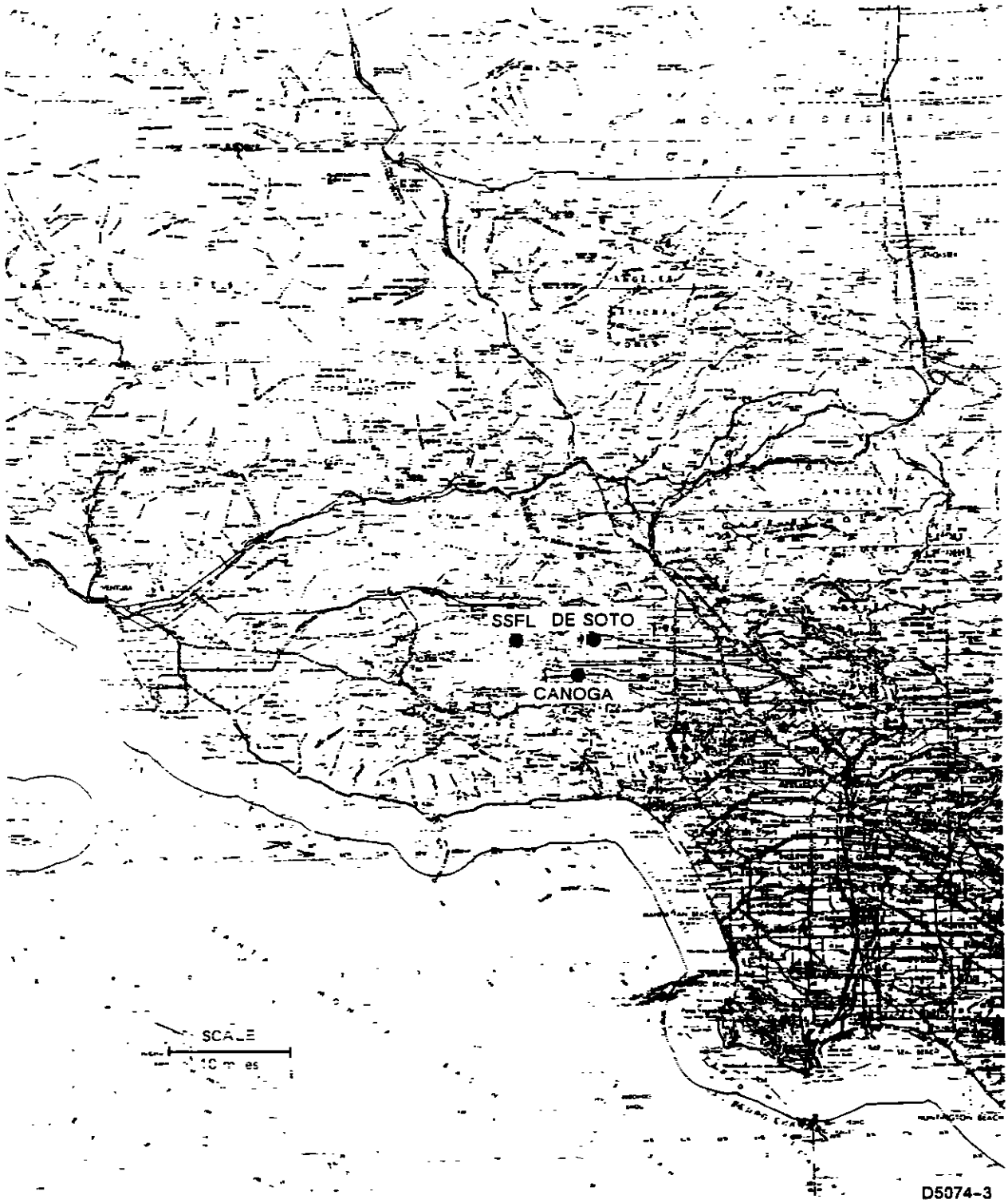

Figure 2-2. Map of General Los Angeles Area Showing Locations of Major Rocketdyne Facilities

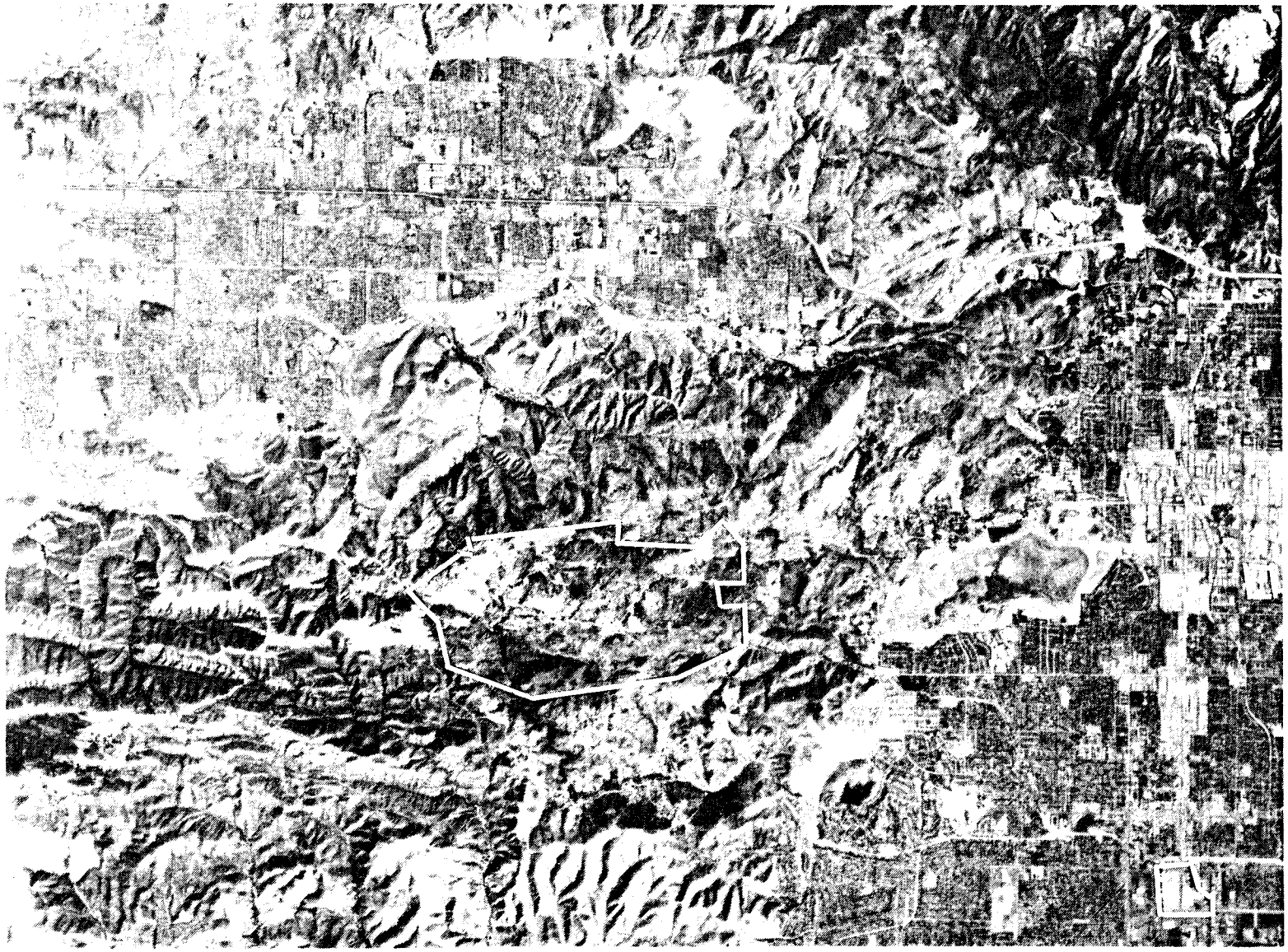

Figure 2–3. Area Surrounding SSFL (De Soto Site is Due East of SSFL, at Right Edge of Photo; Canoga Site, Lower Right Corner)

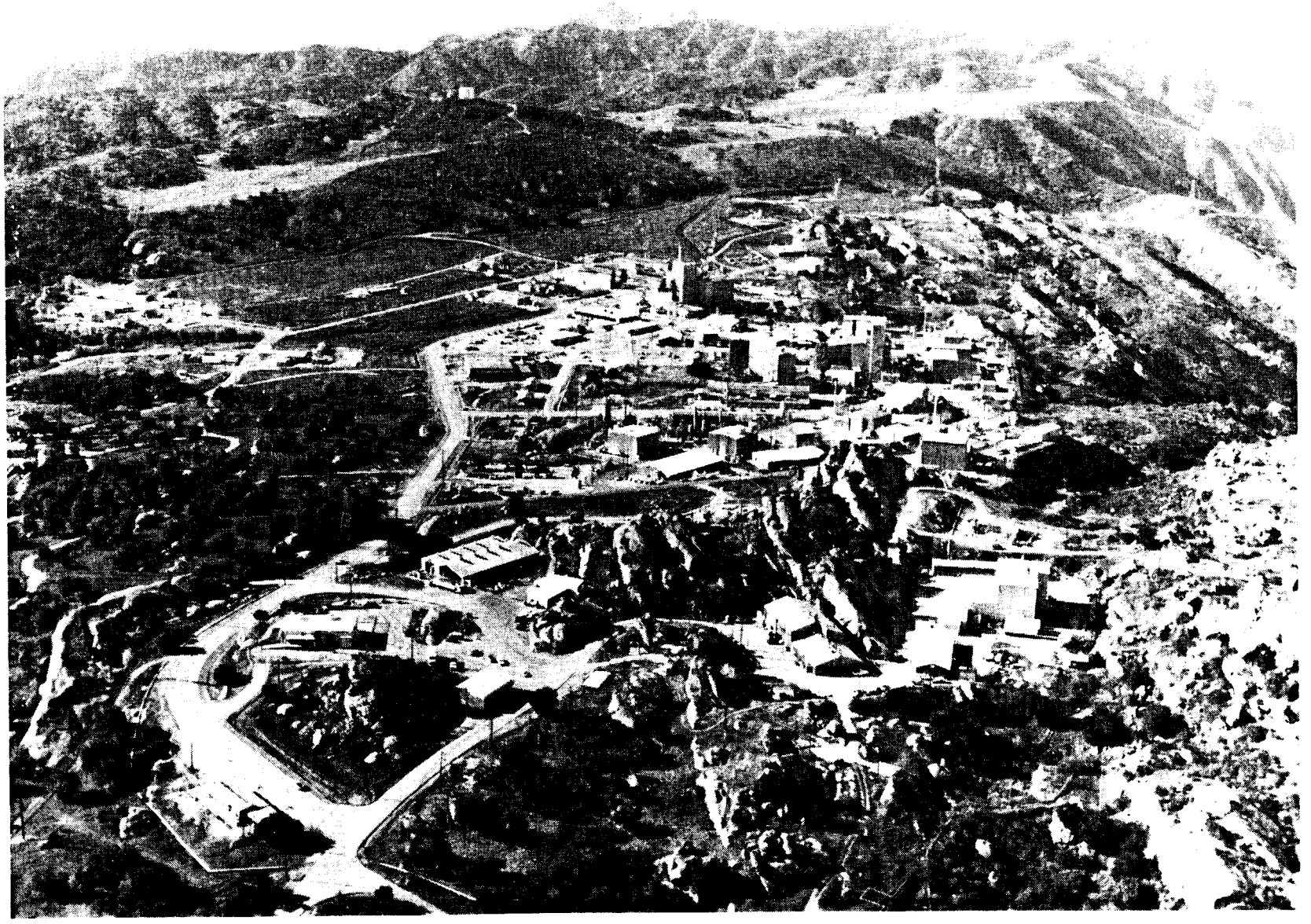

Figure 2-4. Rocketdyne Division – Santa Susana Field Laboratory Site, Area IV

to 2,250 ft) above sea level (ASL). Rockwell International– and DOE–owned facilities (Figure 2–5) share the Area IV portion of this site.

Within Area IV of the SSFL site is a 90–acre government–optioned area where DOE contract activities are conducted. Most of the work is performed by the Energy Technology Engineering Center (ETEC). The major operational nuclear installation within the DOE–optioned area is the Radioactive Materials Disposal Facility (RMDF). This facility has been used for storage of sealed irradiated fuel and for packaging radioactive wastes resulting from nuclear facility decommissioning operations. No nuclear fuel has been present at the RMDF since May of 1989 when the last packages of disassembled Fermi–reactor fuel were shipped to another DOE site. Radioactively contaminated water from 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. Work proceeded on removal of the last significant amounts of radioactive material, in the form of activated steel and concrete, in the reactor test vault of Building 059.

Sealed radiation sources are used at several facilities for process monitoring. 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. The principal licensed facilities are the Rockwell International Hot Laboratory (RIHL) (Building 020) and the radiation instrument calibration laboratory.

Licensed programs conducted during 1993 were directed toward D&D of the RIHL, which was last used for nuclear reactor fuel disassembly in 1987.

Some research licensed by the State of California using radioactive materials is conducted at the De Soto site (Figure 2–6) in the Building 104 Applied Nuclear Technology laboratories and in the Gamma Irradiation Facility. The De Soto location is at an altitude of 267 m (875 ft) ASL.

2.1 FACILITY DESCRIPTIONS

2.1.1 Santa Susana Field Laboratory Site

2.1.1.1 RIHL—NRC and California State–Licensed Activities

Operations at Building 020 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 Building 020 was shut down in 1989, only decontamination of the facility was performed in 1993. No radioactive liquids are released from the facility. Prior radioactive material handled in unencapsulated form in this facility included the following radionuclides that are present in minor amounts as facility contamination: U, Pu, as constituents in the various fuel materials; and Cs–137, Sr–90, and Pm–147 as mixed fission products.

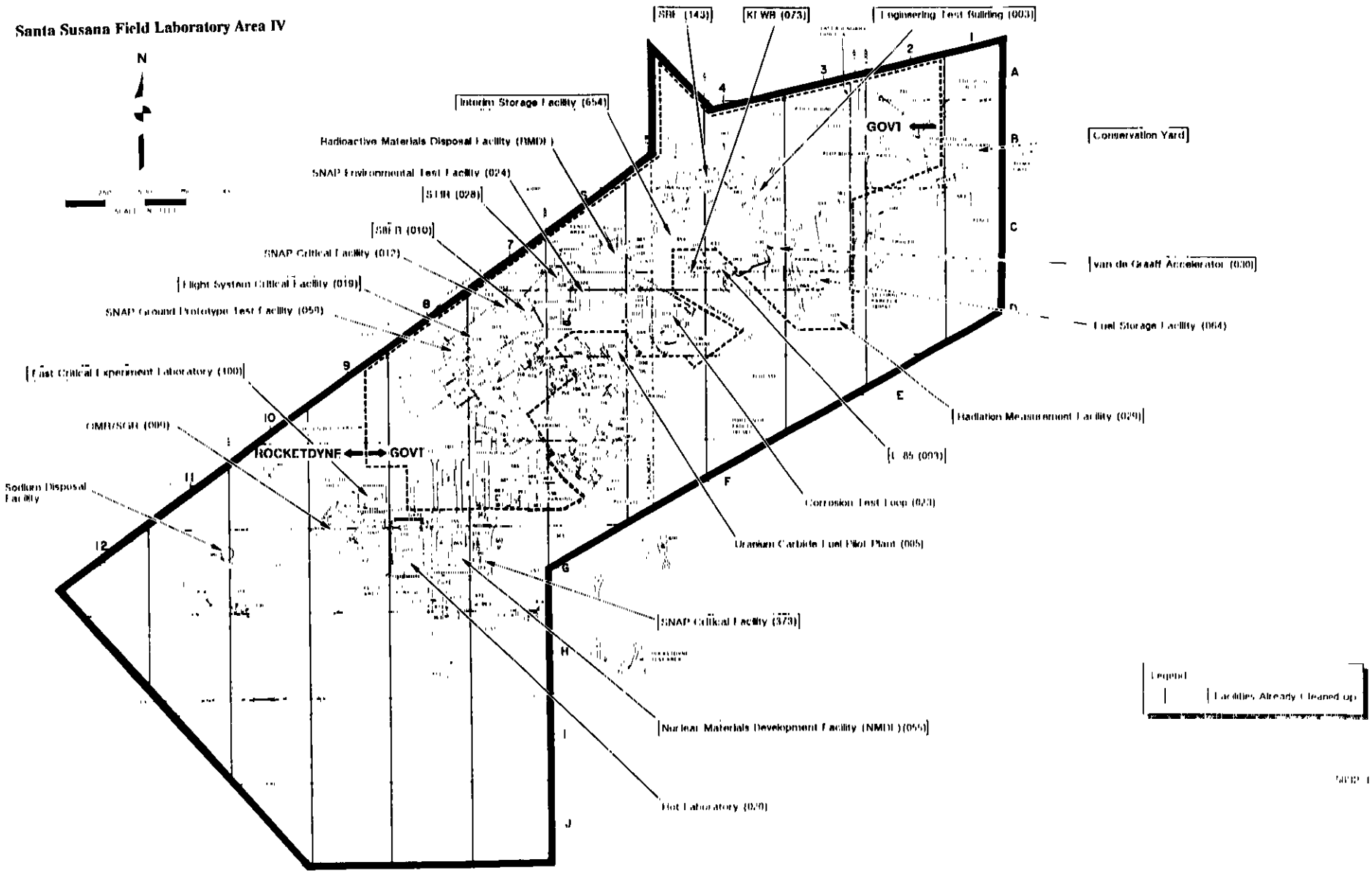

Figure 2–5. Map of Santa Susana Field Laboratory Area IV Facilities

Figure 2-6. Rocketdyne Division – De Soto Site

2.1.1.2 *DOE Contract Activities*

RMDF

Operations at Buildings 021 and 022 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 building 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, Sr–90, and Pm–147 as mixed fission products, and Co–60 and Eu–152 activation products.

Building 059

Operations at Building 059 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. Only filtered atmospheric effluents are released from the building to uncontrolled areas. No radioactive liquid waste is released from the facility. Activation products consist primarily of Fe–55 and Co–60, some minor amounts of Eu–152, and minimal amounts of H–3.

Buildings 005, 023, and 064

Buildings 005, 023, and 064 underwent D&D activities in 1993. Final surveys have been completed. ETEC is awaiting independent verification surveys by the Oak Ridge Institute for Science and Education.

2.1.2 De Soto Site

2.1.2.1 Building 104—California State–Licensed Activities

Operations at Building 104 that could have generated radioactive effluents consist of research studies in applied physics and physical chemistry. Only minimal quantities of filtered atmospheric effluents are released from the building to uncontrolled areas. No liquid effluents are released. The encapsulated Co–60 sources in the Gamma Irradiation Facility were transferred to Neutron Products of Maryland and J. L. Sheperd and Associates of California in June 1994. All irradiation operations were terminated. The mass spectrometer laboratory continues to analyze low–level activated test samples for universities and national laboratories.

2.1.3 Canoga Site

Insufficient quantities of radioactive materials are used at the Canoga facility to warrant environmental monitoring. Radioactive materials at the Canoga facility are exempt quantities of C–14, Sr–90, and Ru–106. The C–14 is embedded in solid ceramic insulator tubes used in the Peacekeeper Stage IV ordnance firing unit switches. The strontium and ruthenium are encapsulated as sealed sources for a beta–backscatter analysis instrument for measuring material plating thickness.

3.0 COMPLIANCE SUMMARY

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

3.1 COMPLIANCE STATUS

3.1.1 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides for the cleanup and emergency response for hazardous substances released into the environment. The Superfund Amendments and Reauthorization Act (SARA) extended and revised CERCLA. SARA provides for emergency planning and preparedness, community right–to–know reporting, and toxic chemical release reporting. SARA requires a facility owner or operator to report hazardous substance releases to specific authorities, depending on the materials.

CERCLA was amended and strengthened by SARA in 1986. SARA adds provisions unrelated to preexisting CERCLA provisions. Title III of SARA created extensive hazardous material reporting, community right–to–know and emergency response planning provisions. ETEC fully complies with SARA Title III. The SSFL Hazardous Materials Release Response Business Plan and Inventory was issued to Ventura County Bureau of Fire Protection on 13 December 1993, addressing the following SARA Title III provisions:

1. Planning Emergency Response (Sections 301–303)
2. Reporting Leaks and Spills (Sections 304–305)
3. Reporting Chemical Inventories (Sections 311–312).

SARA Title III also addresses reporting releases of toxic chemicals (Section 313). Rocketdyne annually submits a Section 313 report to the Environmental Protection Agency (EPA) for toxic chemicals handled at ETEC facilities exceeding the reporting threshold quantity of 10,000 lb. In 1993, ETEC used ammonia and sulfuric acid exceeding the threshold quantity. Preliminary data for the toxic release inventory were submitted to the DOE. A final report was provided to the DOE by 26 June 1994. The DOE submitted the final report to the EPA by 1 July 1994.

A Preliminary Assessment/Site Investigation (PA/SI) review of Area IV dated 11 August 1989 and transmitted to the ETEC on April 1990 was conducted by the EPA Site Evaluation Section. Prior to ranking the facilities, the EPA had requested additional air monitoring be provided for SSFL. Rocketdyne submitted the last quarterly status report in June 1992. The EPA has contracted an outside contractor, PRC Inc., to assist in the ranking of the facilities. There was no activity on this in 1993.

3.1.2 Resource Conservation and Recovery Act

The RCRA gives the EPA broad authority to regulate the treatment, storage, and disposal of hazardous wastes. ETEC Area IV has 16 underground storage tanks, 3 radioactive water, 11 sodium, 1 NaOH, and 1 fuel tank plus 4 above ground tanks for caustic and acid that have been previously permitted by the Ventura County Environmental Health Division (VCEHD). In 1991, VCEHD removed these tanks from the permitting process. ETEC and VCEHD have been reviewing the tank histories and the permit requirements as they pertain to these tanks. The three radioactive water storage tanks will be exempt from permitting by the VCEHD per Article 2, Section 2621.a.11, Exemptions, California Underground Storage Tank Regulations, which states "Tanks containing radioactive material that are regulated by another Federal, State or Local Agency." The DOE is the lead agency for tanks containing radioactive material. The 11 sodium tanks were permitted by VCEHD in 1993.

There are two RCRA-permitted Treatment, Storage, and Disposal Facilities (TSDFs) owned by DOE and operated by Rocketdyne at SSFL. The Radioactive Materials Disposal Facility (RMDF) is an interim status facility. The Hazardous Waste Management Facility (HWMF), Buildings 133 and 029, is a fully permitted facility.

The Part B permit for the B133 and B029 facilities was accepted by DTSC in 1993. Regional Permit No. 93-3-TS-002 was issued and became effective 30 November 1993. The expiration date of the permit is 30 November 2003.

Characterization of the groundwater at the site continues. In 1991, six monitoring wells were constructed less than 200 feet off-site and northwest of Area IV that indicate the presence of trichloroethylene (TCE) at concentrations exceeding the drinking water standard.

Rocketdyne submitted the Sampling and Analysis Plan (SAP) for the SSFL groundwater monitoring program to Cal-EPA DTSC on 1 March 1991.

The next phase of the groundwater site characterization program, "Proposed Interim Well Construction Plan," was prepared and submitted to DTSC in August 1992. DTSC approved the plan in November 1992. This plan proposed the construction of 48 new wells, 8 of which are located in Area IV. In 1993, four of these eight wells were installed. One of them is to assess hydrologic and water quality conditions along the Burro Flats Fault, south of the Former Sodium Disposal Facility. The rest of the wells were drilled within the Former Sodium Disposal Facility area. The remaining four wells, to be drilled at off-site locations, will be completed by the summer of 1994. An extra well (RS-54, shallow zone), beyond the scope of the 1992 plan, was also completed in 1993. Well RS-54 is located in the Lower Pond of the Former Sodium Disposal Facility (Building 886)

3.1.3 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, the DOE assures that appropriate NEPA milestones (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. The DOE has implemented the NEPA as defined in Federal Register Volume 57, Number 80, pages 15122 through 15199.

ETEC subjectively 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. In Calendar Year 1993, ETEC submitted eight requests for NEPA determinations (see Appendix C). All eight were issued as "Categorical Exclusion" determinations. ETEC has either requested NEPA determinations for projects planned for Calendar Year 1994 or is in the process of assessing the environmental effects of the projects in preparation for making a submittal.

3.1.4 Clean Air Act

The Clean Air Act (CAA) resulted in federal regulations that set air quality standards and require state implementation plans, National Emissions Standards for Hazardous Air Pollutants (NESHAPs), New Source Performance Standards (NSPS), and monitoring programs in an effort to achieve air quality levels that improve 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. VCAPCD Rules and Regulations incorporate, by reference, NESHAPs regulations as codified under the CAA.

3.1.4.1 Radiological

The results of radiological environmental monitoring indicate that there are no significant releases of man–made radiological material from Rocketdyne sites. Atmospheric discharge of radioactive materials and direct exposure are the only significant pathways to the general public from Rocketdyne's environmental remediation and waste management operations.

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 the use of high–efficiency particulate air (HEPA) filters, and are continuously monitored by sampling the workplace air and the exhaust effluent. Radionuclide–specific analyses determine the radioactive composition of the effluents, and maximum off–site doses at the nearest residence are estimated by use of the EPA computer program CAP88–PC. The maximum individual annual exposure was estimated to be 1.1×10^{-6} mrem/yr for DOE operations at ETEC. Operations at the Rockwell International Hot Laboratory (RIHL) and the De Soto site were estimated to have resulted in 4.1×10^{-6} mrem/yr and 1.3×10^{-6} mrem/yr, respectively. All effective dose equivalents for the maximally exposed individual are far below the EPA NESHAPs limit of 10 mrem/yr as specified in 40 CFR 61, Subpart H (DOE facilities) and Subpart I (licensed facilities).

3.1.4.2 Nonradiological

The HWMF (formerly the STF), Kalina Plant, Sodium Pump Test Facility (SPTF), Molten Salt Test Facility (MSTF), Sodium Component Test Installation (SCTI), and wipe cleaning operations, as well as offsets for ETEC's Area I bowl area were combined into one permit. The new permit was issued 13 October 1993 and renewed for 1 January 1993 to 31 December 1993.

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 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 31 December 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. An extension of the variance to 30 November 1994 has been granted. Since ETEC was operating under Variance 392–3, until the Rule 74.15 is modified or 30 November 1994, whichever comes first, VCAPCD may not issue the renewal permit until that time. VCAPCD has assured ETEC that ETEC is not in violation as long as VCAPCD is reviewing the permit renewal.

On 9 February 1993, the VCAPCD conducted an annual permit inspection for the site. There were no Notices of Violation issued from this inspection. Additionally, the VCAPCD conducted an on–site visit on 7 April 1993 to evaluate SCTI in preparation of modifying VCAPCD Rule 74.15.

Rocketdyne submitted a Trip Reduction Plan to the VCAPCD on 14 July 1993 to meet the requirements of District Rule 210, Employee Commute Options. The District approved the Rocketdyne plan on 21 September 1993.

Title V of the Clean Air Act requires issuance of a federal permit for the SCTI. VPAPCD met its initial responsibility by issuance of Rule 33, Part 70 Permits. However, the EPA has made the decision to redraft the Title V federal facility permitting rule due to lawsuits filed by local air pollution control districts and other interested parties. Since the EPA has not approved Rule 33, the compliance timetable for application submittal and permit issuance has not been implemented.

Although ETEC has little or no ozone depleting substances (ODSs), Rocketdyne has for years maintained a Hazardous Materials Elimination Team (HMET) to eliminate ODSs at Rocketdyne. This multifunctional team has as its charter to identify suitable alternatives for various toxic chemicals and has been instrumental in eliminating CFC–113 from all of Rocketdyne's Southern California manufacturing operations.

The AB2588 Air Toxics Inventory Report (ATIR) was submitted on 1 March 1993 and was approved by the VCAPCD on 15 April 1993. SSFL, Area IV was listed as a low priority risk on 24 August 1993 and thus no Health Risk Assessment was required.

The California Air Resources Board (CARB), in its role of supporting local air pollution control districts, visited SCTI on 10 and 11 August 1993 to audit Rule 74.15 emission compliance by monitoring NOx and CO emissions from the H–1 and H–2 sodium heaters and the H–101 boiler. The CARB Continuous Emission Monitoring (CEM) system stack test showed that all rule requirements for NOx (40 ppm) and CO (400 ppm) levels were being met.

The CEM system in use at SCTI experienced difficulties during 1993. A software failure occurred on 3 April 1993 and troubleshooting disclosed a failed relay and control board that were then replaced, correcting the problem. On 12 and 22 June 1993 the CEM system KVB Comptrol 1000 oxygen signal was observed to be reading zero. When the Comptrol 1000 was reset, the reading was corrected. Investigation found all gas

flows and monitoring readings to be normal and no exceedances of NOx and CO emissions occurred from either heater during the event. An outside CEM expert was brought in to analyze and correct the problem.

A permit application was submitted to VCAPCD for an ethanol cleaning operation located at the Sodium Pump Test Facility (Building 463). The application has been deemed incomplete until adequate reactive organic compound (ROC) offsets are provided, which is in process.

An application was also submitted 17 May 1993 to VCAPCD to permit contaminated soil treatment equipment, known as "X–TRAX." The equipment was intended to treat low–level mixed waste soils. The application was allowed to lapse when the decision was made not to proceed with the project.

3.1.5 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 to navigable waters, the preparation of Spill Prevention Control and Countermeasure (SPCC) plans, and the discharge of stormwater runoff associated with industrial activities.

As part of the SSFL, ETEC surface water discharges are regulated under the California Water Code (Division 7) as administered by the California Regional Water Quality Control Board (CRWQCB). The existing SSFL NPDES Permit (CA0001309), which was revised and became effective 17 December 1992, is expected to remain in force through 10 November 1997.

During periods of rainfall which create adequate runoff for sampling, grab samples of rain water runoff are collected at the discharge points for the perimeter pond, pond R2A, and the five stormwater catch basins along the northwest slope. When rainfall occurs more than once a week or continuously, samples are taken weekly. During non–rain event discharges from the perimeter pond and pond R2A 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.

Currently, Rocketdyne staff is negotiating with the CRWQCB to eliminate existing Waste Discharge Requirements (WDRs) stemming from a 1959 permit for septic tanks and leach fields.

Additionally, inland surface water quality objectives are established for effluent standards for off–site discharge of storm and industrial wastewater via the SSFL reclamation system. As part of the permit requirements, the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) is required. This living document is revised as needed and includes by reference many existing pollution prevention plans, policies, and procedures. The revised NPDES Permit incorporated federal storm water regulations by requiring development and implementation of a site–wide SWPPP by 7 February 1993. An initial plan was prepared that includes by reference many existing pollution prevention plans, policies, and procedures implemented at the SSFL site. Several key elements of the plan are in the process of being updated, including the required maps. These maps will be completed pending the completion of new baseline facility topographic maps. Another key element also in the process of being updated is the development and implementation of Environmental Control Manual Procedure EC03.50 "SSFL Storm Water Pollution Prevention Requirements."

3.1.5.1 Radiological

All liquid radioactive wastes are processed for 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 man–made radioactivity.

At SSFL, a large number of groundwater monitoring wells are sampled and analyzed periodically and no indication of man–made radioactivity has been found, with the exception of low levels in a localized area (maximum of 1,119 pCi/L) of tritium, considerably below the Federal and State standard for drinking water supply limit of 20,000 pCi/L.

The french drain is sampled weekly at Building 059 as part of the groundwater management program. This inactive facility was previously used for SNAP program reactor testing. These samples are tested for any transfer of gamma–emitting activation products from the underground reactor test vault containment into the surrounding soil by gamma spectroscopy. Activated materials include Co–60 and Eu–152, both of which are easily detected, and none has been found.

Surface water from two NPDES discharge points and five storm water runoff catch basins were also monitored. The Rocketdyne NPDES permit requires radiological measurements of gross alpha, gross beta, tritium, Strontium–90, Radium–226, and Radium–228. No NPDES samples exceeded drinking water limits.

3.1.5.2 Nonradiological

Throughout Calendar Year 1993, discharges associated with the SSFL NPDES permit were for the most part in compliance with discharge standards. Incidents of noncompliance that did occur revolved around the operation of two on–site sewage treatment plants. The Area III sewage treatment plant, which receives waste from Area IV, experiences relatively minor instances of noncompliance with average turbidity standards, and coliform. These instances of noncompliance were attributed to severe rainfall affecting the plant operations and reducing treatment efficiency. No NOVs were issued nor penalties assessed for 1993 relative to NPDES discharge requirements.

3.1.6 Miscellaneous

3.1.6.1 U.S. DOE Tiger Team Assessment

ETEC has submitted a proposal to the DOE to consolidate all remaining action plans as part of normal ETEC management practices. This proposal is under review by the DOE. The status of the 33 action plans that ETEC has lead responsibility is shown in Table 3–1.

3.1.6.2 Building 886 Former Sodium Disposal Facility Closure Order

The Building 886 Former Sodium Disposal Facility was used for removing sodium and sodium–potassium alloys from metal components. The site is listed as a Solid Waste Management Unit (SWMU) with Cal–EPA. In 1992, roughly 7,000 yards of soil were removed from the lower pond, and this portion of the facility was removed from the Toxic Pits Cleanup Act (TPCA) list. Excavation of the upper pond and

Table 3–1. Status of Environmental Corrective Action Plans

Plan Number	Plan Title	Status*
AP001	Upgrade T059, T020, RMDF Stack Sampling System	W
AP002	Meteorological Data for AIRDOS–PC Code	W
AP003	Provide Compliant Ambient Air Sampling Program	E
AP004	*Inadequate Physical Control of the Former Sodium Disposal Facility*	C
AP005	Storm Water and Sediment Characterization – Northwest Area	C
AP006	ID and Implement Secondary Containment	C
AP007	Revisions to the SPEC and the FSCP	C
AP008	Drinking Water Monitoring	C
AP009	Sewage Collection System Investigation and Repair	F
AP010	Groundwater Protection Management Plan	C
AP011	Characterization and Monitoring of Vadose Zone Underlying B/886	C/R
AP012	Hydrogeologic Regime Characterization	C
AP013	Well Monitoring/Maintenance/Abandonment/Closure/Decommissioning	C
AP014	Decontamination of Sampling Equipment Document	C
AP015	Organic Vapor Monitoring Program	C
AP016	Waste Minimization Plan	T
AP017	Storage of Land Disposal Restricted Waste (LDR) Mixed Waste	C
AP018	*Waste Verification Plan – RMDF and HWSA*	F
AP019	Sewage Sludge Monitoring Plan	F
AP020	Incomplete Hazard Identification	T
AP021	Storage of Incompatible Chemicals	C
AP022	Quality Assurance Surveys of Vendor Analytical Laboratories	C
AP023	ETEC QA Surveillance and Audit of Rocketdyne Analytical Laboratory	C
AP024	Environmental Records QA	C
AP025	Pollution Prevention Awareness Program Plan	P
AP026	Development and Implementation of Environmental Monitoring Plan	E
AP027	Environmental Protection Implementation Plan Evaluation	E
AP028	Evaluation of Source Terms and Meteorological Data	C
AP029	Environmental Surveillance Plan	E
AP030	No Contingency Plan for Transuranic Waste	C
AP031	Procedure for Surveys of Radioactive Materials Shipments	C
AP032	*Site Investigation/Remedial Activities Plan*	C/R
AP033	Business Plan Amendment Document and Acutely HAZMAT Registration	Q

* – Status Codes

- C – Complete and closed out by DOE/OAK
- C/R – Complete and recommended for closure
- E – Will be complete upon funding of Environmental Monitoring Plan
- F – DOE funding required to complete
- P – Funding required to implement pollution prevention awareness program
- Q – Milestones complete except ongoing QA surveillance, recommended closeout
- T – Milestones complete except ongoing training, recommended closeout
- W – DOE funding required to complete, waiver of requirement recommended to DOE.

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portions of the western area was completed in 1993. A geophysical survey of the site was also completed in 1993.

In May and June 1993, samples were taken from the area for chemical and radiological analysis. The chemical analysis indicated the presence of residual contaminants in the excavated region. The results from the radiological analysis showed no constituents above background levels.

A systematic sampling of the Former Sodium Disposal Facility and surrounding area is expected to be conducted before the end of FY 1994. A health based risk assessment will then be performed. Further excavation at the facility will occur if the risk assessment determines the soils a risk to human health or the environment.

Previously excavated contaminated soil will be shipped to disposal sites during late spring and summer of 1994.

3.1.6.3 Public Participation

Ongoing quarterly meetings of the EPA–organized SSFL Work Group, consisting of representatives of various regulatory agencies and several legislator–appointed community representatives, were supported with information regarding environmental monitoring, both radiological and nonradiological, and remediation activities. Similarly, a meeting of DOE Stakeholders and a public permit hearing were attended and supported by appropriate staff members.

ETEC and Rocketdyne met with neighboring homeowner groups to provide information about current operations and environmental programs, including site monitoring and cleanup activities.

Rocketdyne is working with local colleges and universities, providing field studies in environmental technology to give students an opportunity for hands–on experience with current environmental monitoring and sampling techniques. In addition, they had the opportunity to work with the chemist performing environmental analytical methods in a state–certified analytical chemistry laboratory environment.

Two guided bus tours of SSFL including ETEC were provided for the public during 1993. These tours were available to interested persons by reservation and covered the entire SSFL site. A total of 150 residents, primarily from local communities surrounding the SSFL facility, participated in these tours. The visitors were provided with a presentation about current site activities and environmental monitoring and remediation activities. Representatives from the various program and functional areas were available to answer questions following the formal presentation. In addition to the formalized public tours, a tour of the SSFL site was provided to the California Historical Society.

The public and media were invited to observe agency sampling to confirm completion of the excavation activity at the Former Sodium Disposal Facility.

Rocketdyne's Environmental Affairs department continues to respond to weekly calls concerning environmental issues and remediation activities at the SSFL including the ETEC site.

3.1.6.4 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. The external exposure from direct radiation at the maximum exposed boundary location for ETEC and the SSFL was estimated to correspond to an average annual dose of about 40 mrem above natural background. A similarly calculated value of 0.0002 mrem/yr was found for the nearest residence. These values are considerably below the DOE long–term limit of 100 mrem/yr. There was no noticeable man–made radiation exposure from the De Soto facility at the site boundary and the nearest neighbor. The average of the site dosimeters was less than that of off–site dosimeters used to determine background. Also, maximum quarterly readings were the same for the De Soto facility and the off–site dosimeters.

3.1.6.5 U.S. DOE Environmental Appraisals

Two environmental appraisals were performed by the DOE in 1993. An Environmental Restoration Waste Management audit was performed 17 August 1993. The audit identified waste containers with improper or faded labels. An Environmental Functional Appraisal was performed 1 through 5 November 1993. The first finding stated that the ALARA (As Low As Reasonably Achievable) program did not address all factors and issues defined in the DOE Guidance on the Procedures in Applying the ALARA Process for Compliance with DOE Order 5400.5, primarily environmental considerations. The appropriate Rocketdyne document was revised 15 December 1993. The second finding, the need to develop and update procedures for laboratory analysis using the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH–0173T). is currently being addressed.

3.2 CURRENT ISSUES AND ACTIONS

3.2.1 Environmental Monitoring and Site Characterization

The DOE–OAK self–assessment, the ETEC self–assessment, and the Tiger Team assessment acknowledged the requirement for Rocketdyne to prepare an environmental monitoring plan (for both radiological and nonradiological monitoring) and for DOE–OAK to provide funds for the preparation of such a plan to meet the requirements of DOE Orders 5400.1, 5400.5, draft 10 CFR 834, and DOE/EH–0173T. A comprehensive plan was approved by the DOE on 7 March 1994. ETEC also prepared a comprehensive Radiological Characterization Plan (RCP). Procedural plans for the RCP have been finalized with survey activities having begun 1 March 1994. The impending cessation of nuclear energy activities and funding will have no effect on the environmental monitoring program. Remediation of buildings and land will continue under funding from DOE Environmental Management.

3.2.2 Epidemiological Study

As a result of attention associated with DOE activities, the State of California legislators called for an epidemiological study of workers and local communities. The California Public Health Foundation has been awarded DOE grant funds and in February 1993 an advisory panel selected the University of California at Los Angeles (UCLA) to perform the study. The 18–month study will cover radiological and nonradiological

health effects on workers. UCLA researchers began the study January 1994 with a review of bioassay records, and compilation of external exposure records.

3.2.3 Resource Conservation and Recovery Act

Pursuant to Health and Safety Code, Section 25187, Cal–EPA, Region 3, DTSC issued on 2 December 1992 a Stipulated Enforcement Order (the Order) to Rockwell International Corporation regarding SSFL, including ETEC. A Stipulated Enforcement Order is an enforcement order issued by the State Attorney General's office in which Rockwell agrees to comply with specific terms and conditions, i.e., a Corrective Action. Noncompliance entails court action.

Under the Hazardous and Solid Waste Amendments of 1984 (HSWA), RCRA facilities are generally brought into the corrective action process when an agency is considering a permit application for the facility or when a release justifying action under Section 3008(h) is identified. The SSFL was initially subject to the corrective action process in 1989 when EPA, Region IX, and the former DHS were reviewing a Part B permit application for Buildings 029 and 133. EPA partially completed the agency–conducted RCRA Facility Assessment (RFA) and has issued an interim final on the RFA (10 July 1991). The EPA has performed the Preliminary Assessment Report (i.e., record search) and the Visual Site Inspection portions of the RFA process. However, the sampling visit step of the RFA process was not conducted by the EPA to confirm or disprove suspected releases.

The State of California has since obtained final 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 (AOC) that were identified in the RFA report. This activity is the equivalent of the sampling visit. This will enable ETEC to determine if further action and/or interim measures will be necessary for SWMUs to be incorporated into the RCRA Facility Investigation (RFI). A schedule for the RFI will be developed after completion of review and negotiation with Cal–EPA.

There are 11 SWMUs and 3 AOCs in Area IV. RFA sampling activities were conducted at Building 005 Coal Gasification and the RIHL (Building 020). Sampling results revealed that no releases have occurred from these SWMUs. The current conditions report and a draft of the RCRA Facility Investigation Workplan for the Area IV SWMUs were submitted to the DTSC by the October 1993 deadline. Currently, one SWMU, the Building 056 Landfill has been proposed for the RFI.

There was one RCRA inspection conducted by DTSC in 1993 at Buildings 029 and 133 prior to issuing the permit.

The Waste Minimization Program at ETEC operations consists primarily of recycling and reusing NaOH that is generated from the HWMF. Options are currently being investigated for the SCTI operations.

No activity was conducted for the Small–Scale Treatability Study (CA3890090001) in 1993.

ETEC reviewed 11 potential Permit By Rule units; none were required.

A request was submitted to DTSC 23 February 1993 for approval to treat mixed waste solids using thermal desorption by Clemson Technical Center (CTC). This request was denied and alternate disposal plans were explored.

3.2.4 Clean Water Act

Water quality objectives set forth by the current NPDES permit are being met on a consistent basis. However, turbidity problems resulting from broken sewage pipes allowing water infiltration, and problems with the control unit at the Area III Sewage Treatment Plant (servicing Area IV) were an issue during 1993. A large section of sewage line was replaced during 1993, and further repairs have been planned for 1994. Additionally, the control unit at the Area III Sewage Treatment Plant will be upgraded during 1994.

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 SPCC for ETEC was updated on 13 December 1993 and was submitted to all local emergency response agencies.

In response to a DOE Tiger Team finding, the Area III Sewage Treatment Plan Sewer Sludge Monitoring Plan Program was implemented 20 October 1993.

3.2.5 *Building 886 Former Sodium Disposal Facility*

ETEC is now planning further soil sampling at the site. The systematic sampling and laboratory analysis of soils from surrounding areas will provide support for the final release and closure of the site. The results will be used to justify the site closed as a SWMU or to remove further amounts of soil. Soil sampling is scheduled to begin in late 1994.

3.2.6 Permits and Licenses (Area IV)*

Air (VCAPCD)

Permit	Facility	Valid
0271	Combined permit renewal	1/1/93–12/31/93 VCAPCD reviewing requested permit changes

*Extremely hazardous waste permits are requested and granted on an as needed basis in the state of California. The extremely hazardous waste permits are issued for a one–year duration, at which time the permit expires and a new permit must be applied for when needed. The two permits 3–920624–02 and 3–920624–06 were the only active hazardous waste permits for Area IV in 1993.

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

Treatment Storage (EPA)

CAD000629972 (93–3–TS–002) CA3890090001	Hazardous Waste Management Facility (B/133 and B/029) Radioactive Materials Disposal Facility (RMDF)	11/30/93–11/30/03 Part A interim status updated 4/93

NPDES (CRWQCB)

CA0001309	Santa Susana Field Laboratory	12/7/92–11/10/97
ORDER 59–68	Subsurface Disposal SSFL (septic tanks, leach fields, and spray fields)	1959 ongoing

CAL–EPA

3–930706–05	Radioactive Materials Disposal Facility (RMDF)	6/24/93–6/24/94

Nuclear Regulatory Agency

SNM–21	Rockwell International Hot Laboratory (B/020)	Amendment 7 issued 11/7/90 ongoing

State of California

Radioactive Materials License (0015–70)	All Rocketdyne facilities	Original issue 8/29/86 Amendment 86 2/11/92–9/11/93 latest submittal under review

Well Permit (VCPWA)

3455	Santa Susana Field Laboratory (Well Permits 1808, 2138, 2322, 2328, 2331, 2342, 2916, and 3359 have been issued to install wells since 1990. Furutre wells will be installed under Permit 3455.)	Issued 7/1/93

There were 16 underground storage tanks permitted in Area IV during 1993. A list of these tanks can be found in Table 3–2.

Table 3–2. SSFL Current Underground Storage Tanks

UST	Location	Capacity (gallons)	Tank Type	Contents
UT–7	Bldg. 020	3,000	Stainless Steel Vaulted	RA water[a]
UT–15	Bldg. 022	8,000	Stainless Steel Vaulted	RA water[a]
UT–16	Bldg. 021	200	Stainless Steel Vaulted	RA water[a]
UT–20	Bldg. 826	12,000	Stainless Steel Vaulted	Sodium
UT–21	Bldg. 826	10,000	Stainless Steel Vaulted	Sodium
UT–23	Bldg. 032	5,500	Stainless Steel Vaulted	Sodium
UT–24	Bldg. 059	12,000	Stainless Steel Vaulted	Sodium
UT–29	Bldg. 356	13,000	Stainless Steel Vaulted	Sodium
UT–30	Bldg. 356	10,000	Stainless Steel Vaulted	Sodium
UT–31	Bldg. 356	10,000	Stainless Steel Vaulted	Sodium
UT–32	Bldg. 356	10,000	Stainless Steel Vaulted	Sodium
UT–33	Bldg. 356	12,000	Stainless Steel Vaulted	Sodium
UT–34	Bldg. 462	36,000	Stainless Steel Vaulted	Sodium
UT–35	Bldg. 462	34,000	Stainless Steel Vaulted	Sodium
UT–37	Area I	10,000	Metal Tank	Gasoline
UT–52	Area II–across from Alpha–Bravo Fuel Farm	12,000	Joors Plasteel	Gasoline

[a] – Regulated by California Department of Health Services (DHS) Radiological Health Branch

RA – Radioactive

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4.0 ENVIRONMENTAL PROGRAM INFORMATION

The purpose of the environmental program is to detect and measure releases of hazardous materials and identify other undesirable impacts on the environment. It includes remediation efforts to correct or improve impacted conditions at the site and prevent off-site effects. For this purpose, the environment is sampled and monitored, effluents are analyzed, and the condition and uses of the surrounding environment are reviewed. A direct goal of this program is to demonstrate compliance with applicable regulations.

The basic policy for the control of radiological and chemical hazards requires that adequate containment of such materials be provided through engineering controls and that facility effluent releases and external radiation levels be reduced to a minimum through rigid operational controls. The environmental monitoring program provides a measure of the effectiveness of safety procedures and of the engineering safeguards incorporated into facility designs. Gross alpha and beta radiation analyses are performed for screening purposes, and radionuclide-specific radiochemistry analyses are performed on representative environmental samples. Facility atmospheric effluent sample filters for 1993 were composited for radiochemistry analysis by Teledyne Brown Engineering Environmental Services.

The radiological environmental monitoring program was initiated in 1952 for nuclear operations by North American Aviation, a predecessor to the current Rockwell International organization. At that time, a program of soil and vegetation sample collection and analysis was begun to study environmental effects from nuclear research and development (R&D). This program was designed with the primary purpose of adequately surveying environmental radioactivity to ensure that operations would not contribute significantly to local radioactivity. Evolving program changes have reflected that primary objective. Environmental sampling was subsequently extended to the then proposed Sodium Reactor Experiment (SRE) site in the Simi Hills in May 1954. Sampling was also begun in the Burro Flats area, southwest of SRE. Other changes were made to the program as new facilities came into operation and as older facilities were closed. After review of the needs and results of the environmental monitoring program in 1986, sampling of vegetation for radioactivity analysis was terminated and soil sampling frequency was reduced to quarterly. This was based on reviews of the sampling program and the continuing reductions in the nuclear operations being conducted at the site. At that time, all nuclear reactors and the plutonium laboratory had been decommissioned. The reduced nuclear operations and the historical data led to the conclusion that quarterly sampling was adequate to confirm any releases of radioactivity that might occur and that would be identified by other monitoring methods. Although the reduction in the number of on-site soil samples taken annually was significant, the number of off-site soil samples was not reduced at that time. After further review of on-site and off-site soil radioactivity data, the elimination of routine off-site soil sampling as a formal part of the environmental monitoring program was done. In view of the extreme reduction in radioactivity and lack of any indication of radioactive contamination spread by routine and special surveys and inspections, routine soil sampling was terminated at the end of 1989.

Occasional gamma-spectrometry analyses of bulk 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.

5.0 ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

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 off–site into Bell Canyon to the south or it may be reused for industrial purposes.

Gross alpha and beta measurements are used for screening purposes and to permit a long–term historical record of radioactivity in the environment. For water, these measurements also permit direct comparison with the screening limits established by EPA for suppliers of drinking water. 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 dose for the air pathway. The following discussion presents a brief summary of pathway dose analysis results for SSFL and De Soto for 1993.

DOE Facilities at SSFL (Area IV)

The RMDF and Building 059 have continuous effluent monitoring. Buildings 005, 023, and 064 underwent final survey in 1993. Buildings 012 and 024 are inactive with no effluent, and thus no effluent monitoring. Airborne releases from the RMDF and Building 059 are detailed in Table 5–1, sheets 1 and 3, and are shown to be below the derived concentration guides (DCGs) of DOE Order 5400.5. Airborne and direct radiation doses from RMDF and Building 059 are detailed in Table 5–19 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.

At the site boundary line location nearest to the RMDF, the external annual exposure from direct radiation is estimated to correspond to an average annual dose of about 40 mrem, above natural background, at the nearest boundary–line location and a calculated annual dose less than 0.0002 mrem 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" (2/8/90). The boundary–line exposure is a conservative estimate of potential dose, in that the rugged terrain at the site boundary nearest the RMDF precludes anything more than the possible rare and temporary presence of any person at that location. These values were determined by calculating the exposure expected at the boundary and nearest residence on the basis of the highest annual result for area dosimeters in place around the facility. 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 off–site locations from the radiation sources. Essentially only natural background radiation inherent to the residence location would be present.

Dose calculations were performed to demonstate compliance with the NESHAPs standard. At the location of the Maximally Exposed Individual, the Effective Dose Equivalenet for DOE operations during 1993 was 1.1×10^{-6} mrem. The DOE site limit 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 area sources are comprised of the RMDF pond, the RMDF north slope, and the Former Sodium Disposal Facility. Dry sediment from the RMDF pond and soil in the RMDF north slope were subject to airborne suspension by the wind. Remediation efforts during 1993 of the Former Sodium Disposal Facility resulted in soil suspension in air.

The maximum estimated individual dose due to potential releases is 3.4×10^{-5} mrem for 1993. 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 detectable by on–site continuous ambient air sampling.

NRC Licensed Facility at SSFL (Area IV)—RIHL

Airborne releases from the Rockwell International Hot Laboratory (RIHL) are detailed in Table 5–1, sheet 2, and are shown to be below the maximum permissible concentrations (MPCs) of 10 CFR 20.106 and State of California, CCR Title 17, Section 30269. Airborne and direct radiation doses at the site boundary are detailed in Table 5–20 and are shown to be less than the dose limits of 10 CFR 20.105 and State of California, CCR Title 17, Section 30269.

Direct radiation dose at the nearest site boundary is 0.04 mrem/yr and less than 3×10^{-6} mrem/yr at the nearest residence, compared to annual NRC and State of California limits of 500 mrem/yr. Airborne effluent is a factor of 10^4 less than the isotopic MPCs of the NRC and State of California. Nearest receptor dose from airborne effluent from RIHL is 4.1×10^{-6} mrem/yr, and, though not applicable to NRC licensed facilities, this compares well with the EPA NESHAPs limit of 10 mrem/yr from 40 CFR 61, Subpart H. Even in the absence of HEPA filters the dose from RIHL would still be below the level requiring continuous monitoring; however, continuous monitoring is still being performed as a best management practice.

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 4, and are shown to be below the MPCs of State of California, CCR Title 17, Section 30269. Airborne and direct radiation doses at the site boundary are detailed in Table 5–21 and are shown to be less than the dose limits of State of California, CCR Title 17, Section 30268.

There was no noticeable man–made direct radiation dose from Building 104 at the site boundary and nearest neighbor. Analysis of the De Soto facility dosimetry resulted in an average value of 46.3 mrem/yr with a maximum of 50 mrem/yr. Off–site dosimetry used to estimate a background level showed an average value of 47.5 mrem/yr with a maximum of 50 mrem/yr. Airborne effluent from Building 104 was a factor of 10^4 less than the isotopic MPCs for the State of California. Nearest receptor dose from airborne effluent was 1.3×10^{-6} mrem/yr, which is less than the EPA NESHAPs limit of 10 mrem/yr from 40 CFR 61, Subpart I.

In the tables that follow, the data are generally presented in an uncensored manner. That is, analytical results that were less than the procedure background value are shown as negative values and results that did not indicate the presence of a radionuclide that could have been detected by the analytical method are shown as "not detected." In showing comparative data, the 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.

5.1 EFFLUENT MONITORING

Workplace ventilation is provided in all areas where unencapsulated or unpackaged radioactive material is handled, such as in the RIHL decontamination project (in the hot cells) and in the decontamination and packaging rooms at RMDF (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 less long–lived radioactivity than does ambient air, caused by the naturally occurring radionuclides in the atmosphere. Essentially all short–lived radioactivity in the air is caused by the naturally present radon daughters, which dominate the airborne activity.

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

Effluents that may contain radioactive material are released at the Rocketdyne Division 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 RMDF, Building 059, Building 023, and RIHL at SSFL, and Building 104 at the De Soto complex.

The only potential release of radioactivity to uncontrolled areas is by way of filtered discharge from the RMDF, the RIHL, Building 059, and Building 104, and the unfiltered exhaust from the small samples analyzed in the Inductively Coupled Plasma (ICP) unit in Building 023 to the atmosphere. No contaminated liquids are discharged to uncontrolled areas.

Due to the short period of operation of the ICP, the effluent from Building 023 was monitored by sample inventory and not by continuous exhaust sampling as performed for the RMDF, the RIHL, and Buildings 059 and 104. The ICP analytical unit was used for elemental content analysis of molten salt oxidation unit test solutions of radioactively contaminated oils. Process air from the ICP was exhausted without filtration. Only very low levels of radioactivity were permitted in Building 023. A radiological evaluation (CAP88–PC) prior to operation of the ICP in 1992 indicated an equivalent expected maximum off–site dose of less than 4.5E–06 mrem/yr without exhaust filtration. This is below the threshold of 1% of the standard requiring the monitoring prescribed in 40 CFR 61.93(b). The dose calculated from actual operation in 1993 using CAP88–PC was an equivalent maximum off–site dose of 2.9E–09 mrem/yr.

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 RIHL and the RMDF provide automatic alarm capability in the event of the release of particulate activity from the RIHL and the RMDF. The HEPA filters used for filtering atmospheric effluents are at least 99.97% efficient for particles 0.3 mm in diameter.

The average concentration and total radioactivity in atmospheric effluents to uncontrolled areas from the RMDF, the RIHL, Building 059, and De Soto 104 are shown in Table 5–1. Since Building 023 exhaust was not continuously sampled, it is not included in Table 5–1. The total shows that no significant quantities of radioactivity were released in 1993.

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 Po–210 that is collected on the RIHL filter due to the use of unfiltered bypass (ambient) air taken into the main exhaust system from the outside is a result of naturally occurring elements in the U–238 decay chain in the environment. The K–40 is due to the presence of this radionuclide in the airborne dust in the ambient air. Materials used in operations conducted at the SSFL site 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 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. These results are also shown in Table 5–2, for comparison with ambient air. (For convenience in presenting and viewing this data, the results are presented in units of femtocuries per cubic meter [fCi/m^3], which is 10^{-15} μCi/mL.) 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 Be–7, 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 analyses for the RMDF, the RIHL, Building 059, and De Soto are also shown in Table 5–2. Since Building 023 exhaust was not continuously sampled, it is not included in Table 5–2.

The effluent at the exhaust stack for each facility is compared with an appropriate limit 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, and CCR 17, Appendix A.

Table 5–1. Atmospheric Effluents to Uncontrolled Areas (Sheet 1 of 4)

SSFL/RMDF – 1993	
Effluent volume (m^3)	193,518,324
Lower limit of detection, LLD	
Gross alpha (µCi/mL)	3×10^{-16}
Gross beta (µCi/mL)	1×10^{-15}
Air volume sampled (m^3)	26,208
Annual average concentration in effluent	
Gross alpha (µCi/mL)	1.58×10^{-16}
Gross beta (µCi/mL)	1.01×10^{-14}
Maximum observed concentration	
Gross alpha (uCi/mL)	7.26×10^{-16}
Gross beta (uCi/mL)	1.31×10^{-13}
Activity released (uCi)	
Gross alpha	0.03
Gross beta	1.95

Radionuclide–Specific Data

Radionuclide	Half-Life (yr)	Activity Detected (pCi)	Annual Release (µCi)	Analysis LLD (pCi)	Release LLD (µCi)	Average Exhaust Concentration (uCi/mL)	DCG (uCi/mL)
Be–7	0.146	ND	0	20	0.15	0	Natural
K–40	1,260,000,000	60.9	0.45	30	0.22	2.32×10^{-15}	Natural
Co–60	5.26	31.2	0.23	2	0.02	1.19×10^{-15}	8×10^{-11}
Sr–90	27.7	ND	0	3	0.02	0	9×10^{-12}
Cs–137	30	63.6	0.47	2	0.02	2.43×10^{-15}	4×10^{-10}
Po–210	0.38	2.9	0.02	0.1	0.0007	1.11×10^{-16}	Natural
Th–228	1.9131	ND	0	0.6	0.004	0	4×10^{-14}
Th–230	80,000	ND	0	0.1	0.0007	0	4×10^{-14}
Th–232	14,100,000,000	ND	0	0.2	0.001	0	7×10^{-15}
U–234	247,000	ND	0	0.08	0.0006	0	9×10^{-14}
U–235	710,000,000	ND	0	0.08	0.0006	0	1×10^{-13}
U–238	4,510,000,000	ND	0	0.08	0.0006	0	1×10^{-13}
Pu–238	86.4	ND	0	0.05	0.0004	0	3×10^{-14}
Pu–239/240	24,390/6,580	0.35	0.003	0.05	0.0004	1.34×10^{-17}	2×10^{-14}

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

Derived concentration guides (DCGs) for exposure of the public, for most restrictive form of radionuclide as specified in DOE Order 5400.5 (2/8/90).

ND = Not detected

Table 5–1. Atmospheric Effluents to Uncontrolled Areas (Sheet 2 of 4)

SSFL/RIHL – 1993	
Effluent volume (m^3)	459,089,618
Lower limit of detection, LLD	
Gross alpha (μCi/mL)	3×10^{-16}
Gross beta (μCi/mL)	1×10^{-15}
Air volume sampled (m^3)	32,582
Annual average concentration in effluent	
Gross alpha (μCi/mL)	1.24×10^{-15}
Gross beta (μCi/mL)	2.28×10^{-14}
Maximum observed concentration	
Gross alpha (μCi/mL)	3.04×10^{-15}
Gross beta (μCi/mL)	2.46×10^{-13}
Activity released (μCi)	
Gross alpha	0.57
Gross beta	10.5

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	145	2.04	50	0.71	4.45×10^{-15}	Natural
K–40	1,260,000,000	ND	0	30	0.42	0	Natural
Co–60	5.26	ND	0	2	0.03	0	3×10^{-10}
Sr–90	27.7	37	0.52	2	0.03	1.14×10^{-15}	3×10^{-11}
Cs–137	30	335	4.72	2	0.03	1.03×10^{-14}	5×10^{-10}
Po–210	0.38	86	1.2	0.1	0.001	2.64×10^{-15}	Natural
Th–228	1.9131	ND	0	0.2	0.003	0	2×10^{-13}
Th–230	80,000	0.30	0.004	0.2	0.003	9.21×10^{-18}	8×10^{-14}
Th–232	14,100,000,000	ND	0	0.05	0.0007	0	1×10^{-12}
U–234	247,000	ND	0	0.3	0.004	0	4×10^{-12}
U–235	710,000,000	ND	0	0.2	0.003	0	4×10^{-12}
U–238	4,510,000,000	ND	0	0.3	0.004	0	3×10^{-12}
Pu–238	86.4	ND	0	0.03	0.0004	0	7×10^{-14}
Pu–239/240	24,390/6,580	0.82	0.012	0.05	0.0007	2.52×10^{-17}	6×10^{-14}

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

Maximum permissible concentrations (MPCs) for release to unrestricted area, for most restrictive form of radionuclide as specified in 10 CFR 20, Appendix B and CCR 17, Appendix A.

ND = Not detected

Table 5–1. Atmospheric Effluents to Uncontrolled Areas (Sheet 3 of 4)

SSFL/059 – 1993	
Effluent volume (m^3)	30,181,334
Lower limit of detection, LLD	
Gross alpha (µCi/mL)	3×10^{-16}
Gross beta (µCi/mL)	1×10^{-15}
Air volume sampled (m^3)	21,024
Annual average concentration in effluent	
Gross alpha (µCi/mL)	3.91×10^{-16}
Gross beta (µCi/mL)	9.19×10^{-15}
Maximum observed concentration	
Gross alpha (µCi/mL)	1.20×10^{-15}
Gross beta (µCi/mL)	7.20×10^{-14}
Activity released (µCi)	
Gross alpha	0.01
Gross beta	0.28

Radionuclide–Specific Data

Radionuclide	Half-Life (yr)	Activity Detected (pCi)	Annual Release (µCi)	Analysis LLD (pCi)	Release LLD (µCi)	Average Exhaust Concentration (µCi/mL)	DCG (µCi/mL)
Be–7	0.146	ND	0	20	0.03	0	Natural
K–40	1,260,000,000	92	0.13	30	0.04	4.38×10^{-15}	Natural
Co–60	5.26	28.1	0.040	2	0.003	1.34×10^{-15}	8×10^{-11}
Sr–90	27.7	ND	0	2	0.003	0	9×10^{-12}
Cs–137	30	ND	0	2	0.003	0	4×10^{-10}
Po–210	0.38	8.5	0.012	0.1	0.0001	4.04×10^{-16}	Natural
Th–228	1.9131	ND	0	0.4	0.0006	0	4×10^{-14}
Th–230	80,000	ND	0	0.2	0.0003	0	4×10^{-14}
Th–232	14,100,000,000	ND	0	0.3	0.0004	0	7×10^{-15}
U–234	247,000	ND	0	0.1	0.0001	0	9×10^{-14}
U–235	710,000,000	ND	0	0.3	0.0004	0	1×10^{-13}
U–238	4,510,000,000	ND	0	0.1	0.0001	0	1×10^{-13}
Pu–238	86.4	ND	0	0.07	0.0001	0	3×10^{-14}
Pu–239/240	24,390/6,580	ND	0	0.07	0.0001	0	2×10^{-14}

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

Derived concentration guides (DCGs) for exposure of the public, for most restrictive form of radionuclide as specified in DOE Order 5400.5 (2/8/90).

ND = Not detected

Table 5–1. Atmospheric Effluents to Uncontrolled Areas
(Sheet 4 of 4)

De Soto 104 – 1993	
Effluent volume (m^3)	39,646,142
Lower limit of detection, LLD	
Gross alpha (μCi/mL)	3×10^{-16}
Gross beta (μCi/mL)	1×10^{-15}
Air volume sampled (m^3)	23,587
Annual average concentration in effluent	
Gross alpha (μCi/mL)	4.11×10^{-16}
Gross beta (μCi/mL)	3.51×10^{-15}
Maximum observed concentration	
Gross alpha (μCi/mL)	3.71×10^{-15}
Gross beta (μCi/mL)	4.01×10^{-14}
Activity released (μCi)	
Gross alpha	0.02
Gross beta	0.13

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	0	20	0.03	0	Natural
K–40	1,260,000,000	ND	0	30	0.05	0	Natural
Co–60	5.26	ND	0	1	0.002	0	3×10^{-10}
Sr–90	27.7	ND	0	2	0.003	0	3×10^{-11}
Cs–137	30	ND	0	2	0.003	0	5×10^{-10}
Po–210	0.38	29	0.049	0.1	0.0002	1.23×10^{-15}	Natural
Th–228	1.9131	ND	0	2	0.003	0	2×10^{-13}
Th–230	80,000	ND	0	0.4	0.0007	0	8×10^{-14}
Th–232	14,100,000,000	ND	0	0.4	0.0007	0	1×10^{-12}
U–234	247,000	6.6	0.011	0.1	0.0002	2.80×10^{-16}	4×10^{-12}
U–235	710,000,000	ND	0	0.3	0.0005	0	4×10^{-12}
U–238	4,510,000,000	ND	0	0.3	0.0005	0	3×10^{-12}
Pu–238	86.4	ND	0	0.05	0.00008	0	7×10^{-14}
Pu–239/240	24,390/6,580	ND	0	0.05	0.00008	0	6×10^{-14}

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

Maximum permissible concentrations (MPCs) for release to uncontrolled area, for most restrictive form of radionuclide as specified in 10 CFR 20, Appendix B and CCR 17, Appendix A.

ND = Not detected

Table 5–2. Filtered Exhaust and Ambient Air Radioactivity Concentrations—1993

	Activity Concentration (femtocuries per cubic meter)														
	Be-7	K-40	Co-60	Sr-90	Cs-137	Po-210	Th-228	Th-230	Th-232	U-234	U-235	U-238	Pu-238	Pu-239/240	Gross Alpha	Gross Beta
Maximum Permissible Concentration	40,000,000		300,000	30,000	500,000	7,000	200	80	1,000	4,000	4,000	3,000	70	60	20	10,000
Exhaust																
RMDF	ND	2.32	1.19	ND	2.43	0.11	ND	ND	ND	ND	ND	ND	ND	0.013	0.2	10.1
RHIL	4.45	ND	ND	1.14	10.3	2.64	ND	0.009	ND	ND	ND	ND	ND	0.025	1.2	22.8
DS 104	ND	ND	ND	ND	ND	1.23	ND	ND	ND	0.28	ND	ND	ND	ND	0.4	3.5
059	ND	4.38	1.34	ND	ND	0.40	ND	ND	ND	ND	ND	ND	ND	ND	0.4	9.2
Ambient																
RMDF	9.42	31.2	ND	ND	ND	9.01	ND	0.012	ND	0.033	ND	0.013	ND	ND	2.5	29.3
RMDF Pond	29.0	ND	ND	ND	ND	9.42	ND	ND	ND	0.069	ND	0.029	ND	ND	2.8	29.4
RHIL	11.5	92.3	ND	0.66	1.04	7.71	ND	0.015	ND	0.022	ND	0.019	ND	0.009	2.7	31.3
100 (7 day)	13.9	ND	ND	ND	ND	8.86	ND	0.012	ND	ND	ND	0.011	ND	ND	1.5	22.5
886	ND	26.0	ND	ND	ND	3.81	0.046	0.034	0.031	0.037	ND	0.021	ND	ND	2.3	20.0
DS 104	13.3	12.5	ND	ND	ND	7.61	ND	0.027	ND	0.036	ND	0.014	ND	ND	2.3	23.1
Exhaust Average	4.45	2.67	1.22	1.14	7.95	1.78	ND	0.009	ND	0.280	ND	ND	ND	0.022	0.9	17.8
Ambient Average	15.4	40.2	ND	0.66	1.04	7.73	0.046	0.020	0.031	0.040	ND	0.018	ND	0.009	2.3	25.9

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ND = Not detected

The most restrictive MPC or DCG for each radionuclide (from CCR 17) is shown at the head of each column of data. (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 of the 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 would occur before the material reaches an unrestricted area.

The downwind concentration of radioactive material emissions to the atmosphere during 1993 from each of the four Rocketdyne 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 man–made radioactivity concentrations at the nearest boundary and residence locations for effluents from the four facilities. These concentrations were estimated by use of CAP88–PC and specific radionuclide releases for each facility.

5.2 ENVIRONMENTAL SAMPLING

5.2.1 Air

Ambient air sampling is performed continuously at De Soto and SSFL with air samplers operating on 24–hour sampling cycles. 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

Table 5–3. Annual Average Radioactivity Concentrations of Atmospheric Effluents—1993

Facility	Annual Release (μCi)	Distance (m) to		Downwind Concentration (10^{-18} μCi/mL)	
		Boundary	Residence	Boundary	Residence
DS 104	0.011	187 E	315 S	0.002	0.001
RIHL	5.25	302 NW	1,900 SE	1.7	0.18
RMDF	0.70	118 NW	2,300 SE	0.003	0.006
059	0.04	80 NW	1,997 SSE	0.13	0.002
023	4.5×10^{-5}	250 NW	3,000 NW	0.40	0.008

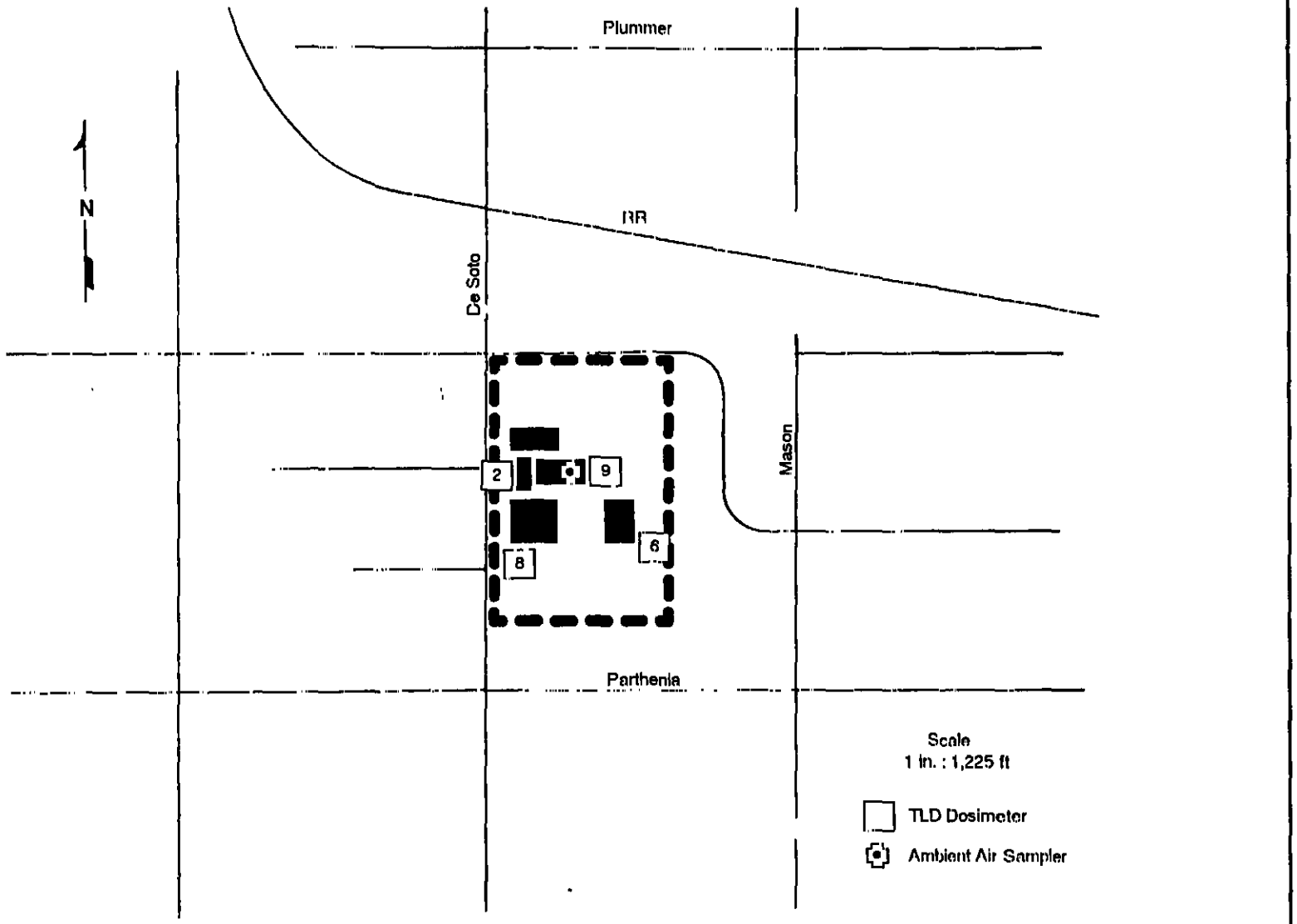

Figure 5-1. Map of De Soto Site Monitoring Stations

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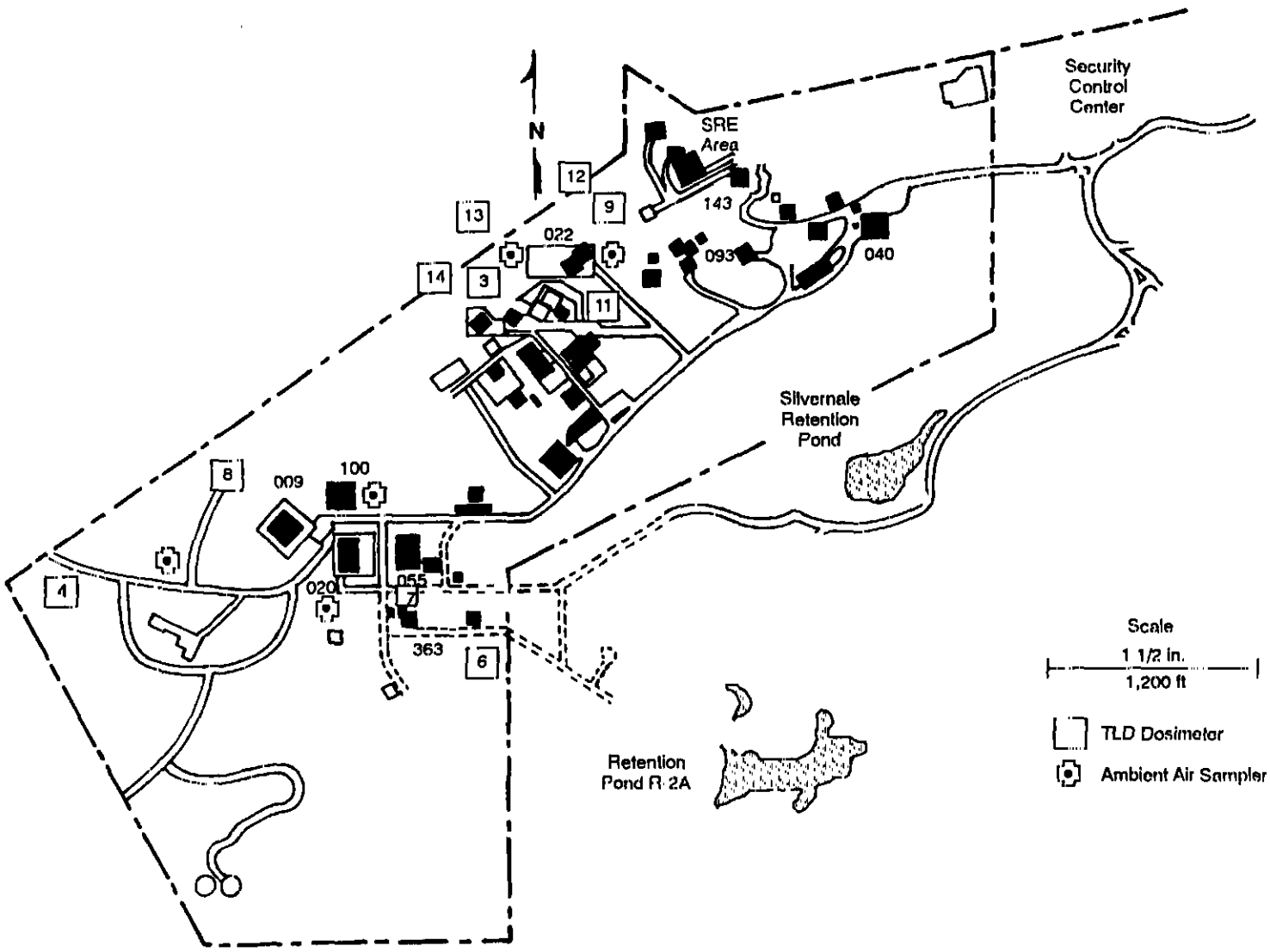

Figure 5-2. Map of Santa Susana Field Laboratory Site Sampling Stations

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Table 5-4. Sampling Location Description
(Sheet 1 of 2)

Station	Location	Frequency of Sampling
Ambient Air Sampler Locations		
A-1	De Soto Site, Building 104 roof	(D)
A-2	SSFL Site, Building 020, southwest side	(D)
A-3	SSFL Site, Building 034, at main gate	(D)
A-4	SSFL Site, Building 886, Former Sodium Disposal Facility	(D)
A-5	SSFL Site, RMDF Pond, north side	(D)
A-6	SSFL Site, Building 100, east side - 7-day sampler	(W)
On-Site—De Soto - Ambient Radiation Dosimeter Locations		
DS-2	De Soto Site, northwest corner of Building 101 (State of California TLD Location Number 2)	(Q)
DS-6	De Soto Site, east boundary, southeast corner of Building 105 (State of California TLD Location Number 1)	(Q)
DS-8	De Soto Site Guard Post 4, southwest corner of Building 101 (State of California TLD Location Number 7)	(Q)
DS-9	De Soto Site, southeast of Building 104	(Q)
On-Site—SSFL - Ambient Radiation Dosimeter Locations		
SS-3	SSFL Site, Electric Substation 719 on boundary fence (State of California TLD Location Number 3)	(Q)
SS-4	SSFL Site, west boundary on H Street	(Q)

Table 5–4. Sampling Location Description
(Sheet 2 of 2)

Station	Location	Frequency of Sampling
SS–6	SSFL Site, northeast corner of Building 353 (State of California TLD Location Number 4)	(Q)
SS–7	SSFL Site, Building 363, north side (State of California TLD Location Number 8)	(Q)
SS–8	SSFL Site, Former Sodium Disposal Facility north boundary	(Q)
SS–9	SSFL Site, Radioactive Materials Disposal Facility, northeast boundary at Building 133	(Q)
SS–11	SSFL Site, Building 036, east side	(Q)
SS–12	SSFL Site, RMDF northwest property line boundary (State of California TLD Location Number 10)	(Q)
SS–13	SSFL Site, RMDF northwest property line boundary	(Q)
SS–14	SSFL Site, RMDF northwest property line boundary	(Q)
Off–Site Ambient Radiation Dosimeter Locations		
OS–1	Off–site, Chatsworth (State of California TLD Location Number 5)	(Q)
OS–5	Off–site, Simi Valley (State of California TLD Location Number 6)	(Q)

Code:

A	Air Sampler Station
TLD	Thermoluminescent Dosimeter Location
D	Daily Sample
W	Weekly Sample
Q	Quarterly Sample

Location:

DS	De Soto
SS	SSFL
OS	Off–Site

alpha and beta radiation following a minimum 120-hour decay period. The volume of a typical daily ambient air sample is about 25 m^3.

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 media for each 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 the case with effluent air samples, the observed ambient air radionuclide concentrations were far below the MPC. The measurements were dominated by analytical and background variations, with the result that negative and inconsistent values were produced.

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 of the short-lived particulate radioactivity is removed from the exhaust air by the HEPA filters, these effects are not significant in the filtered effluent.

The ambient air is sampled at six locations (five at SSFL, one at De Soto). Air is drawn through glass fiber (Type A/E) filter discs for 24-hour periods (one sampler operates on a 7-day cycle) for each calendar day. The collected radioactivity is measured for gross alpha and beta radiation, after a delay of at least 120 hours to allow complete decay of the short-lived radioactivity, with a thin-window gas-flow proportional counter, to determine gross alpha and gross beta activity, as an early measure of the discharged radioactivity and environmental radioactivity.

Since the alpha and beta activity is counted relatively soon after collection, most of the natural Be-7 is detected, elevating the 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 RIHL, 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.

The appropriate guide value of 6×10^{-14} µCi/mL (Pu-239) for SSFL site ambient air alpha activity is due to contamination remaining from work with unencapsulated plutonium (the DOE value is 2×10^{-14} µCi/mL). The appropriate value of 3×10^{-11} µCi/mL (Sr-90) for beta activity is due to the presence of Sr-90 in

Table 5–5. Ambient Air Radioactivity Data—1993

Area	Activity	Number of Samples	Gross Radioactivity Concentrations (µCi/mL)		
			Annual Average Value and Dispersion	Maximum Value* and Date Observed	Average Percent of Guide**
De Soto Building 104	Alpha Beta	362	(2.3 ± 2.7)E–15 (23.1 ± 13.9)E–15	10.8E–15 (11/24) 79.1E–15 (10/03)	0.08 0.01
SSFL Area IV RIHL	Alpha Beta	356	(2.7 ± 2.7)E–15 (31.3 ± 52.1)E–15	12.5E–15 (07/20) 963.5E–15 (07/20)	4.5 0.11
SSFL Area IV RMDF	Alpha Beta	355	(2.5 ± 2.9)E–15 (29.3 ± 15.4)E–15	12.5E–15 (09/18) 78.1E–15 (11/08)	13 0.33
SSFL Area IV Building 886	Alpha Beta	352	(2.3 ± 2.9)E–15 (20.0 ± 13.6)E–15	13.6E–15 (08/24) 66.5E–15 (02/22)	3.8 0.07
SSFL Area IV RMDF pond	Alpha Beta	362	(2.8 ± 2.7)E–15 (29.4 ± 16.2)E–15	13.0E–15 (09/17) 84.0E–15 (02/01)	4.7 0.10

*Maximum value observed for single sample.

**Guide De Soto Site: 3E–12 µCi/mL alpha, 3E–10 µCi/mL beta; 10 CFR 20 Appendix B. CCR 17. SSFL site: 6E–14 µCi/mL alpha, 3E–11 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).

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 of 3×10^{-12} µCi/mL (U–238) for De Soto ambient air alpha activity is due to prior (licensed) work with unencapsulated depleted uranium. The appropriate guide value of 3×10^{-10} µCi/mL (Co–60) for beta activity is for Co–60, since it is the most restrictive limit for any beta–emitting radionuclide currently 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 1993 as indicated by the gross alpha and gross beta counting. (Gaps in the record shown in this figure are due to negative results from samples showing less activity than instrument background.) Generally, the ambient airborne radioactivity was relatively constant during 1993, and showed no significant disturbances.

The daily data were mathematically smoothed in a moving weekly average of daily data for the year. The activity detected in ambient air is attributed to naturally occurring radioactive materials and possibly to aged fission products from past atmospheric tests of nuclear devices or other events such as the Chernobyl accident. Radionuclides detected by gross alpha and beta analysis of air samples collected during 1993 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 RIHL, the RMDF, Building 059, and Building DS104, which are also on a weekly cycle. For both alpha and beta activity, the concentration in the RIHL exhaust is close to that in ambient air, largely due to the use of unfiltered outside air to bypass the HEPA filter system to control suction pressure in

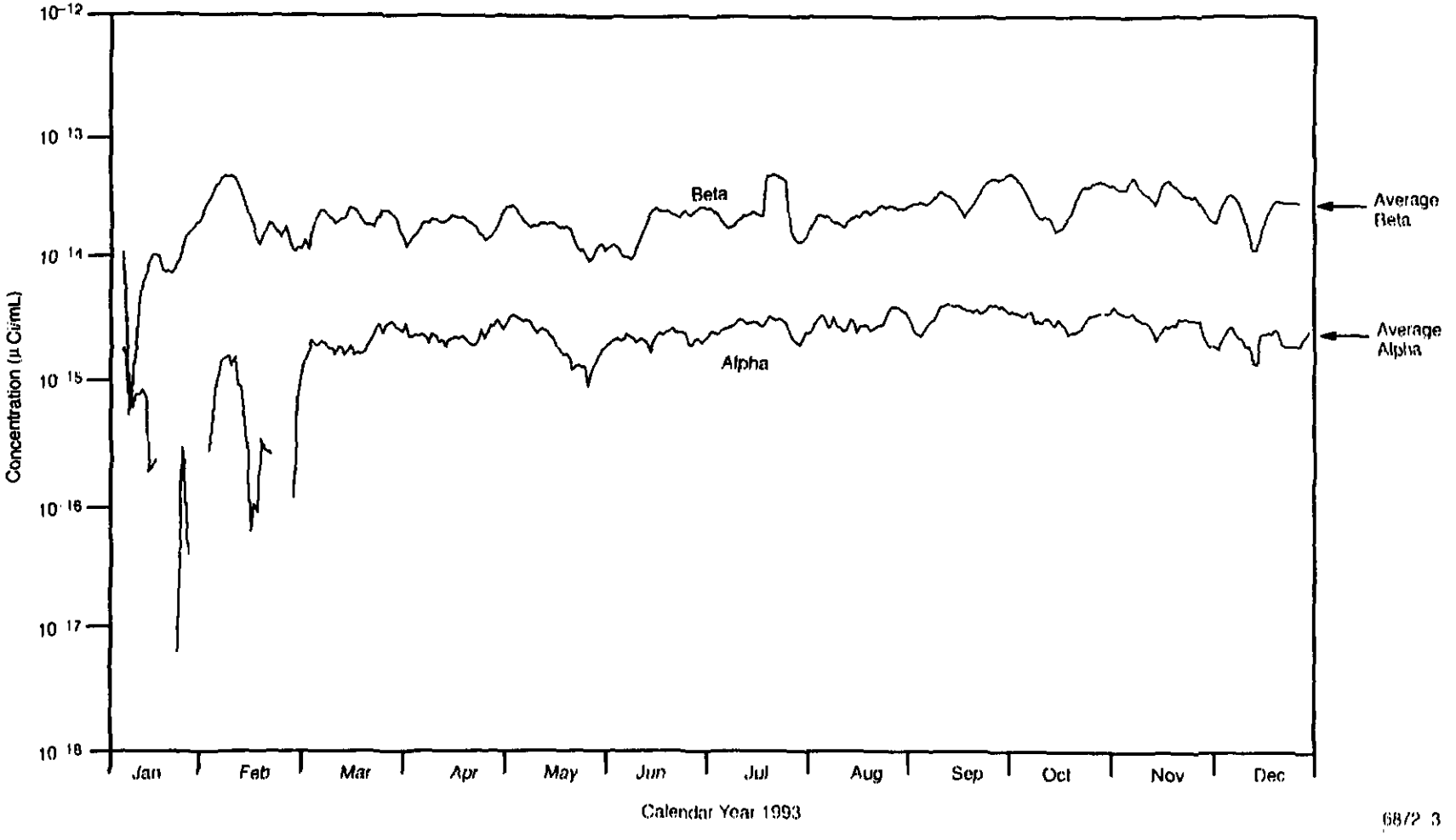

Figure 5–3. Seven–Day Smoothed and Annual Average Airborne Radioactivity at the De Soto and Santa Susana Field Laboratory Sites—1993

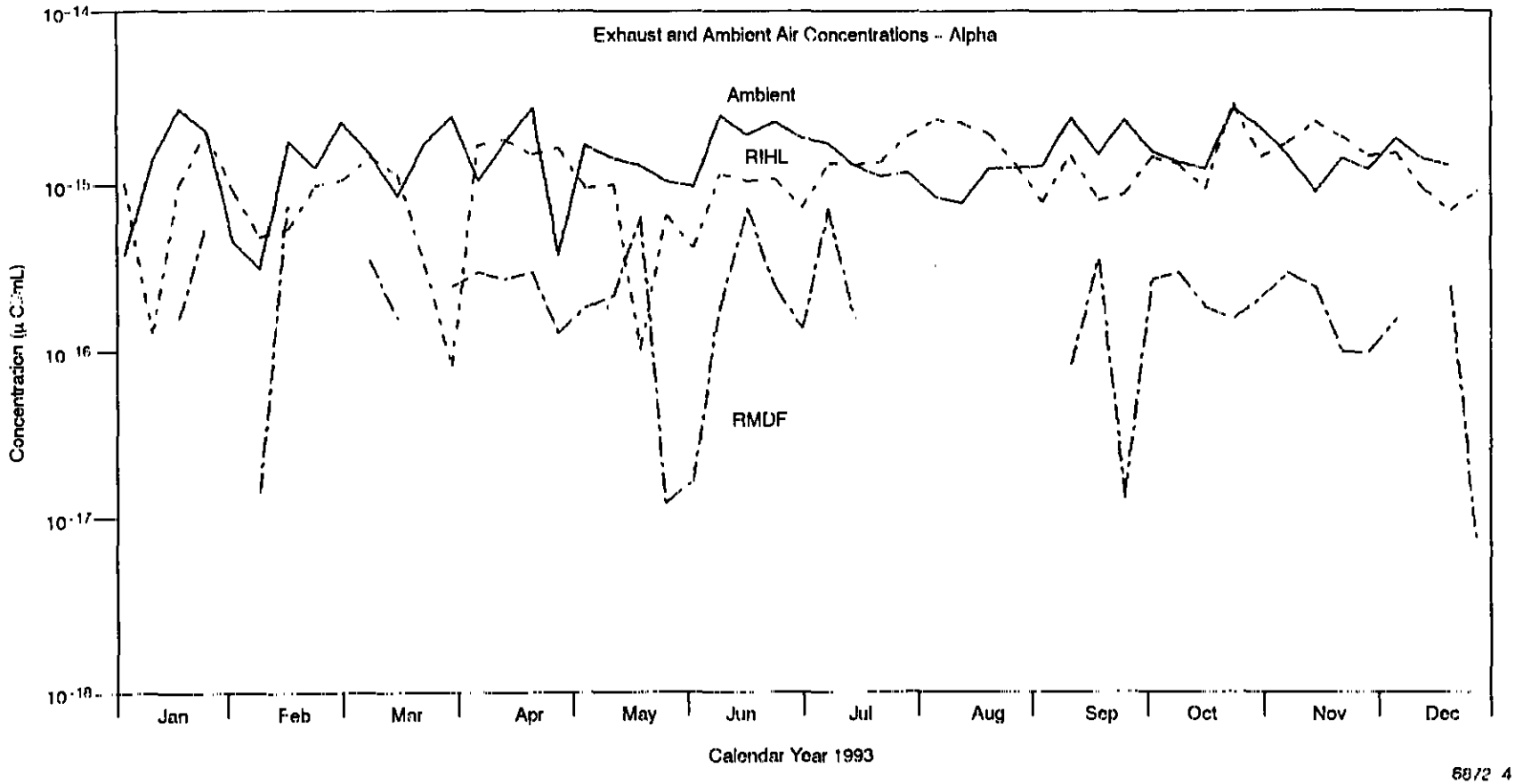

Figure 5-4. Filtered Exhaust and Ambient Air Radioactivity Concentrations (Sheet 1 of 4)

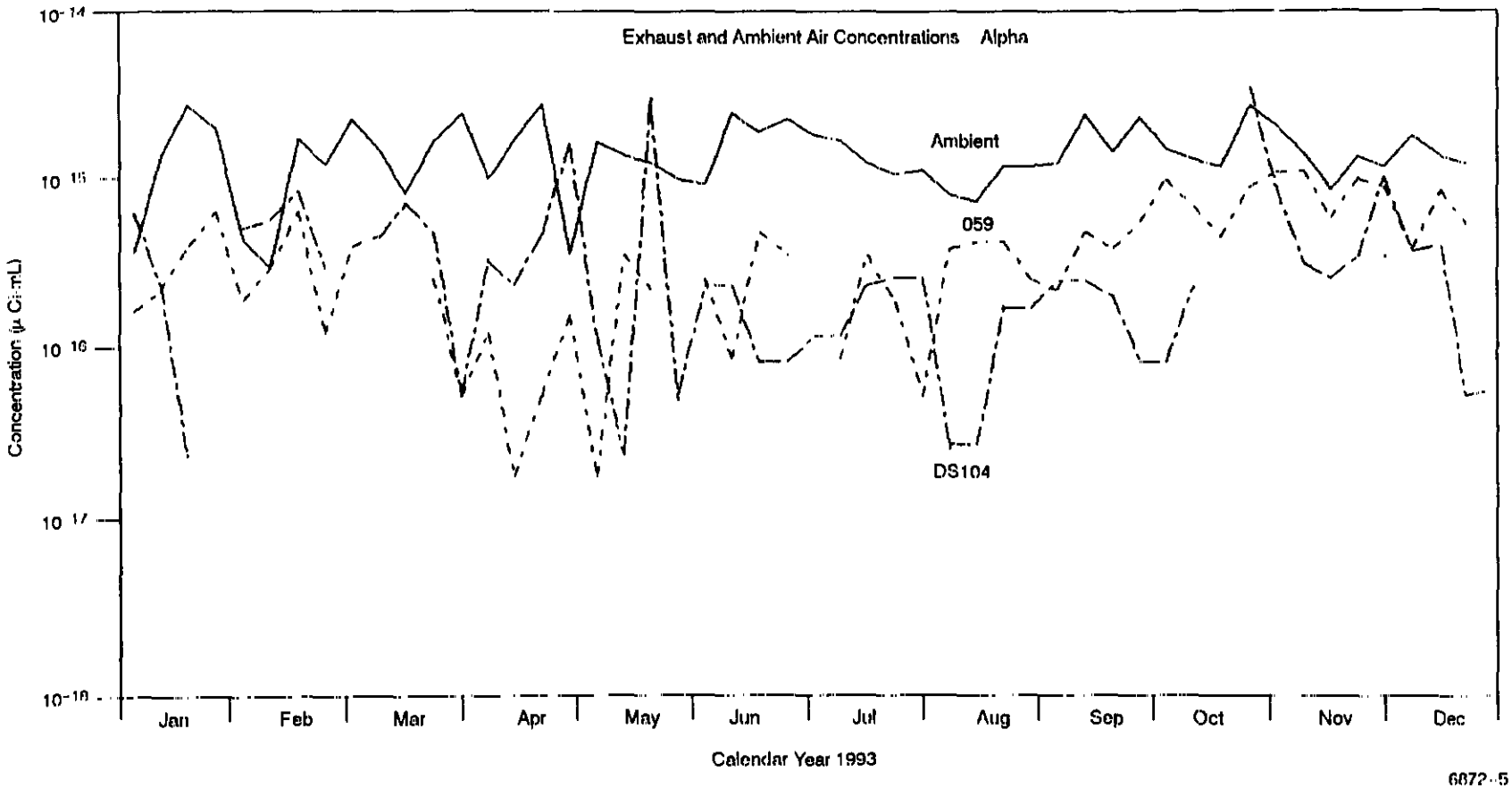

Figure 5–4. Filtered Exhaust and Ambient Air Radioactivity Concentrations (Sheet 2 of 4)

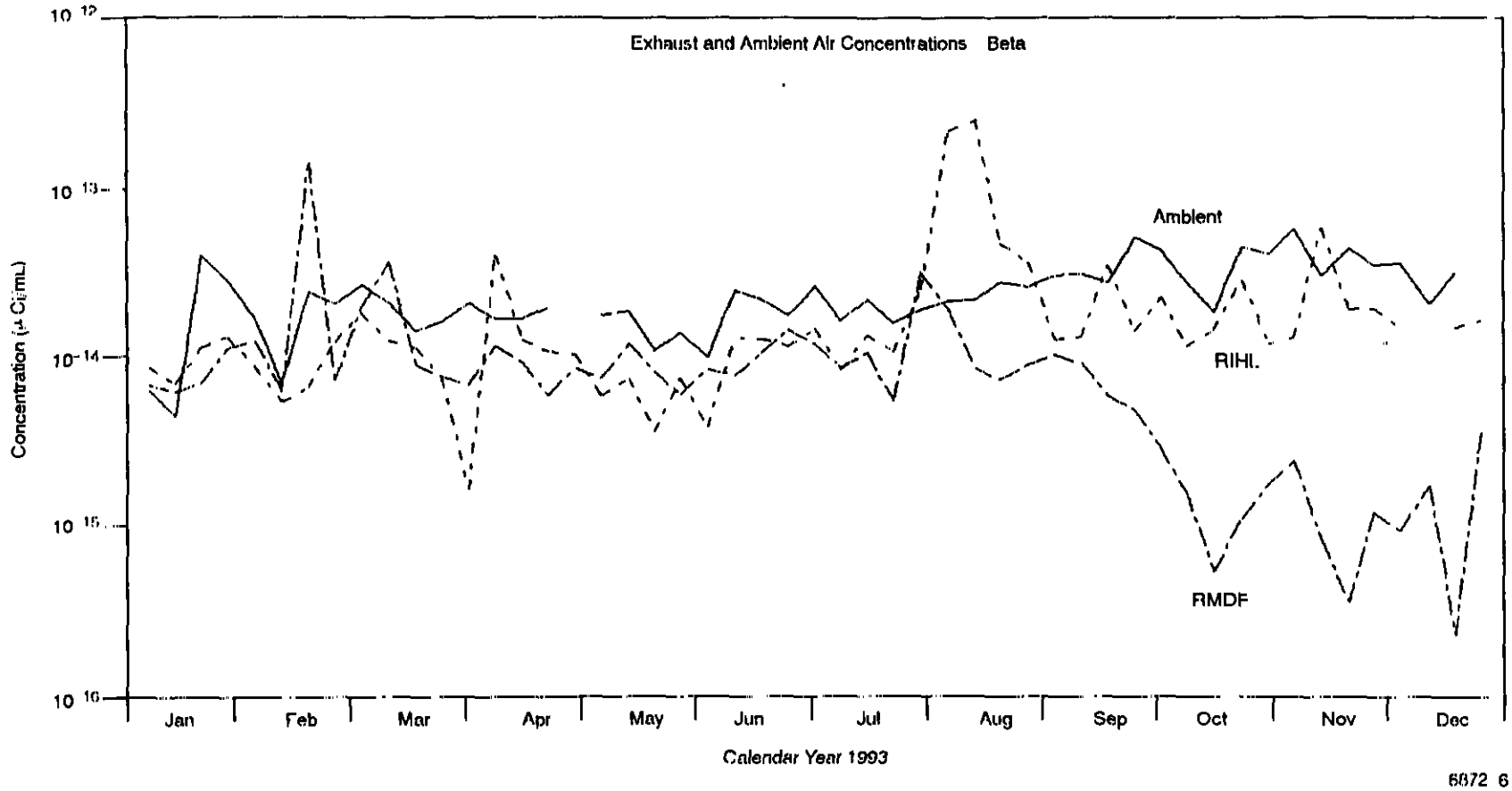

Figure 5-4. Filtered Exhaust and Ambient Air Radioactivity Concentrations (Sheet 3 of 4)

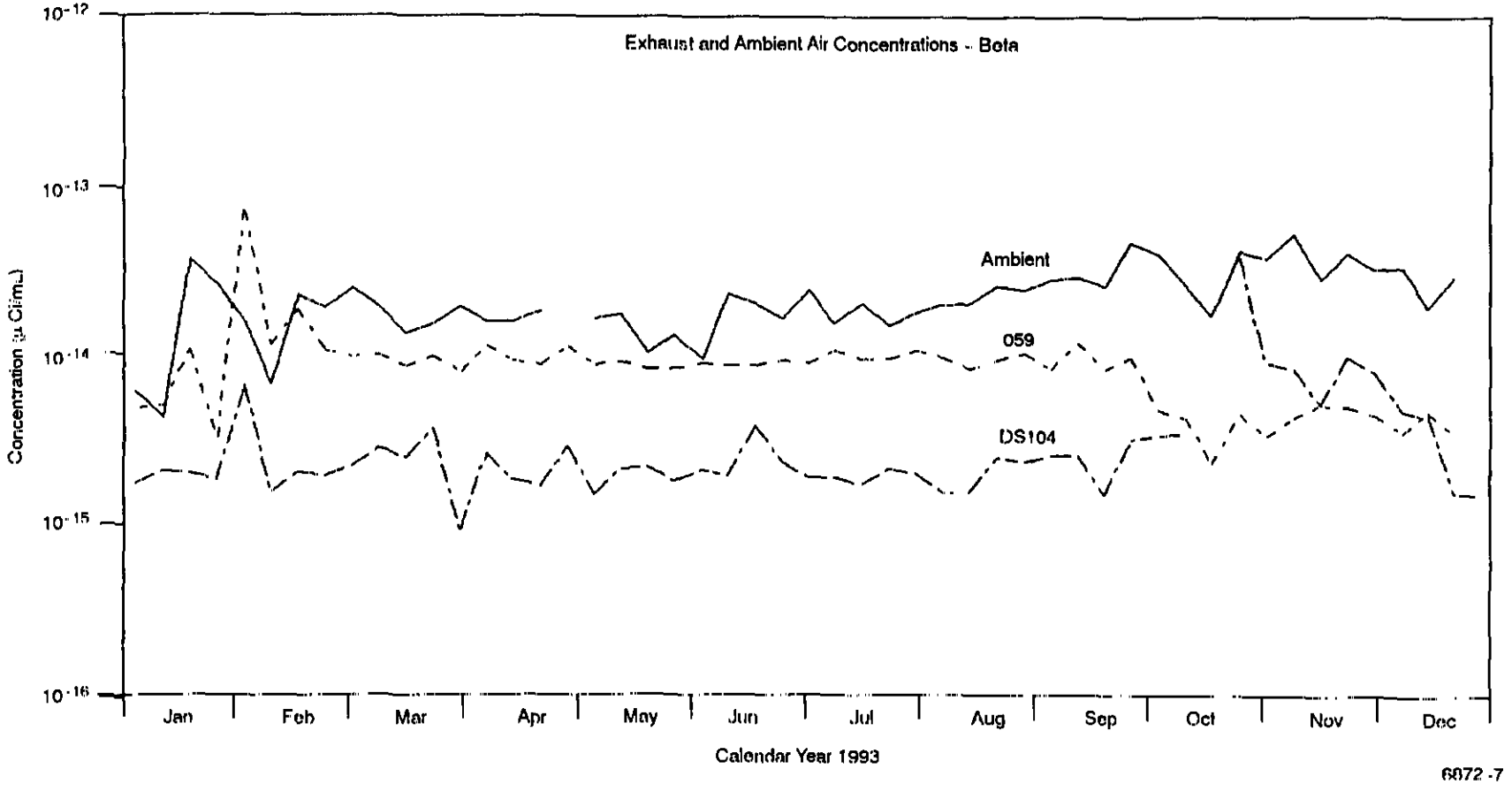

Figure 5-4. Filtered Exhaust and Ambient Air Radioactivity Concentrations (Sheet 4 of 4)

the ventilation system. At the RMDF and Buildings 059 and DS104, all the discharged air is filtered, and so the gross alpha and beta activities are generally lower than in ambient air. Gaps in the plots are due to negative values resulting from air samples showing less activity than instrument background.

5.2.2 Water

Groundwater is sampled from a large number of alluvial and Chatsworth Formation wells and analyzed for radioactivity. The locations of these wells are shown in Figure 6–2. Detailed results of the analysis of groundwater samples are reported quarterly and annually. The summary results for 1993 are shown in Table 5–6. While it may be noted that in some cases the gross alpha activity has exceeded the drinking water supply limits, this activity is due predominantly to naturally occurring uranium. This is confirmed by the uranium isotopic ratios which are consistent with nonenriched natural uranium. No man–made fission products have been detected in the groundwater.

With the exception of four wells, tritium results from all wells were less than the detection level of 500 pCi/L. Well RD–23 had one reading of 672 ± 735 pCi/L. Other RD–23 readings were less than detectable. An elevated level of 560 ± 510 pCi/L was detected at well RD–21. Other well RD–21 readings were 314 and –570 pCi/L. Well RS–54 showed similar results. Two samples taken 18 days apart indicated tritium levels of 1,099 ± 707 pCi/L and –98 ± 500 pCi/L. Both the high error ranges and lack of a consistent trend for RD–23, RS–54, and RD–21 suggest that those results do not indicate contamination. Well RD–34A had readings of 657 to 1,119 pCi/L. In 1992, wells RD–28 and RD–34A had readings of 420 to 1,025 pCi/L and 1,800 to 7,069 pCi/L, respectively. The results from wells RD–28 and RD–34A confirm the downward trend in tritium concentrations observed in 1992. The original source of tritium for well RD–34A was investigated and determined to be Building 010. Building 010 has long since been decommissioned and excavated and is no longer an active source. Soil sampling in the vicinity of the NW boundary of Area IV is planned for early 1994 to further characterize the tritium contamination.

Table 5–6. Radioactivity in Groundwater at SSFL—1993

	Activity (pCi/L)											
	H–3	Cs–137	Ra–226	Ra–228	Th–228	Th–230	Th–232	U–234	U–235	U–238	Gross Alpha	Gross Beta
Maximum Permissible Concentration**	20,000*	20,000	Combined 5*		7,000	2,000	2,000	Combined 20*			15*	50*
Maximum	1,119		10.8	2.0	0.20	0.76	0.33	16.3	0.78	16.3	24.0	38.0
Mean	112	ND	2.2	2.0	0.02	0.26	0.10	8.2	0.39	9.3	5.5	9.4
Minimum	–686		ND	ND	ND	ND	ND	0.84	ND	0.88	ND	ND
Number of analyses***	76	(44)	22 (22)	2 (13)	5 (1)	5 (1)	5 (1)	10	9 (1)	10	92 (30)	98 (24)

*EPA limits for drinking water suppliers ND = not detected

**Above natural background

***Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.

Surface waters discharged from SSFL facilities and the sewage plant outfall drain southward into Rocketdyne retention pond R-2A. When the pond is full, the water may be discharged into Bell Creek, a tributary of the Los Angeles River in the San Fernando Valley, Los Angeles County. Average radioactivity concentrations in two retention ponds and upper Bell Creek samples are presented in Table 5-7.

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 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 1993 are shown in Table 5-8.

Comparison of the radioactivity concentrations in water from the ponds with that of the supply water (Table 5-8) shows no significant differences in either the alpha or beta activity. The values reported in Table 5-8 represent the results of analysis of water supplied from the Metropolitan Water District (MWD), by far the largest contingent of locally consumed potable water. There is some mixing of locally supplied water with the MWD water in the water districts for Simi Valley (7%) and Moorpark (15%), located within 20 km of SSFL. Analyses of this locally supplied water from wells have found gross alpha and uranium concentrations to range from 0.63 to 7.9 pCi/L and < 1 to 11 pCi/L, respectively.

Table 5-7. NPDES Discharge Radioactivity Data (2A and Perimeter Ponds)—1993

	Activity (pCi/L)						
	H-3	Sr-90	Cs-137	Ra-226	Ra-228	Gross Alpha	Gross Beta
Drinking Water Standards NPDES Limits	20,000	8	N/A	5 Combined		15	50
Maximum	994.0	3.7	-	0.4	1.7	7.0	47.0
Mean	413.5	0.8	ND	0.1	0.9	3.7	10.3
Minimum	ND	ND	-	ND	ND	ND	ND
Number of Analyses*	10 (15)	11 (14)	(9)	3 (22)	3 (22)	13 (12)	16 (9)

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = not detected.

Radioactivity concentration guide values used for comparisons for licensed operations are those concentration limits adopted by the NRC and the State of California as MPC values for uncontrolled areas. These values are established in 10 CFR 20 and California Code of Regulations Title 17. For comparisons related to the DOE operations, the DCG for ingested water presented in DOE Order 5400.5 are used. Where noted, limits for drinking water suppliers are also used (tritium, gross alpha, gross beta).

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. This water is then used for cooling the rocket engine test stand flame buckets or, if in excess, is released to Bell Creek under the NPDES permit. Most of this water is runoff because the rain falls on building roofs and roadways. 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 near the site boundary to accumulate runoff. The results of analyses for radioactivity in this water are shown in Table 5-9.

Table 5-8. Domestic Water Supplies Radioactivity Data—1993

	Activity (pCi/L)						
	H-3	Sr-90	Ra-226	Ra-228	Uranium	Gross Alpha	Gross Beta
State Maximum Contamination Level	20,000	8	5 combined		20	15	50
Maximum					(5)*	1.0 (4.9)	4.8 (19)
Mean	ND	ND	ND	ND	2	0.5	3.1
Minimum					(ND)	0.1 (ND)	0.4 (ND)

*City of Los Angeles water supply expressed as ranges.
ND = not detected.

Table 5-9. NPDES Discharge Radioactivity Data (Northwest Catch Basins)—1993

	Activity (pCi/L)						
	H-3	Sr-90	Cs-137	Ra-226	Ra-228	Gross Alpha	Gross Beta
Drinking Water Standards/ NPDES Limits	20,000	8	N/A	5 Combined		15	50
Maximum	1,798	2.30		2.4	2.3	6.9	23.0
Mean*	610	1.06	ND	0.9	1.3	4.1	8.0
Minimum	ND	ND		ND	ND	ND	ND
Number of Analyses**	10 (21)	12 (22)	(23)	7 (24)	5 (26)	8 (22)	14 (16)

*Average of values greater than detection limit.
**Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected

Three catch–basin rainfall runoff sample analyses for Sr–90 reported concentrations ranging from 9.4 ± 3.0 pCi/L to 59.4 ± 10.9 pCi/L. An investigation of these results found the analyst to have used an improper procedure. This finding was verified in subsequent analyses where much lower concentrations were found. The results of the investigation were reported to the RWQCB.

5.2.3 Rock and Soil

While not considered by any regulations, the radioactivity in environmental rock and soil can serve as an indicator of any spread of contamination outside the operating facilities and other known areas of radioactive contamination. The results of sampling following the decontamination of the Former Sodium Disposal Facility and the final surveys of Buildings 005, 023, and 064 are shown in Tables 5–10 through 5–15. Sampling locations are shown in Figure 5–5. All results are consistent with natural background.

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.

The natural origin of radioactive materials such as thorium and uranium has been confirmed by comparison of their activities in uncontaminated soils and the ratios of their activities to each other and to their daughter radionuclides. These analytical results indicated that the thorium and uranium are natural occurrences.

5.2.4 Vegetation

Sampling and analysis of native vegetation was performed on grass from an area outside the RIHL. The results are shown in Table 5–16.

5.2.5 Wildlife

Since no hunting is permitted at SSFL, wildlife is abundant. Occasional samples are collected as the result of road–kills and analyzed for radioactivity. The most commonly found radionuclide is the natural activity, K–40. These analyses (Table 5–17) showed no indication of radioactive contamination from operations in Area IV. The Cs–137 activity was found in a snake at the RMDF.

5.2.6 Ambient Radiation

Standard commercial thermoluminescent dosimeters (TLDs) using lithium fluoride (LiF) are placed, in pairs, at locations near the site boundaries at SSFL and De Soto, and at two off–site locations. These are processed on a quarterly basis by a contractor laboratory and the paired results are averaged for each location. These results are shown in Table 5–18, and include the contributions due to natural background radiation (about 47.5 mrem/yr for 1993, as measured by these TLDs). These results show compliance with the annual limits of NRC and the Radiologic Health Branch (RHB) of the State of California Department of

Table 5–10. Building 886 Former Sodium Disposal Facility Rock and Soil Radioactivity Data—1993

	Activity (pCi/g)										
	H–3	Sr–90	Cs–137	Th–228	Th–230	Th–232	U–234	U–235	U–238	Pu–238	Pu–239
Maximum	0.34	0.12	0.08	0.78	0.47	1.08	1.78	0.15	2.26	0.09	
Mean	0.04	0.10	0.05	0.58	0.39	0.66	0.59	0.09	0.66	0.09	ND
Minimum	ND	ND	ND	0.42	0.23	ND	ND	ND	ND	ND	
Number of analyses*	4 (14)	2 (8)	10 (8)	10	10	16 (2)	17 (1)	6 (12)	17 (1)	2 (8)	(18)

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

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Table 5–11. Building 005 Rock and Soil Radioactivity Data—1993

	Activity (pCi/g)												
	K–40	Cs–137	Tl–208	Pb–212	Bi–212	Pb–214	Bi–214	Ra–224	Ra–226	Ac–228	Th–234	U–235	U–238
Maximum	22.3	0.303	1.33	1.36	0.89	0.96	0.87	1.85	1.50	1.15	1.45	0.103	3.34
Mean	18.0	0.039	1.02	1.02	0.64	0.67	0.63	1.14	0.82	0.88	0.89	0.046	1.59
Minimum	13.2	ND	0.57	0.62	ND	0.39	0.36	0.53	ND	0.52	ND	ND	ND
Number of analyses*	61	22 (39)	61	61	11 (50)	61	61	61	56(5)	61	60 (1)	60 (1)	10 (51)

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

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Table 5–12. Building 023 Rock and Soil Radioactivity Data—1993

	Activity (pCi/g)										
	K–40	Cs–137	Tl–208	Pb–212	Pb–214	Bi–214	Ra–224	Ra–226	Ac–228	Th–234	U–235
Maximum	24.2	0.07	1.08	1.26	0.83	0.74	1.24	1.08	1.05	0.90	0.054
Mean	20.1	0.07	1.02	1.11	0.74	0.68	0.98	0.88	0.93	0.78	0.044
Minimum	16.1	ND	0.88	0.84	0.54	0.58	ND	0.57	0.81	0.61	0.028
Number of analyses*	5	1 (4)	5	5	5	5	4 (1)	5	5	5	5

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

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Table 5–13. Building 064 Rock and Soil Radioactivity Data—1993

	Activity (pCi/g)										
	K–40	Cs–137	Tl–208	Pb–212	Pb–214	Bi–214	Ra–224	Ra–226	Ac–228	Th–234	U–235
Maximum	22.3	4.42	1.31	1.33	0.98	0.87	1.74	1.76	1.21	1.12	0.071
Mean	19.6	1.04	1.29	1.30	0.89	0.82	1.57	1.38	1.16	0.89	0.040
Minimum	14.3	0.02	ND	ND	ND	ND	ND	ND	ND	ND	0.021
Number of analyses*	18	18	4 (14)	4 (14)	4 (14)	4 (14)	4 (14)	4 (14)	4 (14)	4 (14)	18

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

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Table 5–14. SRE Facility Rock and Soil Radioactivity Data—1993

	Activity (pCi/g)																
	Be–7	K–40	Co–60	Sr–90	Cs–136	Cs–137	Tl–208	Pb–212	Bi–212	Pb–214	Bi–214	Ra–224	Ra–226	Ac–228	Th–234	U–235	U–238
Maximum	1.19	22.9	0.11	0.08	0.08	1.58	1.44	1.12	0.71	0.73	0.82	1.22	1.41	1.21	1.17	0.09	3.74
Mean	0.62	17.2	0.11	0.08	0.08	0.84	1.07	0.88	0.58	0.61	0.69	0.97	0.99	0.93	1.07	0.08	2.16
Minimum	ND	13.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Number of analyses*	3 (13)	4	1 (15)	1 (15)	1 (15)	9 (7)	4 (12)	4 (12)	4 (12)	4 (12)	6 (10)	4 (12)	2 (14)	4 (12)	4 (12)	4 (12)	3 (13)

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

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Table 5–15. Miscellaneous SSFL Rock and Soil Radioactivity Data—1993

	Activity (pCi/g)														
	K–40	Sb–125	Cs–137	Eu–152	Tl–208	Pb–212	Bi–212	Pb–214	Bi–214	Ra–224	Ra–226	Ac–228	Th–228	Th–234	U–235
Maximum	22.5	0.50	0.81	0.40	1.16	1.19	0.66	0.53	0.76	1.64	1.32	1.03	1.12	1.76	0.07
Mean	19.0	0.46	0.71	0.40	1.01	0.98	0.57	0.52	0.67	1.28	1.32	0.86	1.12	1.59	0.06
Minimum	13.2	ND	ND	ND	ND	ND	ND	ND	ND	0.74	ND	ND	ND	ND	ND
Number of analyses*	3	2 (1)	2 (1)	1 (2)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	3	1 (2)	2 (1)	1 (2)	2 (1)	2 (1)

*Numbers *in parentheses represent the number* of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

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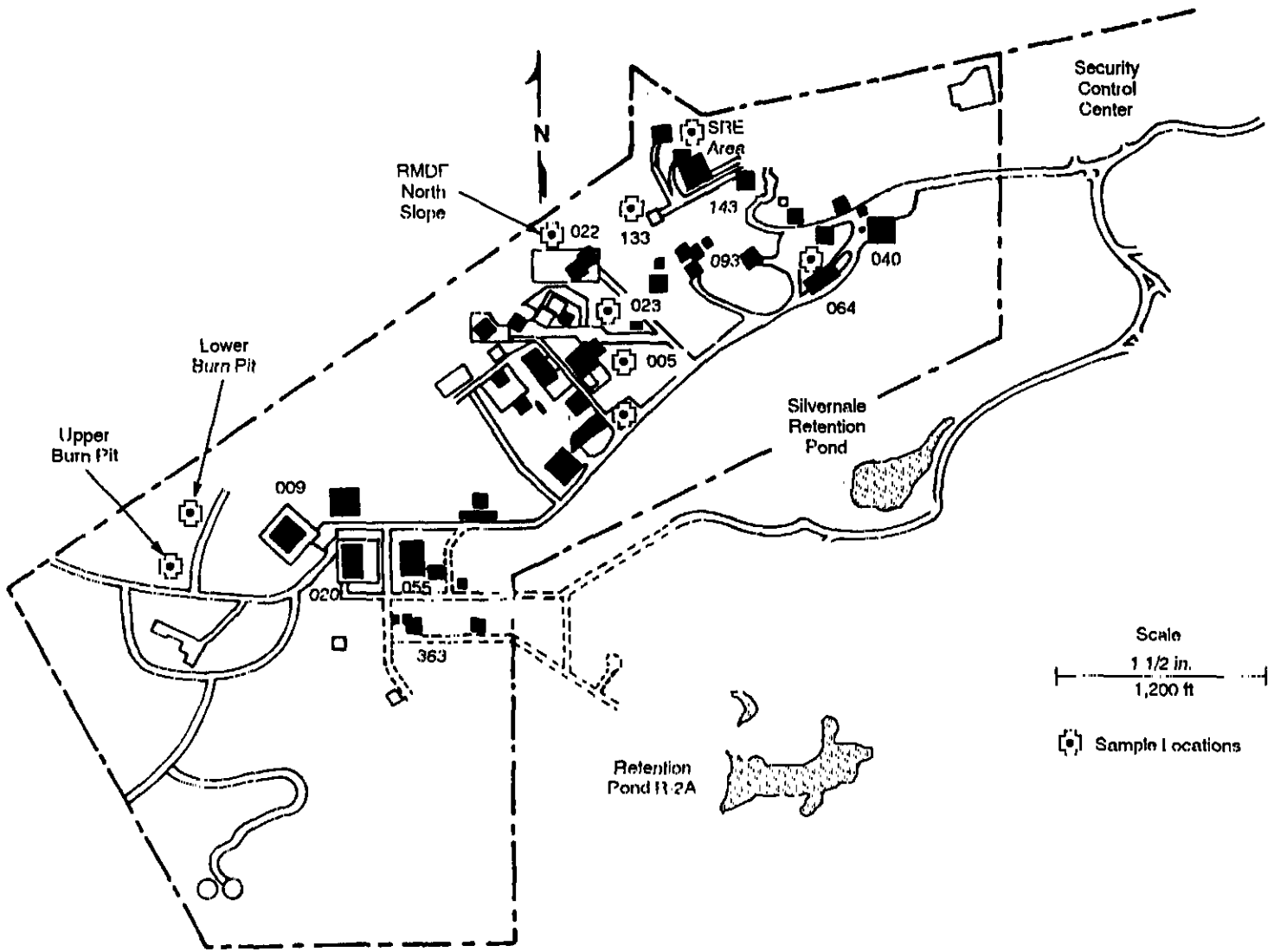

Figure 5-5. Map of Santa Susana Field Laboratory Site Soil Sampling, Area IV

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Table 5–16. Vegetation Radioactivity Data—1993

	Activity (pCi/g)												
	Be–7	K–40	Cs–137	Tl–208	Pb–210	Pb–212	Pb–214	Bi–214	Ra–226	Ac–228	Th–234	U–235	U–238
Maximum	1.46	8.71	0.021	0.079	1.05	0.110	0.046	0.045	0.22	0.14	0.60	0.011	3.54
Mean	1.46	8.59	0.021	0.076	0.92	0.098	0.030	0.037	0.19	0.13	0.43	0.010	3.54
Minimum	1.46	8.51	0.021	ND	0.80	0.089	0.010	ND	0.17	0.12	ND	0.008	ND
Number of analyses*	3	3	3	2 (1)	3	3	3	2 (1)	3	3	2 (1)	3	1 (2)

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

Table 5–17. Animal Radioactivity Data—1993

	Activity (pCi/g)					
	K–40	Cs–137	Tl–208	Pb–212	Pb–214	Bi–214
Maximum	1.64	0.15	0.04	0.03	0.04	0.04
Mean	1.27	0.15	0.04	0.03	0.04	0.03
Minimum	0.90	ND	ND	ND	ND	0.02
Number of analyses*	2	1 (1)	1 (1)	1 (1)	1 (1)	2

*Numbers in parentheses represent the number of analyses reported as less than the detectable limit (<DL). The mean has been calculated from reported values only.
ND = Not detected.

Table 5–18. De Soto and SSFL—Ambient Radiation Dosimetry Data—1993*

TLD Location		Quarterly Exposure (mrem)				Annual Exposure (mrem)	Annual Average Exposure Rate (µR/h)	
		Q–1	Q–2	Q–3	Q–4		Rocketdyne	State DHS**
De Soto	DS–2	10.0	10.0	10.0	10.0	40.0	4.6	8.8
	DS–6	20.0	10.0	10.0	10.0	50.0	5.7	9.6
	DS–8	15.0	10.0	10.0	10.0	45.0	5.1	8.4
	DS–9	20.0	10.0	10.0	10.0	50.0	5.7	
Mean value		16.3	10.0	10.0	10.0	46.3	5.3	8.9
SSFL	SS–3	20.0	20.0	10.0	10.0	60.0	6.8	9.9
	SS–4	20.0	10.0	10.0	10.0	50.0	5.7	
	SS–6	20.0	15.0	10.0	10.0	55.0	6.3	10.6
	SS–7	20.0	20.0	10.0	10.0	60.0	6.8	10.3
	SS–8	20.0	15.0	20.0	10.0	65.0	7.4	
	SS–9	20.0	20.0	20.0	10.0	70.0	8.0	
	SS–11	20.0	10.0	10.0	10.0	50.0	5.7	
	SS–12	10.0	20.0	20.0	20.0	70.0	8.0	15.0
	SS–13	50.0	20.0	30.0	20.0	120.0	13.7	
	SS–14	10.0	15.0	15.0	10.0	50.0	5.7	
Mean value		21.0	16.5	15.5	12.0	65.0	7.4	11.1
Off–site	OS–1	20.0	10.0	10.0	10.0	50.0	5.7	10.1
	OS–5	10.0	15.0	10.0	10.0	45.0	5.1	7.1
Mean value		15.0	12.5	10.0	10.0	47.5	5.4	8.6

*Includes natural background radiation of approximately 47.5 mrem per year.
**Fourth quarter results not available.

Health Services (DHS) (500 mrem/yr) and the DOE (100 mrem yr for extended exposure), above natural background.

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 with the Rocketdyne TLDs. The State dosimeters are returned to the RHB for evaluation by their vendor laboratory. Data for these TLDs, placed at nine Rocketdyne dosimeter locations, both on–site and off–site, are also shown in Table 5–18. The differences between exposure rates determined by Rocketdyne and the State may be due to differences in the precision with which the results are reported, and differences in gamma–radiation energy response for the two different dosimeter materials. The Rocketdyne vendor reports these results to the nearest 10 mrem, while the State vendor reports results to 0.1 mrem.

Table 5–18 shows that radiation exposures and equivalent annual exposure rates monitored on–site are nearly identical to levels monitored at the two off–site locations. These data reflect natural background radiation from cosmic radiation, radionuclides in the soil, radon and thoron in the atmosphere, and local radioactive fallout. Locally, the natural background radiation level as measured by these dosimeters is about 47.5 mrem/yr. The small variability observed in the data is attributed to differences in elevation and geologic conditions at the various dosimeter locations. The altitude range for the dosimeter locations is from about 260 m (850 ft) above sea level (ASL) at the Canoga facility to a maximum of about 580 m (1,900 ft) ASL at SSFL.

5.3 ESTIMATION OF PUBLIC RADIATION DOSE

Because so little radioactive material is released from the Rocketdyne facilities, and the radiation exposure is so small, it is not possible to directly measure radiation dose to the public. Hypothetical doses are estimated based on measurements at the facilities, and extrapolated to occupied areas off–site by well–established mathematical procedures.

The external dose calculations assume that differences in TLD readings represent true differences in local exposure. These differences are extrapolated to the boundary and nearest residence using an inverse square distance relation from an assumed source of radiation and accounting for air attenuation of the radiation. The estimated doses are far below the applicable limits of DOE, NRC, and the State of California.

The external exposures, above background, are based on the averaged off–site exposure measurements. The mean value for two off–site dosimeters was 47.5 mrem with a maximum annually observed value for a single location of 50 mrem. Boundary dose estimates assume 100% occupancy, whereas the actual presence of persons at the boundary is rare or nonexistent.

Except for the nearest boundary line exposure for the Radioactive Materials Disposal Facility (RMDF), the estimated off–site 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 for DOE facilities or 500 mrem/yr for NRC and State of California licensed facilities. The RMDF boundary to the north of the facility received an estimated average "property line" exposure of about

40 mrem above background for the year. 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, adjusted for wind direction frequency, throughout the year 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 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 Tables 5–19 through 5–21. These tables present the estimated exposures in comparison to the regulatory standards and that received due to natural radioactivity in the environment.

Figure 5–6 shows the arrangement of the census tract boundaries from the 1990 census. Figures 5–7 through 5–9 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.

The general population (person–rem) dose estimates were calculated using CAP88–PC. This code uses release rate, wind speed, wind direction and frequency stability fractions, and stack height parameters as input data. Population dose estimates are 1.6×10^{-3} person–rem for the SSFL site and 6.6×10^{-5} person–rem for the De Soto site. The collective effective dose equivalent estimated for potential area sources in 1993 is 2.1×10^{-3} person–rem. Inhalation is the only potential exposure pathway likely to exist. The doses reported for SSFL site emissions are summed for all release points and nuclides.

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.

Table 5–19. Public Exposure to Radiation and Radioactivity from DOE Operations at SSFL—1993

Radioactive Materials Disposal Facility (RMDF), Building 059, and Building 023 Department of Energy (DOE, Exempt from Licensing)

1. All pathways	
a. Maximum estimated external dose to an individual	2×10^{-4} mrem/yr
b. Maximum estimated internal dose to an individual*	8.2×10^{-8} mrem/yr
Total	2×10^{-4} mrem/yr
Limit ("Radiation Protection of the Public and the Environment" DOE Order 5400.5, 2/8/90)	100 mrem/yr
2. Air pathway (reported in NESHAPs report)	1.1×10^{-6} mrem/yr
Limit (40 CFR 61, Subpart H)	10 mrem/yr
Natural Exposure to Average Member of U.S. Public	
1. All pathways ("Health Effects of Exposure to Low Levels of Ionizing Radiation – BEIR V." National Academy Press, Washington DC, 1990)	300 mrem/yr
2. Air pathway ("Health Effects of Exposure to Low Levels of Ionizing Radiation – BEIR V." National Academy Press, Washington DC, 1990)	200 mrem/yr

*Inhalation and ingestion exposure from CAP88–PC calculation of air pathway; NESHAPs report contains only total air pathway exposure.

Table 5–20. Public Exposure to Radiation and Radioactivity from Rocketdyne Operations at SSFL—1993

Rockwell International Hot Laboratory (RIHL)
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		3.5×10^{-2} mrem/yr
Limits (10 CFR 20.105. CCR 17 Section 30268)	Annual	500 mrem in 1 yr
	Weekly	100 mrem in 7 days
	Hourly	2 mrem in 1 h
2. Airborne (nonnatural radioactivity) effluent at boundary		1.7×10^{-18} µCi/mL
Limits (10 CFR 20.106. CCR 17 Section 30269)		2×10^{-14} µCi/mL
Natural Exposure to Average Member of U.S. Public		
1. Direct radiation ("Health Effects of Exposure to Low Levels of Ionizing Radiation – BEIR V." National Academy Press, Washington DC. 1990)		100 mrem/yr
2. Airborne (natural) radioactivity (Estimated by De Soto site measurements of gross alpha and beta radioactivity concentrations in ambient air.)		2.5×10^{-14} µCi/mL

Table 5–21. Public Exposure to Radiation and Radioactivity from Rocketdyne Operations at De Soto—1993

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

1. Direct radiation at boundary		5.3×10^{-2} mrem/yr
Limits (CCR 17 Section 30268)	*Annual*	*500 mrem in 1 yr*
	Weekly	100 mrem in 7 days
	Hourly	2 mrem in 1 h
2. Airborne (nonnatural radioactivity) effluent at boundary		1.9×10^{-21} µCi/mL
Limit (CCR 17 Section 30269)		2×10^{-14} µCi/mL
Natural Exposure to Average Member of U.S. Public		
1. Direct radiation ("Health Effects of Exposure to Low Levels of Ionizing Radiation – BEIR V," National Academy Press. Washington DC, 1990)		100 mrem/yr
2. Airborne (natural) radioactivity (Estimated by De Soto site measurements of gross alpha and beta radioactivity concentrations in ambient air.)		2.5×10^{-14} µCi/mL

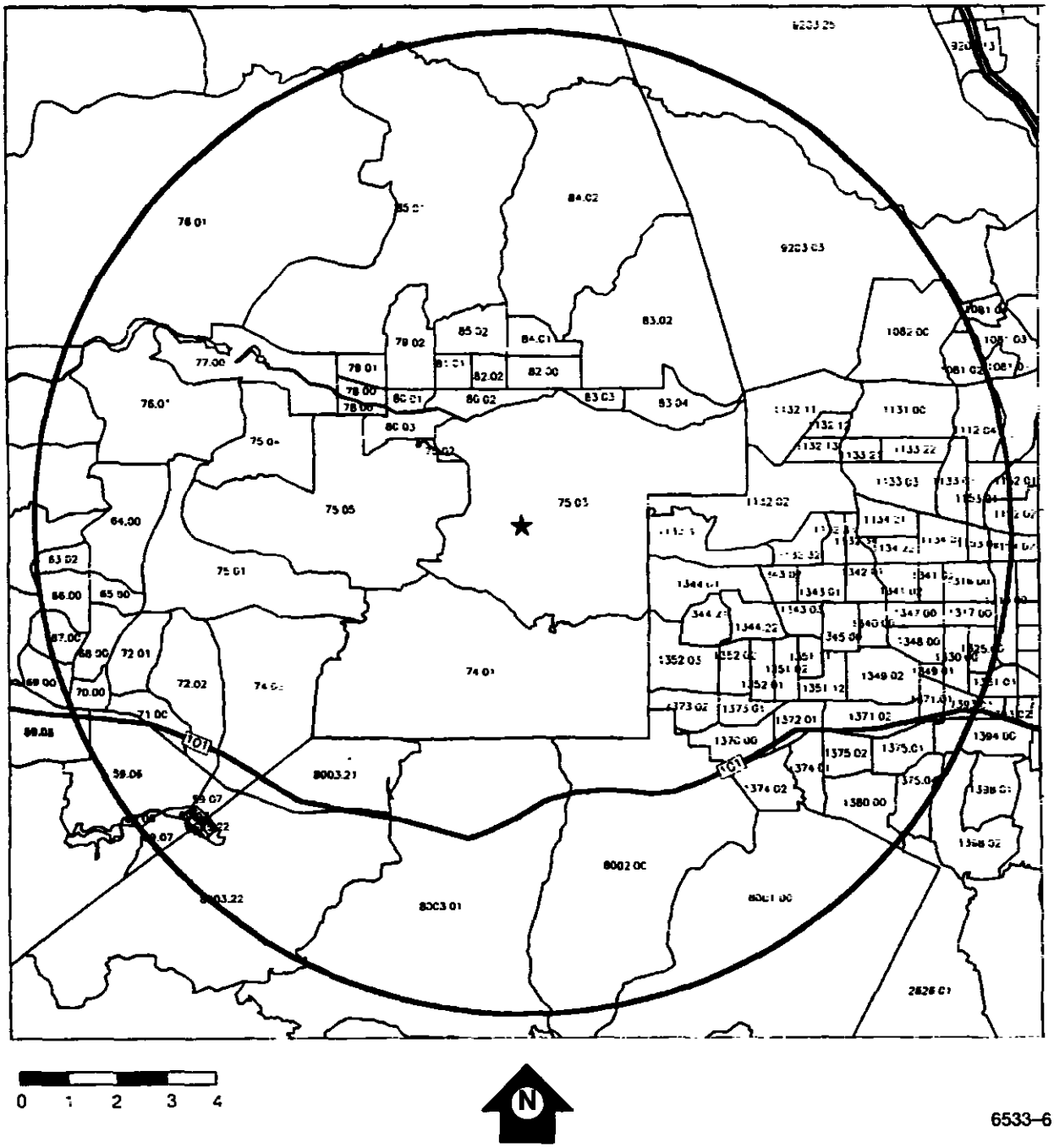

Figure 5–6. Census Tract Boundaries (1990) within 10 miles of SSFL (Individual tracts are identified by number)

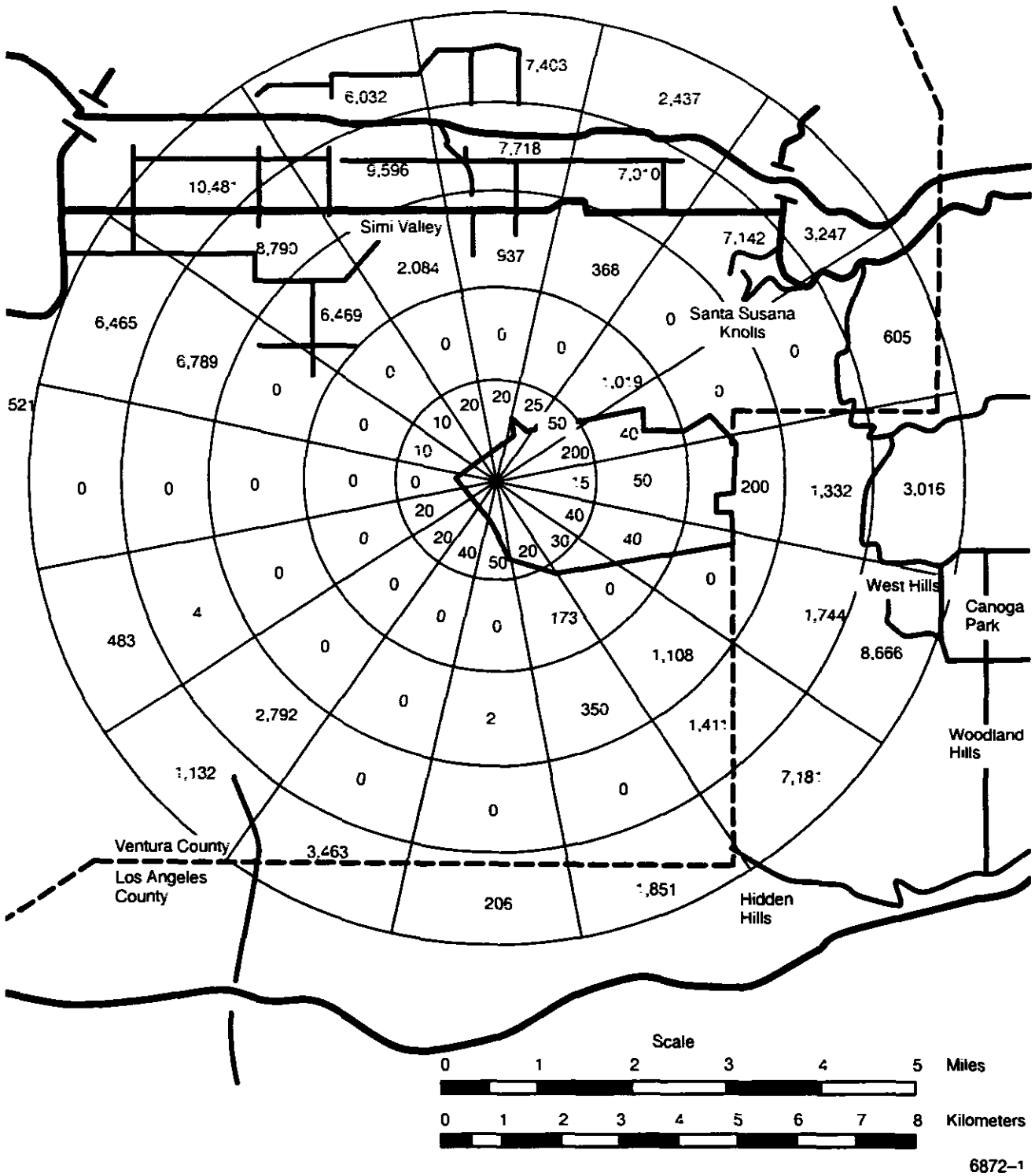

Figure 5–7. SSFL Site–Centered Demography to 8 km, Showing Number of Persons Living in Each Grid Area—1990 (Daytime Employment for SSFL)

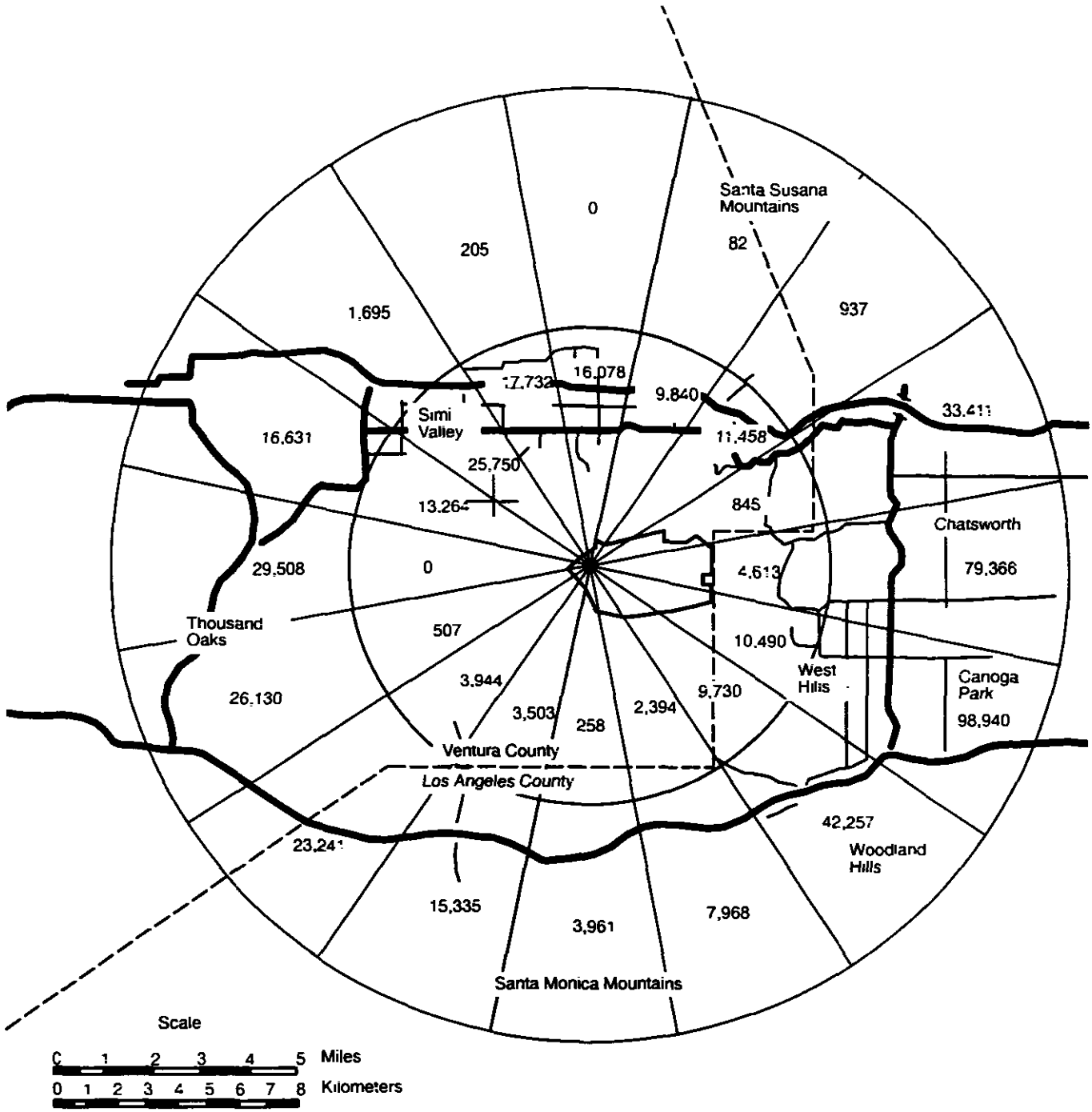

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Figure 5–8. SSFL Site–Centered Demography to 16 km, Showing Number of Persons Living in Each Grid Area—1990

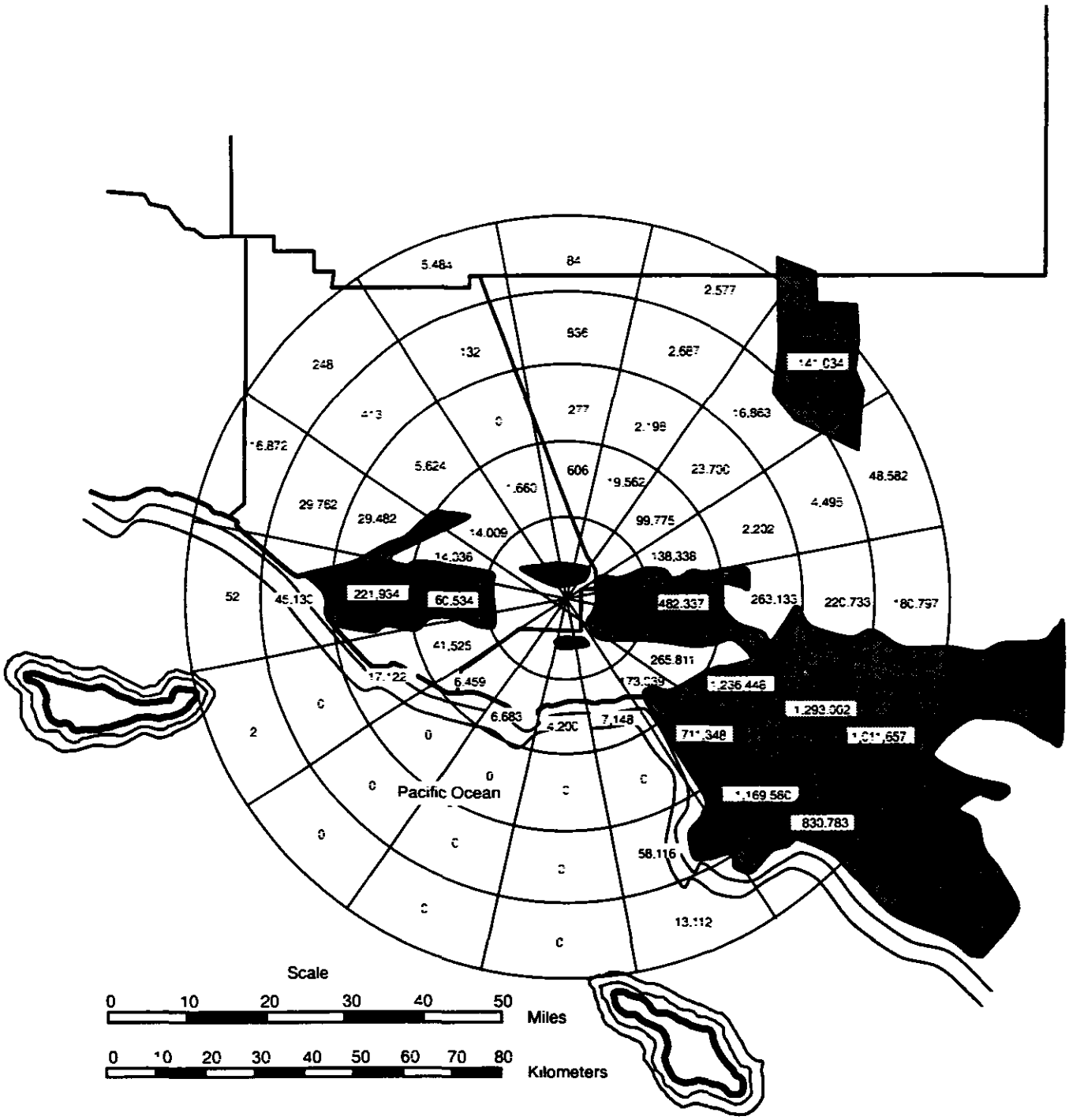

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Figure 5–9. SSFL Site–Centered Demography to 80 km, Showing Number of Persons Living in Each Grid Area—1990 (heavily populated areas are shown by shading)

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6.0 ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

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. As a part of this program, Rocketdyne is currently involved in an extensive groundwater remediation program and has the capacity for removing solvent contamination from approximately one million gallons of groundwater per day at SSFL. All former surface impoundments have been closed and are in the closure approval process with the Cal–EPA Department of Toxic Substance Control (DTSC). Contamination resulting from underground storage tanks (USTs) has been remediated as tanks are removed. The majority of the storage tanks have been removed. The few remaining USTs are equipped with automatic leak detection systems in compliance with Ventura County UST ordinances. After an extensive review of past UST closures, it appeared that one tank, UT–55, warranted further investigation. ETEC is working with the Ventura County Environmenetal Health Division on this matter. The environmental restoration activities at SSFL include an extensive review of past programs and historical practices to identify, characterize, and correct all areas of potential concern.

Extensive monitoring programs for both radiological and 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.

The discharge of surface water at SSFL is usually rain induced or due to the nonutilization of treated groundwater and is regulated by the California Regional Water Quality Control Board 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 near Area IV generates rainfall runoff to five northwest boundary runoff channels where monitoring locations (see 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.

Soil analyses have been and are site specific according to the activities generating the analyses 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 RCRA regulations.

The 1993 SARA Title III Form R (Toxic Release Inventory) submission will be sent to both the state and federal agencies by the 1 July 1994 deadline. The forms include questions regarding off–site waste shipments and air emission calculations. At ETEC only two chemicals met the threshold requirements this year: ammonia and sulfuric acid.

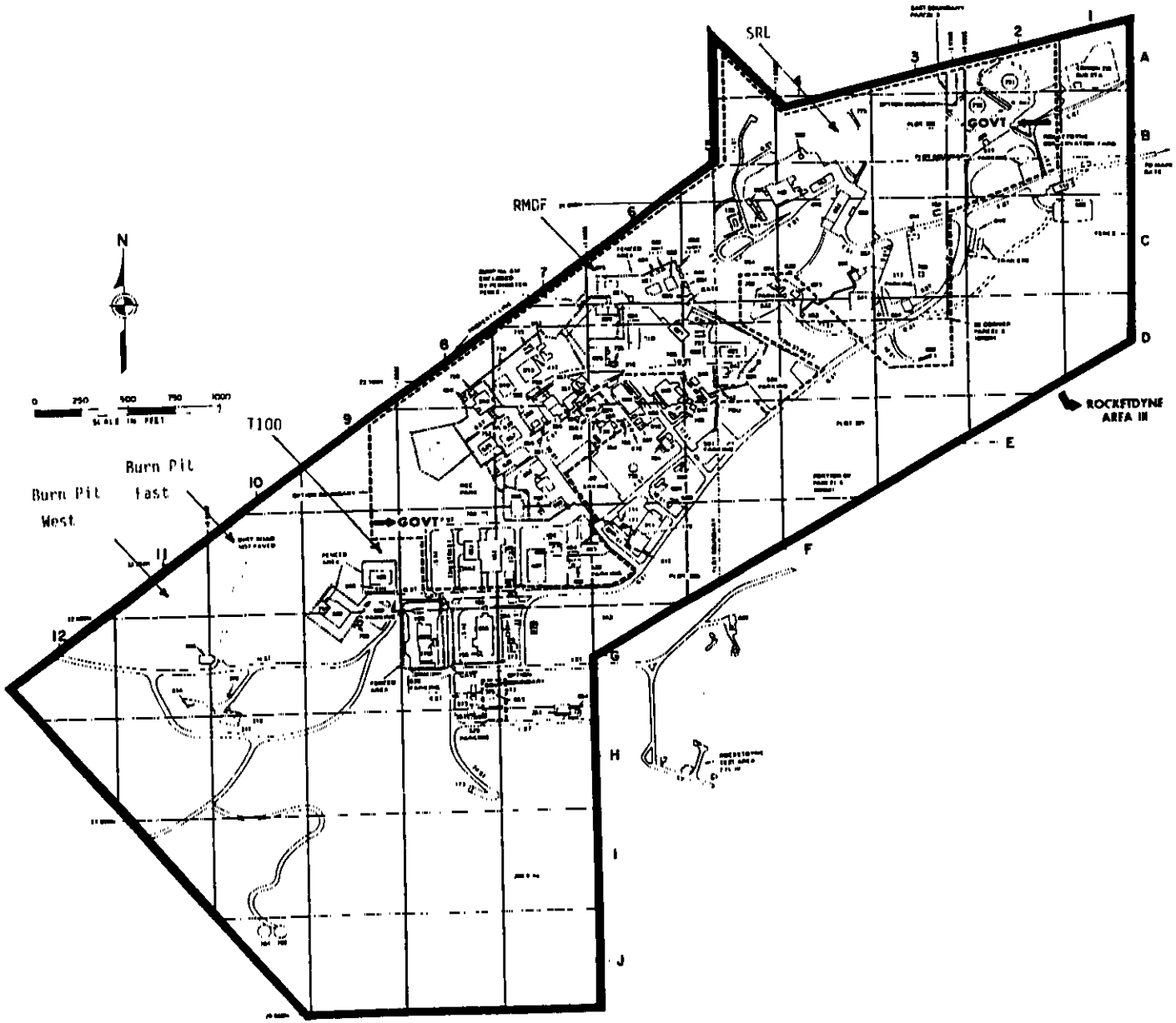

Figure 6–1. Locations of Rainfall Runoff Collectors Along Northwest Boundary of SSFL, Area IV

The overall annual groundwater monitoring program at SSFL addresses collection and analysis of groundwater samples and measurement of the water levels for the 186 Rocketdyne installed wells on–site and 16 off–site private wells. The locations of these wells within and around 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.

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). Alluvium along the major surface drainage systems may store and transmit groundwater to the underlying Chatsworth Formation through fractures. Water levels in the alluvium respond to recharge resulting from surface flows and may vary considerably between wet and dry periods. 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.

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 direction of groundwater flow in the formation is probably radially off–site toward the surrounding lowlands. The permeability of the Chatsworth Formation is very low except along open fractures. Groundwater within fractures occurs under both confined and unconfined conditions.

The hydrogeologic environment at the SSFL site is a dynamic system. Groundwater is recharged at the site, moves through the aquifers, and discharges to the surface or to other aquifers down–gradient of the site. The groundwater system is recharged by precipitation and by 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 contaminant transport along fracture zones are difficult to predict on the basis of on–site well data. Fracture zones vary widely in frequency and geometry from one location to the other as well as from one specific depth to another. Recharge over the area may also vary over both space and time.

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 oil are collected and recycled to the maximum extent possible. 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 circulated in the Rocketdyne newspaper to promote environmental awareness among all employees.

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 13 December 1993. 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. Additionally, an

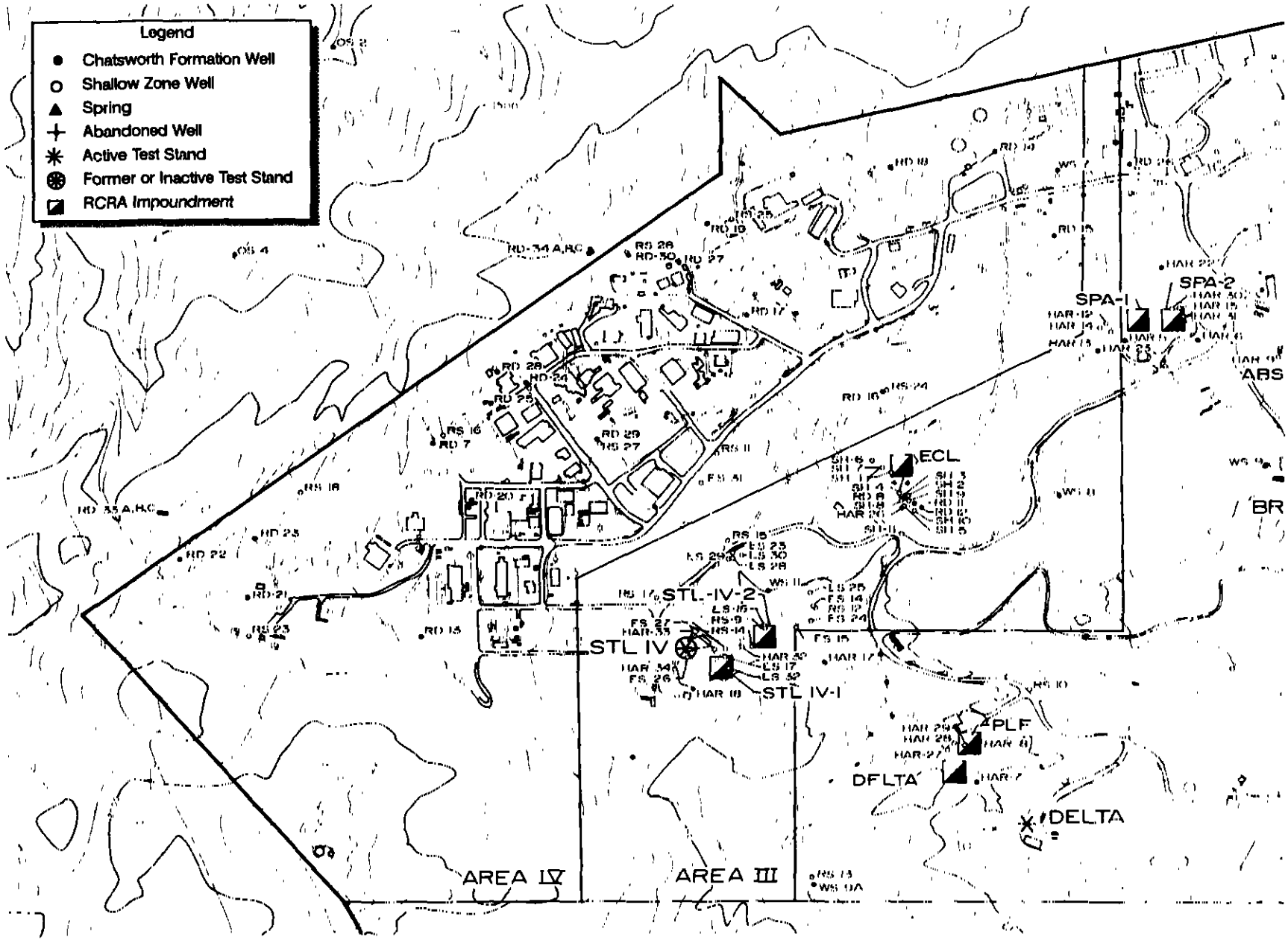

Figure 6–2. Locations of Wells Used in Groundwater Management Program

updated hazardous materials inventory was submitted as an update of the business plan on 13 December 1993. The hazardous materials disclosure fee was also submitted.

Asbestos control at Rocketdyne 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 asbestos abatement program. Several steps in managing an asbestos program 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. With 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.

In summary, Rocketdyne is committed to sound environmental management of all programs at our facilities and to correcting existing environmental problems before they pose a threat to our employees or the public. We have a longstanding record of our commitment to protecting the environment and will continue to strengthen that commitment in the future.

6.1 SURFACE WATER

Rocketdyne has filed a Report of Waste Discharge with the California Regional Water Quality Control Board (RWQCB) 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 27 September 1976. The permit was renewed with minor changes effective 17 September 1984 and has since undergone significant modifications subsequent to reissuance on 7 December 1992. This 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 generally occurs only during and after periods of heavy rainfall along the northwest slope (Outfalls 003 through 007). 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 discharged 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. The remaining pond is identified as Perimeter Pond. Analytical results from 1993 surface water discharge events and storm water runoff are shown in Tables 6–1 through 6–6.

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 Lab. Analytes include nonradioactive chemical constituents such as heavy metals, volatile organics, base/neutral and acid extractables, and general

Table 6–1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 1 of 8)

29 DECEMBER 1992 – 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	29-Dec	7-Jan	13-Jan	28-Jan	8-Feb	18-Feb
RAINFALL	INCHES	NOT APPLICABLE	0.82	2.42	7.21	0.06	3.7	7.49
VOLUME DISCHARGED	MG	150 MGD	10.5	6.6	76.6	5.04	15.5	62.9
pH	pH UNITS	6.0 TO 9.0	7.5	7.8	6.6	8	7.4	7.3
TEMPERATURE	DEG. F	NTE > 100	52	52	53	51	52	52
TURBIDITY	TU	NOT STATED	49	18	56	ND	91	60
TOTAL SUSPENDED SOLIDS	mg/l	75/ - /15	59	60	52	1	240	81
SETTLEABLE SOLIDS	mg/l	0.3/ - /0.1	0.2	0.1	0.5	0.1	0.3	0.2
TOTAL DISSOLVED SOLIDS	mg/l	950/ - / -	302	47	184	1144	60	144
TOTAL ORGANIC CARBON	ug/l	NOT STATED	11	12.2	10.5	13.2	16.1	15.2
CONDUCTIVITY @ 25 C	umhos/cm	NOT STATED	410	265	223	1440	189	175
BOD 5-DAY A@ 20 C	mg/l	30/ - / -	9.8	4.5	15	<5	<5	7
OIL AND GREASE	mg/l	15/ - / -	1	ND	0.7	0.6	8.7	ND
CHLORIDE	mg/l	150/ - / -	25.5	21	13.6	49.5	10.6	10.9
FLUORIDE	mg/l	1.0/ - / -	0.3	0.3	0.2	0.6	0.2	0.2
NITRATE AND NITRITE (AS NITROGEN)	mg/l	8.0/ - / -		0.5	1.5	0.9	0.2	0.01
SULFATE	mg/l	300/ - / -	80	35	41	502	44	48
SURFACTANTS (AS MBAs)	mg/l	0.5/ - / -	ND	0.034	ND	0.104	ND	ND
RESIDUAL CHLORINE	mg/l	0.1/ - / -	ND	ND	ND	ND	0.1	ND
ARSENIC	ug/l	360/ 190 / 5.0	2	2	2	ND	4	3
BARIUM	ug/l	1,000/ - / -	40	54	66	77	87	58
BORON	mg/l	1.0/ - / -	ND	0.2	ND	0.6	0.2	ND
TOTAL HARDNESS (CaCO3)	mg/l	NOT APPLICABLE	151.8	100.4	89.6	615.2	93.4	102
RADIOACTIVITY								
GROSS ALPHA	Pci/l	15/ - / -	3 +/- 2	7 +/- 3	<2	NA	5 +/- 4	<2
GROSS BETA	Pci/l	50/ - / -	8 +/- 6	17 +/- 4	<3	NA	6 +/- 3	<3
TOTAL RADIUM 226 & RADIUM 228	Pci/l	5/ - / -	<1.6	<1.6	<1.6	NA	<1.6	<1.6
TRITIUM	Pci/l	20,000/ - / -	<500	<500	984 +/- 487	NA	<500	NA
STRONTIUM-90	Pci/l	8/ - / -	<0.5	<0.5	<0.5	NA	1.7 +/- 1.5	<0.5
METALS								
CADMIUM	ug/l	NC/ NC /10	ND	ND	ND	ND	ND	ND
CHROMIUM	ug/l	16/ 11 /50	ND	27	12	75	18	ND
COPPER	ug/l	NC/ NC /1000	9	11	10	ND	11	7
LEAD	ug/l	NC/ NC /12	ND	ND	6	ND	7	ND
MERCURY	ug/l	2400/ NC /12	ND	ND	ND	ND	ND	ND
NICKEL	ug/l	NC/ NC /600	ND	ND	ND	ND	ND	ND
SELENIUM	ug/l	20/ 5 /10	ND	ND	ND	ND	ND	ND
SILVER	ug/l	nc/ - /50	57	56	ND	ND	ND	ND
ZINC	ug/l	388 / 351 /5000	76	130	71	17	66	59

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6–1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 2 of 8)

29 DECEMBER 1992 - 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	29-Dec	7-Jan	13-Jan	28-Jan	8-Feb	18-Feb
PESTICIDES & HERBICIDES			ND	ND	ND	ND	ND	ND
VOLITILE ORGANICS								
CHLOROFORM	µg/l	-/-/100	4	ND	ND	ND	ND	ND
ALL OTHERS			ND	ND	ND	ND	ND	ND
SEMI-VOLITILES								
FLUORANTHENE	µg/l	-/-/42	ND	ND	ND	ND	ND	ND
BASE/NEUTRAL/ACID EXTRACTIBLES			ND	ND	ND	ND	ND	ND
MISCELLANEOUS								
CYANIDE	µg/l	22/-/-	ND	ND	ND	ND	ND	ND
PCB's	µg/l	-/14000/70	ND	ND	ND	ND	ND	ND
PAH's	µg/l	-/-/2.8	ND	ND	ND	ND	ND	ND
HALOMETHANES	µg/l	-/-/100	ND	ND	ND	ND	ND	ND
TOXICITY - BIOASSAYS								
ACUTE	% SURVIVAL	70% MINIMUM	90%	100%	100%	100%	100%	100%
CHRONIC	TUC	-/-/1	1	3.13	NA	NA	NA	NA

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6–1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 3 of 8)

29 DECEMBER 1992 - 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	1-Mar	8-Mar	22-Mar	29-Mar	14-Apr	11-May
RAINFALL	INCHES	NOT APPLICABLE	0	0	0	0	0	0
VOLUME DISCHARGED	MG	150 MGD	0.396	0.252	1.018	1.2	0.15	0.49
pH	pH UNITS	6.0 TO 9.0	7.4	7.8	8.2	8.1	8.2	8.3
TEMPERATURE	DEG F	NTE = 100	53	63	63	63	65	68
TURBIDITY	TU	NOT STATED	5	2.4	2	12	ND	2.5
TOTAL SUSPENDED SOLIDS	mg/l	75/ - /15	ND	1	5.5	8	3.5	2
SETTLEABLE SOLIDS	mg/l	0.3/ - /0.1	ND	ND	ND	ND	0.1	ND
TOTAL DISSOLVED SOLIDS	mg/l	950/ - / -	252	475	536	364	634	606.2
TOTAL ORGANIC CARBON	µg/l	NOT STATED	10.5	10.9	16.9	12.9	18.1	17
CONDUCTIVITY @ 25 C	umhos/cm	NOT STATED	320	668	834	500	978	870
BOD 5-DAY A@ 20 C	mg/l	30/ - / -	<5.0	<5.0	<5.0	<5.0	ND	<5
OIL AND GREASE	mg/l	15/ - / -	ND	0.5	2.2	1.4	0.5	0.6
CHLORIDE	mg/l	150/ - / -	21.3	42.6	41.3	25.9	46.5	61.7
FLUORIDE	mg/l	1.8/ - / -	0.4	0.3	0.3	0.2	0.4	0.5
NITRATE AND NITRITE (AS NITROGEN)	mg/l	5.0/ - / -	0.01	1.2	0.4	0.83	1.18	1.6
SULFATE	mg/l	300/ - / -	41	85	152	83	103	158
SURFACTANTS (AS MBAs)	mg/l	0.5/ - / -	0.06	0.039	0.034	0.027	0.025	0.043
RESIDUAL CHLORINE	mg/l	0.1/ - / -	ND	ND	ND	ND	ND	ND
ARSENIC	µg/l	360/ 190 / 5.0	2	1	ND	3	ND	2
BARIUM	µg/l	1,000/ - / -	33	53	48	35	49	45
BORON	mg/l	1.0/ - / -	ND	0.3	0.3	0.2	0.3	0.4
TOTAL HARDNESS (CaCO3)	mg/l	NOT APPLICABLE	128	250	260	160	305.6	278
RADIOACTIVITY								
GROSS ALPHA	Pci/l	15/ - / -	<2	<2	<2	<2	<2	2 +/- 1
GROSS BETA	Pci/l	50/ - / -	<3	9 +/- 2	<3	<3	<3	6 +/-3
TOTAL RADIUM-226 & RADIUM 228	Pci/l	5/ - / -	<1.6	<1.6	<1.6	<1.6	<1.6	0 +/- 1
TRITIUM	Pci/l	20,000/ - / -	<1000	<500	<500	940 +/- 464	<500	0 +/- 230
STRONTIUM-90	Pci/l	8/ - / -	3.7 +/- 2.0	<0.5	<0.5	<0.5	<0.5	0.1 +/- 1
METALS								
CADMIUM	µg/l	NC/ NC /10	ND	ND	ND	ND	ND	ND
CHROMIUM	µg/l	10/ 11 /50	ND	20	10	ND	ND	ND
COPPER	µg/l	NC/ NC /1000	ND	6	15	ND	ND	8
LEAD	µg/l	NC/ NC /12	ND	ND	ND	ND	ND	ND
MERCURY	µg/l	2400/ NC /12	ND	ND	ND	ND	ND	ND
NICKEL	µg/l	NC/ NC /500	ND	ND	ND	ND	ND	ND
SELENIUM	µg/l	20/ 5 /10	ND	ND	ND	ND	ND	ND
SILVER	µg/l	NC/ - /50	ND	ND	ND	ND	ND	ND
ZINC	µg/l	388 / 351 /5000	36	11	22	ND	6	14

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6–1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 4 of 8)

29 DECEMBER 1992 – 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	1-Mar	8-Mar	22-Mar	29-Mar	14-Apr	11-May
PESTICIDES & HERBICIDES			ND	ND	ND	ND	ND	ND
VOLITILE ORGANICS								
CHLOROFORM	µg/l	-/-/ 100	ND	ND	ND	ND	ND	ND
ALL OTHERS			ND	ND	ND	ND	ND	ND
SEMI-VOLITILES								
FLUORANTHENE	µg/l	-/-/ 42	ND	ND	ND	ND	ND	ND
BASE/NEUTRAL/ACID EXTRACTIBLES			ND	ND	ND	ND	ND	ND
MISCELLANEOUS								
CYANIDE	µg/l	22/-/-	ND	ND	ND	ND	ND	ND
PCB's	pg/l	-/ 14000 / 70	ND	ND	ND	ND	ND	ND
PAH's	ng/l	-/-/ 2.8	ND	ND	ND	ND	ND	ND
HALOMETHANES	µg/l	-/-/100	ND	ND	ND	ND	ND	ND
TOXICITY - BIOASSAYS								
ACUTE	% SURVIVAL	70% MINIMUM	100%	95%	95%	100%	100%	100%
CHRONIC	TUC	-/-/ 1	NA	NA	NA	NA	NA	1

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6–1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 5 of 8)

29 DECEMBER 1992 – 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	29-Jun	22-Jul	5-Aug	7-Sep	12-Oct	2-Nov
RAINFALL	INCHES	NOT APPLICABLE	0	0	0	0	0	0
VOLUME DISCHARGED	MG	150 MGD	0.22	0.22	0.28	0.2	0.19	0.007
pH	pH UNITS	6.0 TO 9.0	8.2	8.3	8.4	8.2	8.2	8.1
TEMPERATURE	DEG. F	NTE = 100	67	65	71	67.2	63	64
TURBIDITY	TU	NOT STATED	1.9	3	0.5	2	2	0.71
TOTAL SUSPENDED SOLIDS	mg/l	75/ - /15	4	ND	ND	6	4.5	3
SETTLEABLE SOLIDS	mg/l	0.3/ - /0.1	ND	ND	ND	0.5	ND	ND
TOTAL DISSOLVED SOLIDS	mg/l	950/ - / -	600	655	665	644	709	698
TOTAL ORGANIC CARBON	mg/l	NOT STATED	15	10.2	7.3	10.4	12.4	10.2
CONDUCTIVITY @ 25 C	umhos/cm	NOT STATED	1037	1022	1165	1046	1154	972.8
BOD 5-DAY A@ 20 C	mg/l	30/ - / -	5	2	ND	2	ND	ND
OIL AND GREASE	mg/l	15/ - / -	0.84	50.1	1.4	1	1.1	0.95
CHLORIDE	mg/l	150/ - / -	80	72.3	81	77.3	84.4	78.5
FLUORIDE	mg/l	1.6/ - / -	0.4	0.5	0.5	0.4	0.3	0.4
NITRATE AND NITRITE (AS NITROGEN)	mg/l	5.0/ - / -	1.08	1.2	2	1.26	4.4	4.8
SULFATE	mg/l	300/ - / -	182	159	155	151	196	179
SURFACTANTS (AS MBAs)	mg/l	0.5/ - / -	0.026	0.1	0.05	ND	0.469	0.05
RESIDUAL CHLORINE	mg/l	0.1/ - / -	ND	ND	ND	ND	ND	ND
ARSENIC	µg/l	350/ 190 / 5.0	3	2	ND	2	ND	2
BARIUM	µg/l	1,000/ - / -	48	48	49	64	47	55
BORON	mg/l	1.0/ - / -	0.3	0.4	0.4	0.3	0.4	0.4
TOTAL HARDNESS (CaCO3)	mg/l	NOT APPLICABLE	325	277	317	325	345	412
RADIOACTIVITY								
GROSS ALPHA	Pci/l	15/ - / -	3 +/- 1	4 +/- 2	3 +/- 1	3 +/- 1	1 +/- 0.2	2.2 +/- 0.6
GROSS BETA	Pci/l	50/ - / -	6 +/- 3	2 +/- 5	3 +/- 2	5 +/- 1	5 +/- 0.3	7.0 +/- 0.8
TOTAL RADIUM-226 & RADIUM 228	Pci/l	5/ - / -	0 +/- 1	0 +/- 1	0 +/-1	0 +/- 1	0 +/-1	<1.0
TRITIUM	Pci/l	20,000/ - / -	0 +/- 200	340 +/- 290	0 +/- 220	350 +/-110	<200	<500
STRONTIUM-90	Pci/l	8/ - / -	0.2 +/- 1	0 +/- 1	0.1 +/- 1	0 +/-1	0 +/- 1	<0.5
METALS								
CADMIUM	µg/l	NC/ NC /10	ND	ND	ND	ND	ND	ND
CHROMIUM	µg/l	15/ 11 /50	ND	ND	ND	ND	ND	ND
COPPER	µg/l	NC/ NC /1000	ND	ND	ND	ND	6	ND
LEAD	µg/l	NC/ NC /12	ND	ND	ND	ND	ND	ND
MERCURY	µg/l	2400/ NC /12	ND	ND	ND	ND	ND	ND
NICKEL	µg/l	NC/ NC /600	ND	ND	ND	ND	ND	ND
SELENIUM	µg/l	20/ 5 /10	ND	ND	ND	ND	ND	ND
SILVER	µg/l	nc/ - /50	ND	ND	ND	ND	ND	ND
ZINC	µg/l	386 / 351 /5000	12	4	12	24	16	20

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6–1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 6 of 8)

29 DECEMBER 1992 – 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	29-Jun	22-Jul	5-Aug	7-Sep	12-Oct	2-Nov
PESTICIDES & HERBICIDES			ND	ND	ND	ND	ND	ND
VOLITILE ORGANICS								
CHLOROFORM	µg/l	-/ - / 100	ND	ND	ND	ND	ND	ND
ALL OTHERS			ND	ND	ND	ND	ND	ND
SEMI-VOLITILES								
FLUORANTHENE	µg/l	-/ - / 42	ND	ND	ND	ND	ND	ND
BASE/NEUTRAL/ACID EXTRACTIBLES			ND	ND	ND	ND	ND	ND
MISCELLANEOUS								
CYANIDE	µg/l	22/ - / -	ND	ND	ND	ND	ND	ND
PCB's	pg/l	-/ 14000 / 70	ND	ND	ND	ND	ND	ND
PAH's	ng/l	-/ - / 2.8	ND	ND	ND	ND	ND	ND
HALOMETHANES	µg/l	-/ - / 100	ND	ND	ND	ND	ND	ND
TOXICITY - BIOASSAYS								
ACUTE	% SURVIVAL	70% MINIMUM	100%	100%	100%	100%	100%	100%
CHRONIC	TUC	-/ - / 1	NA	NA	NA	NA	NA	NA

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6−1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 7 of 8)

29 DECEMBER 1992 – 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	6-Dec	12-Dec
RAINFALL	INCHES	NOT APPLICABLE	0	0
VOLUME DISCHARGED	MG	150 MGD	0.21	0.28
pH	pH UNITS	6.0 TO 9.0	8.3	8.3
TEMPERATURE	DEG. F	NTE > 100	62.4	48.9
TURBIDITY	TU	NOT STATED	2.3	43
TOTAL SUSPENDED SOLIDS	mg/l	75/ - /15	3.5	10.5
SETTLEABLE SOLIDS	mg/l	0.3/ - /0.1	ND	0.3
TOTAL DISSOLVED SOLIDS	mg/l	950/ - / -	536	495
TOTAL ORGANIC CARBON	µg/l	NOT STATED	7	16
CONDUCTIVITY @ 25 C	umhos/cm	NOT STATED	861	824
BOD 5-DAY A@ 20 C	mg/l	30/ - / -	4	4
OIL AND GREASE	mg/l	15/ - / -	1.6	0.7
CHLORIDE	mg/l	150/ - / -	71.2	57.3
FLUORIDE	mg/l	1.0/ - / -	0.456	0.4
NITRATE AND NITRITE (AS NITROGEN)	mg/l	8.0/ - / -	0.8	0.2
SULFATE	mg/l	300/ - / -	140	133
SURFACTANTS (AS MBAs)	mg/l	0.5/ - / -	0.1	ND
RESIDUAL CHLORINE	mg/l	0.1/ - / -	ND	ND
ARSENIC	µg/l	360/ 190 / 5.9	ND	1
BARIUM	µg/l	1,000/ - / -	52	46
BORON	mg/l	1.0/ - / -	0.3	0.3
TOTAL HARDNESS (CaCO3)	mg/l	NOT APPLICABLE	336	292
RADIOACTIVITY				
GROSS ALPHA	PCi/l	15/ - / -	3.3 +/- 3.3	4.8 +/- 2.6
GROSS BETA	PCi/l	50/ - / -	4.7 +/- 6	6.3 +/- 2.2
TOTAL RADIUM-226 & RADIUM 228	PCi/l	5/ - / -	0.8 +/- 1.6	2.1 +/- 2.6
TRITIUM	PCi/l	20,000/ - / -	0 +/- 290	0 +/- 190
STRONTIUM-90	PCi/l	8/ - / -	0.5 +/- 2.1	1.1 +/- 1.3
METALS				
CADMIUM	µg/l	NC/ NC /10	ND	ND
CHROMIUM	µg/l	16/ 11 /50	ND	ND
COPPER	µg/l	NC/ NC /1000	ND	ND
LEAD	µg/l	NC/ NC /12	ND	ND
MERCURY	µg/l	2400/ NC /12	ND	ND
NICKEL	µg/l	NC/ NC /5000	ND	ND
SELENIUM	µg/l	20/ 5 /10	ND	ND
SILVER	µg/l	0.9/ - /50	ND	ND
ZINC	µg/l	388 / 351 /5000	25	38

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6–1. 1993 Analytical Results for NPDES Water Releases from Outfall 002 (R2A Flume) (Sheet 8 of 8)

29 DECEMBER 1992 – 31 DECEMBER 1993

CONSTITUENT	UNITS	EFFLUENT LIMITS A=INST.MAX B=DAILY MAX C=30 DAY AVE. (A/B/C)	6-Dec	12-Dec
PESTICIDES & HERBICIDES			ND	ND
VOLITILE ORGANICS				
CHLOROFORM	µg/l	-/ - / 100	ND	ND
ALL OTHERS			ND	ND
SEMI-VOLITILES				
FLUORANTHENE	µg/l	-/ - / 42	ND	ND
BASE/NEUTRAL/ACID EXTRACTIBLES			ND	ND
MISCELLANEOUS				
CYANIDE	µg/l	22/ - / -	ND	ND
PCB's	µg/l	-/ 14000 / 70	ND	ND
PAH's	µg/l	-/ - / 2.8	ND	ND
HALOMETHANES	µg/l	-/ - /100	ND	ND
TOXICITY - BIOASSAYS				
ACUTE	% SURVIVAL	70% MINIMUM	100%	100%
CHRONIC	TUC	-/ - / 1	4	NA

NA = NOT ANALYZED
ND = NOT DETECTED
NC = NOT CALCULATED

Table 6-2. 1993 Analytical Results for NPDES Water Releases from Outfall 003 (RMDF)

FOR 29 DECEMBER 1992 - 31 DECEMBER 1993

CONSTITUENT	UNITS	LIMITS	29-Dec	7-Jan	14-Jan	8-Feb	18-Feb	26-Feb	25-Mar	14-Dec
RAINFALL	INCHES	NOT APPLICABLE	0.82	2.42	7.21	3.7	7.49	0.74	2.5	0.3
VOLUME DISCHARGED	MG	150 MGD	0.23	0.66	2.03	1.04	2.11	0.21	0.70	0.08
pH	pH UNITS	6.0 TO 9.0	7	8.3	7.3	7.3	7.5	7.7	7.7	8.4
TEMPERATURE	DEG. F	NTE + 100	53	55	53	56	54	54	53	50
TOTAL DISSOLVED SOLIDS	mg/l	950	19,635	51	725	139	138	231	799	198
OIL AND GREASE	mg/l	15	3.2	ND	0.3	1.4	2	0.8	2.5	2.7
CHLORIDE	mg/l	150	2.3	1.8	62.8	4.5	6.6	9.7	56	16.6
FLUORIDE	mg/l	1	0.2	0.1	0.1	0.2	0.1	0.3	0.3	0.2
NITRATE AND NITRITE (AS NITROGEN)	mg/l	5	NA	0.3	5.2	0.6	0.1	ND	ND	1.2
SULFATE	mg/l	300	8	ND	155	28	23	42	223	45
RESIDUAL CHLORINE	mg/l	0.1	ND	ND	ND	ND	ND	ND	ND	ND
BORON	mg/l	1	ND	ND	0.2	ND	ND	ND	0.5	0.2
RADIOACTIVITY										
GROSS ALPHA	Pci/l	15	<2	<2	6 +/-3	<2	3 +/- 2	<2	5 +/- 3	2.6 +/- 1.5
GROSS BETA	Pci/l	50	5 +/- 4	<3	20 +/- 4	5 +/- 3	<3	<3	5 +/- 4	3.9 +/- 1.7
TOTAL RADIUM-226 & RADIUM 228	Pci/l	5	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	23. +/- 2.3
TRITIUM	Pci/l	20,000	<500	<500	<500	<500	<500	<500	<500	0 +/- 190
STRONTIUM-90	Pci/l	8	2.4 +/- 1	<0.5	1.1 +/- 0.9	<0.5	<1	<0.5	<0.5	0 +/- 1.2
TOXICITY - BIOASSAYS										
ACUTE	% SURVIVAL	70% MINIMUM	100%	100%	100%	100%	100%	100%	100%	100%
CHRONIC	TUC	1	NA	1	NA	NA	NA	NA	NA	1

NA = NOT ANALYZED
ND = NOT DETECTED

Table 6-3. 1993 Analytical Results for NPDES Water Releases from Outfall 004 (SRE)

FOR 29 DECEMBER 1992 - 31 DECEMBER 1993

CONSTITUENT	UNITS	LIMITS	29-Dec	7-Jan	14-Jan	8-Feb	18-Feb	26-Feb	25-Mar	14-Dec
RAINFALL	INCHES	NOT APPLICABLE	0.82	2.42	7.21	3.7	7.49	0.74	2.5	0.3
VOLUME DISCHARGED	MG	150 MGD	0.32	0.96	2.85	1.46	2.97	0.29	0.99	0.12
pH	pH UNITS	6.0 TO 9.0	6.8	7.6	7.7	7.5	7.5	7.3	7.3	7.2
TEMPERATURE	DEG. F	NTE + 100	52	53	53	61	55	54	55	50
TOTAL DISSOLVED SOLIDS	mg/l	956	110	365	242	178	50	111	105.5	81
OIL AND GREASE	mg/l	15	0.9	1.2	1.1	0.2	1.8	1.2	2.4	1.1
CHLORIDE	mg/l	150	2.6	12.7	8.4	1.3	2.3	4.2	4.1	3
FLUORIDE	mg/l	1	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1
NITRATE AND NITRITE (AS NITROGEN)	mg/l	8	NA	2.2	5.2	0.8	0.012	ND	ND	0.8
SULFATE	mg/l	300	5	36	10	14	11	15	18	5
RESIDUAL CHLORINE	mg/l	0.1	ND	ND	ND	ND	ND	ND	ND	ND
BORON	mg/l	1	ND	ND	0.2	ND	ND	ND	ND	ND
RADIOACTIVITY										
GROSS ALPHA	pCi/l	15	8 +/- 7	3 +/- 2	<2	<2	<2	<2	<2	0.7 +/- 0.7
GROSS BETA	pCi/l	50	26 +/- 17	5 +/- 4	6 +/- 3	6 +/- 3	<3	<3	<3	4.0 +/- 1.6
TOTAL RADIUM-226 & RADIUM 228	pCi/l	5	15 +/- 25	<1.6	<1.6	<1.6	<1.6	<1.6	<0.6	1.7 +/- 2.3
TRITIUM	pCi/l	20,000	<500	<500	<500	<500	<500	<500	<500	0 +/-190
STRONTIUM-90	pCi/l	8	<500	<0.5	<0.5	<0.5	<0.5	2.3 +/- 1.4	<0.5	0.3 +/- 1.3
TOXICITY - BIOASSAYS										
ACUTE	% SURVIVAL	70% MINIMUM	100%	100%	100%	100%	100%	100%	100%	100%
CHRONIC	TUC	1	NA	3.13	NA	NA	NA	NA	NA	1

NA = NOT ANALYZED
ND = NOT DETECTED

Table 6-4. 1993 Analytical Results for NPDES Water Releases from Outfall 005 (SBP-1)

29 DECEMBER 1992 – 31 DECEMBER 1993

CONSTITUENT	UNITS	LIMITS	29-Dec	7-Jan	14-Jan	8-Feb	18-Feb	26-Feb	25-Mar	12-Dec	14-Dec
RAINFALL	INCHES	NOT APPLICABLE	0.82	2.42	7.21	3.7	7.49	0.74	2.5	0	0.3
VOLUME DISCHARGED	MG	150 MGD	0.34	0.99	2.95	1.51	3.06	0.30	1.02	0.00	0.12
pH	pH UNITS	6.0 TO 9.0	7.8	7.6	7.7	7.8	8.2	8.3	7.7	7.4	NA
TEMPERATURE	DEG. F	MTE > 100	53	53	53	61	58	53	54	46.2	NA
TOTAL DISSOLVED SOLIDS	mg/l	950	373	365	242	351	564	211	309	314	NA
OIL AND GREASE	mg/l	15	1.1	1.2	1.1	9.7	1.6	0.4	2.4	1	NA
CHLORIDE	mg/l	150	5.6	12.7	6.4	3.9	4	3.5	30.4	40.6	NA
FLUORIDE	mg/l	1	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.2	NA
NITRATE AND NITRITE (AS NITROGEN)	mg/l	5	NA	2.2	5.2	0.015	0.01	ND	ND	10	NA
SULFATE	mg/l	300	ND	36	10	145	173	130	60	27	NA
RESIDUAL CHLORINE	mg/l	0.1	ND	ND	ND	ND	ND	ND	ND	ND	NA
BORON	mg/l	1	ND	ND	0.2	ND	ND	ND	ND	0.1	NA
RADIOACTIVITY											
GROSS ALPHA	Pci/l	15	6 +/- 5	3 +/- 2	<2	<2	<2	<2	<2	6.9 +/-2.4	NA
GROSS BETA	Pci/l	50	15 +/- 6	5 +/- 4	6 +/- 3	4 +/- 3	<3	<3	<3	8.2 +/- 2.0	NA
TOTAL RADIUM 226 & RADIUM 228	Pci/l	5	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.6	0.7 +/- 2.8	NA
TRITIUM	Pci/l	20,000	<500	<500	<500	<500	NA	NA	<500	20 +/- 190	NA
STRONTIUM-90	Pci/l	8	3.2 +/-3.1	<0.5	<0.5	<0.5	0.4 +/- 1.1	<0.5	<0.5	0.0 +/-1.3	NA
TOXICITY - BIOASSAYS											
ACUTE	% SURVIVAL	70% MINIMUM	100%	100%	100%	100%	100%	100%	100%	NA	100%
CHRONIC	TUC	1	NA	3.13	NA	NA	NA	NA	NA	NA	2

NA = NOT ANALYZED
ND = NOT DETECTED

Table 6-5. 1993 Analytical Results for NPDES Water Releases from Outfall 006 (SBP-2)

29 DECEMBER 1992 - 31 DECEMBER 1993

CONSTITUENT	UNITS	LIMITS	29-Dec	7-Jan	14-Jan	8-Feb	18-Feb	26-Feb	25-Mar	12-Dec	14-Dec
RAINFALL	INCHES	NOT APPLICABLE	0.82	2.42	7.21	3.7	7.49	0.74	2.5	0	0.3
VOLUME DISCHARGED	Mg	150 MGD	0.25	0.73	2.17	1.12	2.26	0.22	0.75	0.00	0.09
pH	pH UNITS	6.0 TO 9.0	7.3	7.7	7	7.1	7.2	7.5	7.7	9	NA
TEMPERATURE	DEG. F	NTE > 100	53	54	52	59	55	54	55	49.1	NA
TOTAL DISSOLVED SOLIDS	mg/l	950	134	500	163	166	432	230	225	150	NA
OIL AND GREASE	mg/l	15	0.7	0.3	0.4	4.7	2.4	1.3	2.1	1	NA
CHLORIDE	mg/l	150	5.3	5.4	8.6	2.7	5.9	3.6	27.9	5.4	NA
FLUORIDE	mg/l	1	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	NA
NITRATE AND NITRITE (AS NITROGEN)	mg/l	5	NA	0.2	4.9	0.11	0.68	0.31	0.14	1.2	NA
SULFATE	mg/l	300	11	11	13	ND	ND	ND	ND	5	NA
RESIDUAL CHLORINE	mg/l	0.1	ND	ND	ND	44	129	100	91	ND	NA
BORON	mg/l	1	ND	ND	ND	ND	ND	ND	ND	ND	NA
RADIOACTIVITY											
GROSS ALPHA	Pci/l	15	<2	<2	<2	<2	<2	<2	<2	4.4 +/- 1.6	NA
GROSS BETA	Pci/l	50	<3	<3	<3	<3	<3	<3	<3	5.4 +/- 1.8	NA
TOTAL RADIUM-226 & RADIUM 228	Pci/l	5	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<0.6	1.8 +/- 1.3	NA
TRITIUM	Pci/l	20,000	<500	<500	<500	<500	NA	NA	<500	0 +/- 190	NA
STRONTIUM-90	Pci/l	8	<0.5	9.4 +/- 3	<0.6	<0.5	<0.5	<0.5	<0.5	1.1 +/- 1.4	NA
TOXICITY - BIOASSAYS											
ACUTE	% SURVIVAL	70% MINIMUM	100%	100%	100%	100%	100%	100%	100%	NA	100%
CHRONIC	TUC	1	NA	10	NA	NA	NA	NA	NA	NA	1

NA = NOT ANALYZED
ND = NOT DETECTED

Table 6-6. 1993 Analytical Results for NPDES Water Releases from Outfall 007 (B100)

29 DECEMBER 1992 - 31 DECEMBER 1993

CONSTITUENT	UNITS	LIMITS	29-Dec	7-Jan	14-Jan	8-Feb	18-Feb	26-Feb	25-Mar	12-Dec	14-Dec
RAINFALL	INCHES	NOT APPLICABLE	0.82	2.42	7.21	3.7	7.49	0.74	2.5	0	0.3
VOLUME DISCHARGED	MG	150 MGD	0.23	0.67	1.99	1.02	2.06	0.20	0.69	0.00	0.08
pH	pH UNITS	6.0 TO 9.0	6.9	7.3	7	7.3	7	7.4	7.3	7.1	NA
TEMPERATURE	DEG. F	NTE > 100	51	53	53	60	57	50	53	46.4	NA
TOTAL DISSOLVED SOLIDS	mg/l	850	124	112	112	116	99	117	104.5	264	NA
OIL AND GREASE	mg/l	15	1	0.2	0.5	2.9	1.7	0.7	5	1.6	NA
CHLORIDE	mg/l	150	1.8	2.2	3.6	3	3.2	3.4	4.3	7.8	NA
FLUORIDE	mg/l	1	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.2	NA
NITRATE AND NITRITE (AS NITROGEN)	mg/l	8	NA	1.3	2	0.017	0.01	ND	ND	1.5	NA
SULFATE	mg/l	300	9	5	8	45	23	11	ND	5	NA
RESIDUAL CHLORINE	mg/l	0.1	ND	ND	ND	ND	ND	ND	ND	ND	NA
BORON	mg/l	1	ND	ND	ND	ND	ND	ND	0.1	0.2	NA
RADIOACTIVITY											
GROSS ALPHA	Pci/l	15	6 +/- 6	<2	<2	<2	<2	<2	<2	3.9 +/-1.8	NA
GROSS BETA	Pci/l	50	16 +/- 12	8 +/- 4	<3	6 +/- 3	<3	<3	<3	23 +/- 3	NA
TOTAL RADIUM-226 & RADIUM 228	Pci/l	5	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	2.8 +/- 3.1	NA
TRITIUM	Pci/l	20,000	<500	<500	<500	828 +/- 709	NA	NA	<500	0 +/- 160	NA
STRONTIUM-90	Pci/l	8	<0.5	11.5 +/- 3.2	<0.5	2.3 +/- 1.5	<0.5	<0.5	<0.5	1.3 +/-1.4	NA
TOXICITY - BIOASSAYS											
ACUTE	% SURVIVAL	70% MINIMUM	100%	100%	100%	100%	100%	100%	100%	NA	100%
CHRONIC	TUC	1	NA	1	NA	NA	NA	NA	NA	NA	1

NA = NOT ANALYZED
ND = NOT DETECTED

chemistry in addition to specified radionuclides. Toxicity testing is also conducted in the form of fish and chronic toxicity bioassays. The NPDES permit, shown as Appendix A, lists the specific constituents that are analyzed, as well as their respective effluent limits.

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 Disposal Facility watershed (Outfall 003), Sodium Reactor Experiment watershed (Outfall 004), the Former Sodium Disposal Facility (Outfalls 005 and 006), and behind Building 100 (Outfall 007). Runoff monitoring is currently conducted as set forth by the NPDES permit referenced above. Additionally, any surface water runoff program activity, i.e., Northwest Slope outfall in connection with the SWPPP implementation was accomplished by the formalization of the NPDES permit (December 1992). The SWPPP and the NPDES permits were both prepared in accordance with the current federal and state regulations.

6.2 AIR

In addition to the wastewater discharge limitations, 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 Kalina.

In September 1991, Rocketdyne petitioned for and received a VCAPCD variance No. 392 from rule 74.15 pertaining to boilers and steam generators. This variance was required to allow ETEC to operate during start–up and checkout of the newly installed low NOX burners in H–1, H–2, and H–101 boilers and heaters. Problems encountered during checkouts of the system necessitated the request on 15 January 1992 for an extension of the variance that was granted (No. 392–1) until 31 December 1992. The H–1, H–2, and H–101 heaters and boilers are in full compliance at the load levels 25%, 50%, 75%, and 100% as of the H–1 source test in June 1992. However, at load levels lower than 25% and at start–up and shutdown the heaters and boilers have been out of compliance. An extended variance (No. 392–2) was issued by the VCAPCD on 18 November 1992 to cover these noncompliant operations. Variance No. 392–2 was valid until 30 November 1993.

On 18 October 1993, Rocketdyne filed a petition with the VCAPCD Hearing Board to extend the existing variance. On 15 December 1993, the extension (variance No. 392–3) was granted effective 1 December 1993 to 30 November 1994, or when a modified Rule 74.15 is adopted by the APCD; whichever occurs first.

The VCAPCD performed a routine inspection on 9 February 1993. No violations were cited.

On 4 April 1993, VCAPCD engineers from the Permitting and Rules Development sections toured the SCTI facility looking at the H–1 and H–2 sodium heaters and the H–1 boiler pursuant to modifying Rule 74.15 as it pertains to the variance (No. 392–3).

On 13 October 1993, the VCAPCD issued the renewal permit to operate No. 0271 for the permit period 1 January 1993 to 31 December 1993. There were no changes in the permitted emissions.

6.3 GROUNDWATER

A groundwater monitoring program has been in place at the SSFL site since 1984. This has been accomplished largely under the direction and guidance of the regulatory agency responsible during the period 1984 through July 1989, the Los Angeles office of the California RWQCB. (The EPA appointed the Cal-EPA DTSC [Region 3/Burbank] as lead agency in July 1989.) During the past 6 years, a network that now consists of 186 on-site wells and seven off-site wells near the northwest boundary has been completed. Ninety-three of these are in the Shallow Zone, and 93 have been drilled into the Chatsworth Formation, the indurated sandstone that represents the dominant aquifer underlying the facility. In 1987, as part of the statewide requirements under the Toxic Pits Cleanup Act, Rocketdyne submitted the Hydrogeological Assessment Report (HAR) for the entire facility while addressing the ten RCRA-permitted surface impoundment closures. (There are no RCRA surface impoundments in Area IV.) Subsurface soil sampling at over 150 locations has been accomplished. Routine quarterly chemical and radiological monitoring of the wells scheduled for annual review is conducted according to the monitoring plan submitted to the lead agency for the groundwater program.

At the facility, Rocketdyne has seven permitted remedial water treatment systems operating in Areas I, II, and III with one additional treatment system in the permitting process. The combined treatment capacity of these systems is nearly 1,000,000 gallons of solvent-contaminated water per day. Two of the systems are ultraviolet light/hydrogen peroxide treatment units (UV/H_2O_2). The six air stripping tower systems include those at the Area I Road, Alfa, Bravo, Canyon, STL-IV (now in the permitting process), and Delta sites. The combined pumping total of these remediation units has resulted in treatment of 827 million gallons of solvent-contaminated water since 1987. The summaries of the water quality results for the treatment systems are included in the quarterly groundwater program reports submitted to the regulatory agencies. Although seasonal variations exist, examination of the results has revealed that there has been substantial progress in groundwater remediation via the treatment technologies utilized by Rocketdyne.

Plans are in progress to batch the solvent-contaminated waters of two new extraction wells (to be constructed in the near future when permitted by DTSC) and transport them to the STL-IV Stripping Towers Treatment System. One well will be located northwest of the RMDF. The second well will be near Building 886, the Former Sodium Disposal Facility. Additional treatment options for Area IV are being considered, pending DOE funding. These include an air stripping tower unit or a UV H_2O_2 unit on-site in Area IV or newer technologies (using solar radiation).

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).

The solvents found in the groundwater include trichloroethylene (TCE) and its family of decomposition products. The results of the analyses 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 the 1993 Annual Report.

Three existing TCE occurrences in the northwest part of Area IV were monitored in 1993. No new data changing the shape and size of these occurrences and the potential for their off–site extensions were obtained. The northwestern boundaries of these occurrences have not been defined (see Figure 6–3).

Two wells within the occurrence (No. 1. Figure 6–3) northwest of RMDF, recorded an increase in the range of TCE concentration in 1993 compared to 1992. The shallow zone well RS–28, one of the two on–site wells within the occurrence, recorded 46 to 60 µg/L TCE in 1992 compared to 63 to 82 µg/L TCE in 1993 (see Table 6–3). The other well, a Chatsworth Formation well (RD–30) showed 20 to 38 µg/L TCE in 1992. In 1993, RD–30 recorded 40 to 44 µg/L TCE. Both wells were installed in 1989. RS–28 decreased from the 1990 peak of 85 µg/L TCE to the 1991–1993 level, but RD–30 did not record any significant change in the trend during the same period. RD–34A, an off–site Chatsworth Formation well (shallowest well of a three–well cluster constructed in 1991), within the same occurrence recorded an increase in the range of the TCE concentration above MCL. It showed 27 to 61 µg/L TCE in 1992, compared to 49 to 91 µg/L in 1993.

The Chatsworth Formation well (RD–7), the only well within the occurrence (No. 2. Figure 6–3) southwest of Building 059, also recorded an increase in TCE concentration from 12 to 29 µg/L in 1992 to 36 to 45 µg/L in 1993. Since its construction in 1986, RD–7 generally maintained the TCE concentration in 16 to 35 µg/L range with three peaks of 120 to 130 µg/L.

Two wells, a Chatsworth Formation well (RD–23) and a shallow zone well (RS–18) of the occurrence (No. 3, Figure 6–3) near Building 886, recorded a significant increasing trend in TCE concentration during 1991 to 1993. TCE in RD–23 increased from a 1992 range of 52 to 78 µg/L to the 1993 range of 280 to 580 µg/L. RD–23 was constructed in 1989. From 1989 to 1990, TCE concentration in the well ranged from 38 to 200 µg/L. RS–18, mostly dry since its construction in 1985 to 1991, recorded an increase in TCE from 2,300 to 2,700 µg/L in 1993. RD–21, the third well within the occurrence, recorded 52 to 78 µg/L TCE in 1992 and 730 to 1,800 µg/L TCE in 1993. From 1989 (the year of construction) to 1990, RD–21 showed 450 to 1,900 µg/L TCE. RD–33A, an off–site Chatsworth Formation well (shallowest well of a three–well cluster constructed in 1991) of the occurrence, showed 7.1 to 9.4 µg/L TCE in 1993, compared to 4 to 6 µg/L TCE in 1992.

TCE concentrations increased due to an unusually wet rainy reason in the winter of 1992–1993. The flushing effect caused by rainwater infiltration has contributed to the higher values.

RD–25, located southwest of Building 059, continued to record perchloroethene (PCE). In 1993, the well recorded 20 to 39 µg/L PCE, compared to 9.7 to 14 µg/L PCE in 1992. From 1989 to 1990, the well showed less than 1 to 7.6 µg/L PCE.

In 1992, an Interim Well Construction Plan for the next phase of monitor well drilling and testing at SSFL was submitted to Cal–EPA DTSC. The plan was approved in November 1992. According to the plan, eight new Chatsworth Formation wells are to be constructed in Area IV with DOE funding. Six of these wells were planned to be drilled as two well clusters, each with three wells. One of these two clusters was to be drilled in the Building 886 area as required by the Building 886 closure. The other cluster was to be located off–site, down gradient and west of the RMDF area. An off–site well was also to be drilled down gradient of Building 886. The eighth well was to be drilled south of Building 886 near the Burro Flats Fault. In

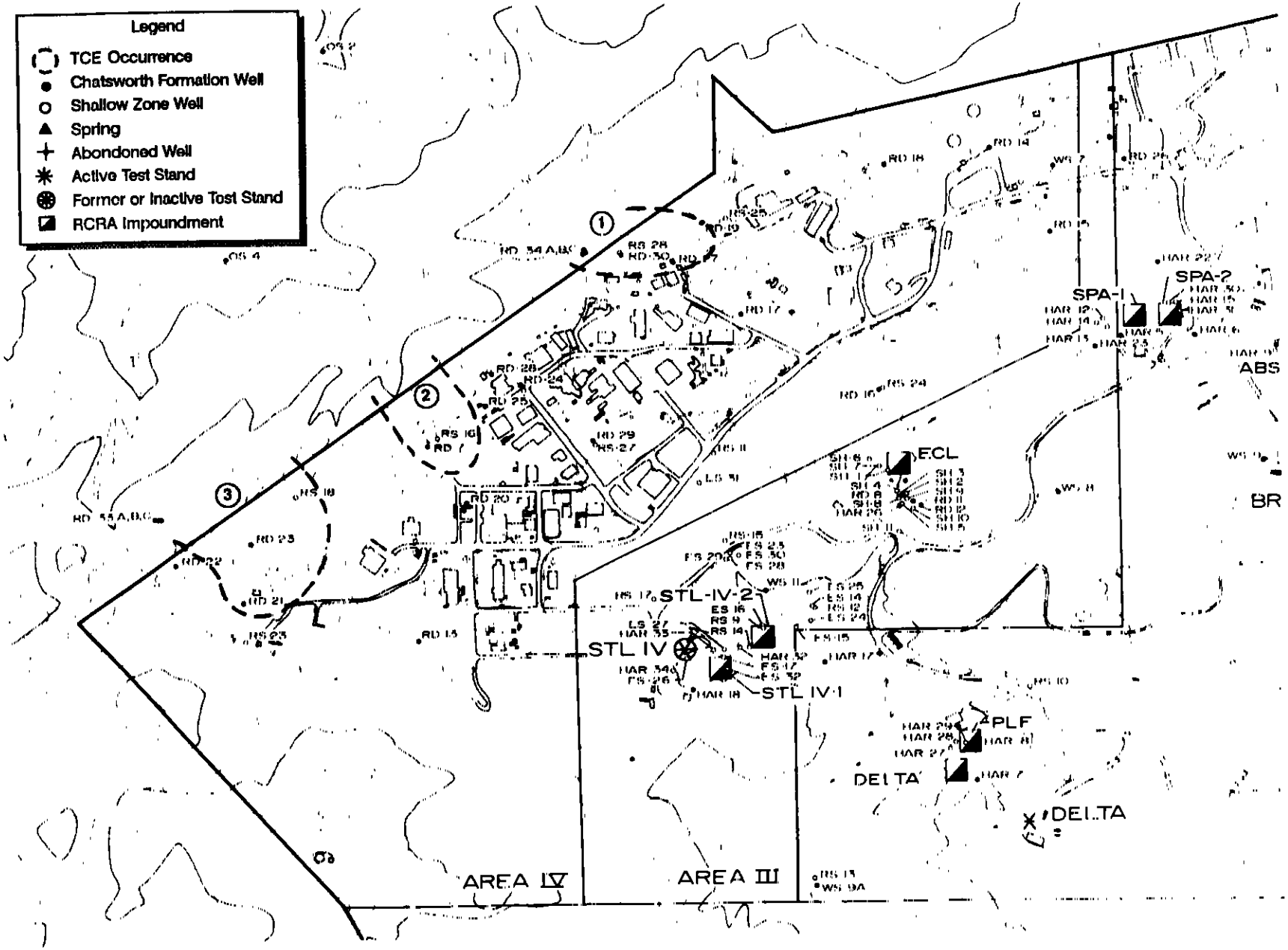

Figure 6-3. TCE Occurrences in Groundwater of Area IV

1993, all except the four off–site wells were installed. One extra well beyond the scope of the 1992 plan was also completed.

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 of new wells started in January 1993 in Areas I, II, and III of SSFL. Wells completed in Area IV were drilled during May and July to August 1993.

A proposed plan for the construction and testing of two pilot groundwater extraction systems in Area IV was submitted to DTSC in August 1993. In addition to the initial request for approval of the pilot groundwater extraction plan, a response to DTSC's questions and a formal work plan have been submitted.

The plan calls for the construction of one extraction well downgradient northwest side of the Former Sodium Disposal Facility B/886 site and one extraction well downgradient west of the RMDF leach field. Each of these wells will be constructed on–site within the Area IV boundary. The two systems would be installed and then tested for a period of up to 90 days. The goal of this project is to develop data required to design a long–term, full–scale groundwater extraction system necessary to contain and withdraw degraded groundwater from beneath the boundary of Area IV.

Each pilot system will consist of one extraction well and one temporary above–ground 5,000–gallon dual–wall tank for short–term storage of degraded groundwater. Once the stored water is found to be free of elevated radionuclide concentrations, it will be transported to an on–site permitted air stripper treatment system for removal of volatile organic constituents and discharged to the SSFL reclaimed water system.

There were no draft or final environmental impact statements or reports, site assessments, or remedial action reports produced during 1993. Additionally, there were no actions taken by local authorities relative to CERCLA/SARA activities or Notices of Violation for the DOE Area.

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