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ROCKETDYNE DIVISION ENVIRONMENTAL MONITORING AND FACILITY EFFLUENT ANNUAL REPORT DE SOTO AND SANTA SUSANA FIELD LABORATORIES SITES 1989

Rockwell International

Rocketdyne Division
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Canoga Park, California 91303

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I. INTRODUCTION

Work in nuclear energy research and development 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 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 the Santa Susana Field Laboratories (SSFL) and is described in detail in Reference 18. No work with nuclear materials has been conducted since 1987, and the only ongoing work during 1989 was the cleanup of the Rockwell International Hot Laboratory (RIHL) and continuing decontamination of the remaining nuclear facilities. 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.

These operations have been conducted under State and Federal licenses and under contract to DOE and its predecessors at three main locations, identified as the Santa Susana Field Laboratories (SSFL), De Soto (DS), and Canoga (CA).

The location of these sites in relation to nearby communities is shown in Figure 1. Undeveloped land surrounds most of the SSFL site, with occasional cattle grazing on the southern portion and some orchard farming at the eastern boundary. No significant agricultural land use exists within 30 km of the SSFL site. Surrounding the De Soto and Canoga complexes is light industry, other commercial establishments, apartment buildings, and single-family houses. With the exception of the Pacific Ocean about 20 km 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 of SSFL. However, the closest reservoir to SSFL (Bard Reservoir) is more than 10 km away.

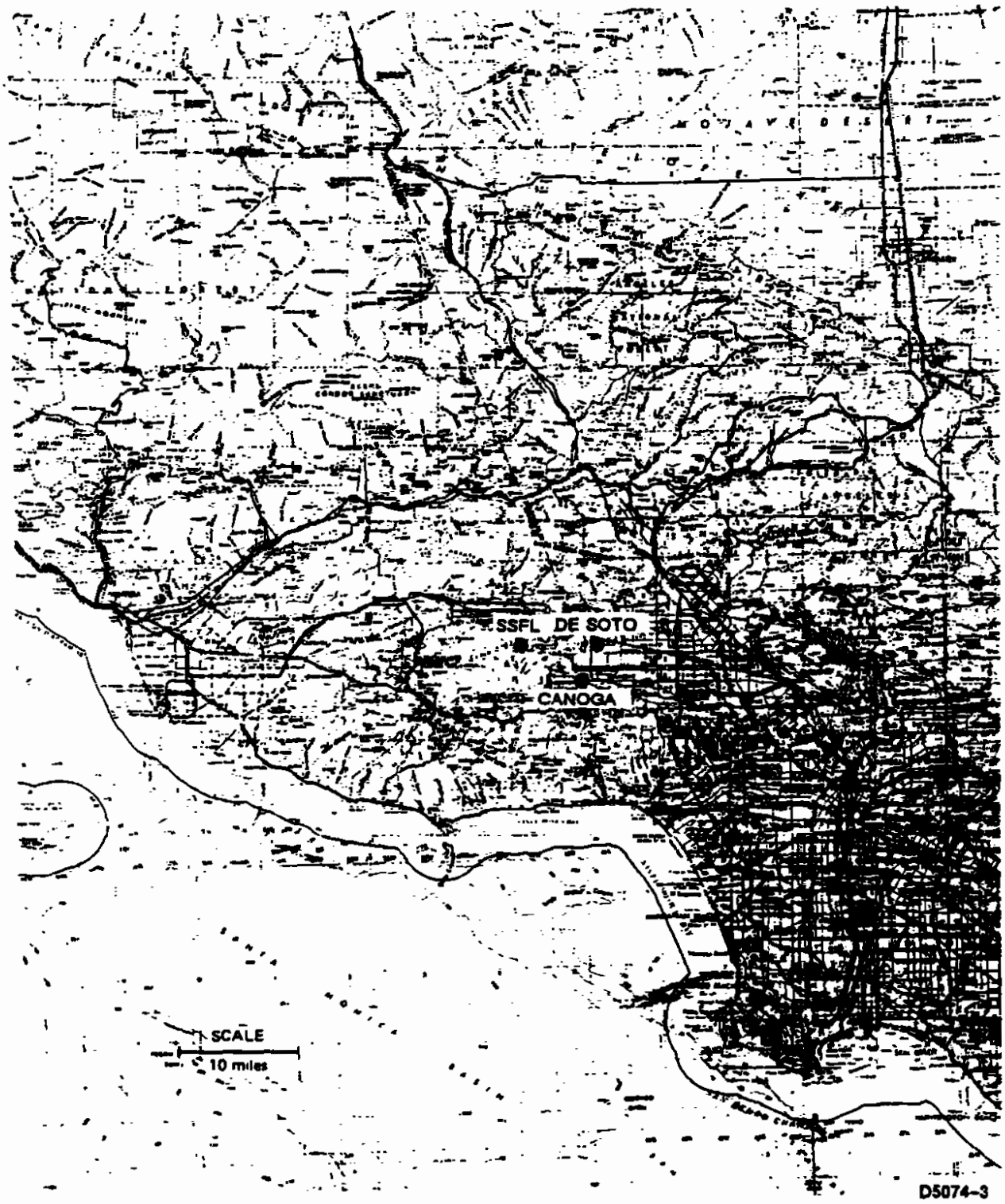

Figure 1. Map of General Los Angeles Area Showing Locations of Major Rocketdyne Facilities

The Santa Susana Field Laboratories (SSFL) site (Figure 2) occupies 2,668 acres located in the Simi Hills of Ventura County, approximately 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 1650 to 2250 ft above sea level. Both Department of Energy (DOE) and Rockwell International owned facilities, shown in Figure 3, share the Area IV portion of this site. The SSFL site also contains facilities in which operations with nuclear materials licensed by the U.S. Nuclear Regulatory Commission and radioactive materials licensed by the State of California are conducted. The principal licensed facilities are (1) the Rockwell International Hot Laboratory (RIHL) (Building 020), (2) several X-ray and radioisotope industrial radiography inspection facilities, and (3) a radiation instrument calibration laboratory. Sealed sources are used for process monitoring. The main DOE facility is the Radioactive Material Disposal Facility which receives, processes, and packages radioactive wastes for disposal at authorized DOE disposal sites.

Some research licensed by the State of California using radioactive materials is conducted at the De Soto site (Figure 4) in the Building 104 Applied Nuclear Technology laboratories and in the Gamma Irradiation Facility. The De Soto location is typical of the San Fernando Valley floor at an altitude of 875 ft above sea level. Research programs are conducted in the Building 104 Applied Nuclear Research laboratories and in the Gamma Irradiation Facility (containing approximately 30 kCi of ^{60}Co and 560 kCi of ^{137}Cs as sealed sources).

At the Canoga site, the predominant use of radiation is in industrial radiography for quality control inspection of rocket engine components using ^{192}Ir sealed sources and X-ray machines. Other uses of radiation and/or radioactive materials involve research and development. These include sealed sources and alloys activated by charged-particle irradiation.

Within Area IV of the SSFL site is an 90-acre government-optioned area where Department of Energy (DOE) contract activities are conducted. Most of

Figure 2. Rocketdyne Division— Santa Susana Field Laboratories Site

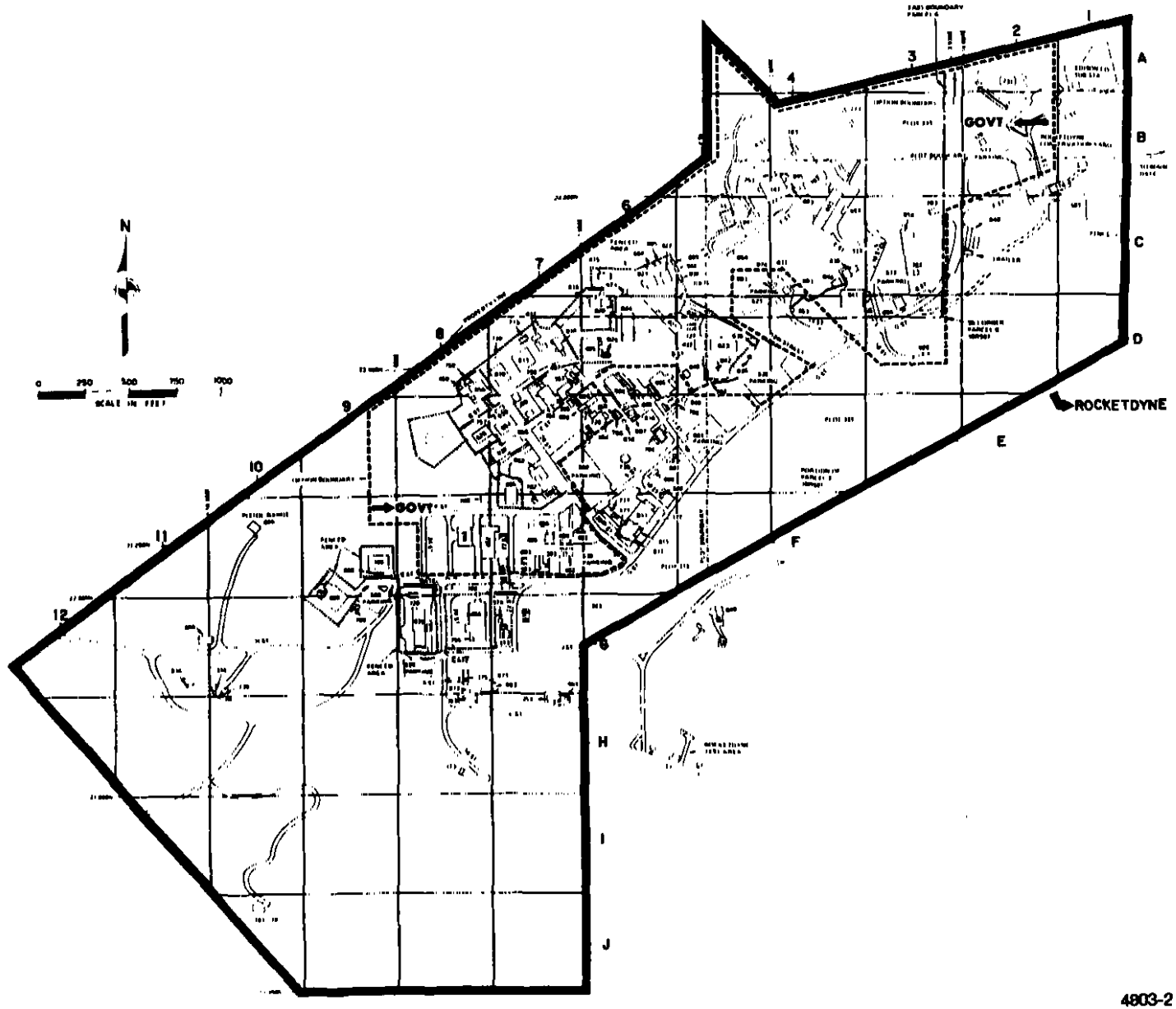

Figure 3. Map of Santa Susana Field Laboratories Area IV Facilities

Figure 4. Rocketdyne Division--De Soto Site

the work is performed by the nonnuclear Energy Technology Engineering Center (ETEC). The major operational nuclear installation within the DOE-optioned area is the Radioactive Material 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 fuel were shipped to another DOE site. Radioactively contaminated water is evaporated and the sludge is dried and disposed as packaged dry waste together with other dry wastes at a DOE disposal site.

Licensed programs conducted during 1989 were directed towards decontamination and decommissioning of the RIHL, which was last used for nuclear reactor fuel disassembly in 1987.

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II. SUMMARY AND EVALUATION OF ENVIRONMENTAL MONITORING RESULTS

The results of this environmental monitoring indicate that there are no significant sources of unnatural radioactive material in the vicinity of the Rocketdyne sites. The atmospheric discharge of radioactive materials and direct exposure are the only potential exposure pathways to the general public from Rocketdyne nuclear operations. 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 artificial radioactivity. With the exception of negligible concentrations of tritium, only natural radioactivity has been found in this water.

The maximum individual annual exposures estimated for persons at the site boundary and also at nearby residences are small when compared with natural radiation and with all applicable guidelines. Airborne pathway dose estimates were calculated by use of AIRDOS-PC for unnatural radionuclides identified in the effluent from each nuclear facility. All estimates for the maximum hypothetical exposed individual are below the EPA (NESHAPs) limits. The external radiation exposure estimates at the maximum exposed boundary location and at the nearest residence are based on results for site ambient radiation dosimeters and also for several facility workplace radiation dosimeters.

The unshielded external annual exposure resulting from operations conducted at the RMDF is estimated to be about 36 mR at the nearest boundary-line location and less than 0.1 mR for the nearest residence. These values are below the DOE long-term limit of 100 mrem per year as specified in "Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities" (9-3-85). The boundary-line exposure is conservative in that the rugged terrain at the site boundary nearest the RMDF precludes anything more than the 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 lowers direct radiation to practically nonexistent levels. In most cases, intervening irregular rock formations and hills completely shield off-site locations from the radiation sources. Only natural background radiation inherent to the residence location would be present.

Boundary-line direct radiation exposures for the State of California and U.S. NRC-licensed operations at other Rocketdyne nuclear facilities were well below 0.1 mR for the year. These values are below the NRC and State of California limits of 500 mrem per year, 100 mrem per week, and 2 mrem per hour.

Similarly for the De Soto site, airborne pathway dose estimates at the boundary and at the nearest residence do not differ significantly from zero. Estimates of the external radiation exposure at the De Soto boundary (less than 0.01 $\pm$ 0.01 mR) and at the nearest residence (less than 0.01 $\pm$ 0.01 mR) are based on the difference between the single highest on-site TLD measurement and the average of off-site measurements. The difference is more likely the result of random variability in the measurements than from actual radiation exposure.

These dose estimates are summarized in Table II-1.

Supply water at the SSFL site is sampled monthly at two locations. This supply consists of water from deep wells site-blended with potable water from the Ventura County Water District 17. In addition, shallow groundwater is sampled weekly as part of the groundwater management at a standpipe adjacent to the basement level of a deactivated reactor test facility (Building 059). These samples are tested by gamma spectroscopy for any transfer of gamma-emitting activation product radioactivity from the underground reactor test vault containment into the surrounding soil. Activated materials include ^{60}Co and ^{152}Eu, both of which are easily detected, and none has been found.

Table II-1

Public Exposure to Radiation and Radioactivity
from Rocketdyne Operations

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

1.	Direct radiation at boundary		0
	Limits (CCR17 Section 30268)	annual	500 mrem in one year
		weekly	100 mrem in seven days
		hourly	2 mrem in one hour
2.	Airborne Effluent at boundary		7.E-20 uCi/ml
	Limit (CCR17 Section 30269)		2.0E-14 uCi/ml
3.	Air Pathway (NESHAPs)		
		whole body	2.4E-06 mrem/yr
		critical organ	2.4E-06 mrem/yr
	Limits (40CFR61.102)		
		whole body	25 mrem/yr
		initial organ	75 mrem/yr

Natural Exposure to Average Member of U. S. Public

1.	Direct radiation	1.0E+02 mrem/yr (1.0 mSv/yr)
2.	Airborne radioactivity	3.5E-14 uCi/ml
3.	Air pathway (radon)	2.0E+02 mrem/yr (2.0 mSv/yr)

("Health Effects of Exposure to Low Levels of Ionizing Radiation - BEIR V," National Academy Press, Washington DC 1990) and offsite measurements of gross alpha and beta radioactivity concentrations in ambient air. (See Table 6, sum of DeSoto activities)

Table II-1 (Cont'd)

Public Exposure to Radiation and Radioactivity from Rocketdyne Operations

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		5.6E-03	mrem/yr
	Limits (10CFR20.105, CCR17 Section 30268)	annual	500	mrem in one year
		weekly	100	mrem in seven days
		hourly	2	mrem in one hour
2.	Airborne effluent at boundary		2.0E-19	uCi/ml
	Limits (10CFR20.106, CCR17 Section 30269)		2.0E-14	uCi/ml
3.	Air Pathway (NESHAPs)			
		whole body	7.1E-09	mrem/yr
		critical organ	2.9E-09	mrem/yr
	Limits (40CFR61.102)			
		whole body	25	mrem/yr
		critical organ	75	mrem/yr

Natural Exposure to Average Member of U. S. Public

1.	Direct radiation	1.0E+02	mrem/yr
		(1.0	mSv/yr)
2.	Airborne radioactivity	3.5E-14	uCi/ml
3.	Air pathway (radon)	2.0E+02	mrem/yr
		(2.0	mSv/yr)

("Health Effects of Exposure to Low Levels of Ionizing Radiation - BEIR V," National Academy Press, Washington DC 1990) and offsite measurements of gross alpha and beta radioactivity concentrations in ambient air. (See Table 6, sum of DeSoto activities)

Table II-1 (Cont'd)

Public Exposure to Radiation and Radioactivity
from Rocketdyne Operations

Radioactive Material Disposal Facility (RMDF)
Department of Energy (DOE, license-exempt)

1. All Pathways

a. Maximum estimated external dose to an individual		4.5E-05 mrem/y (4.5E-07 mSv/y)
b. Maximum estimated internal dose to an individual		1.4E-07 mrem/y (1.4E-09 mSv/y)
Total		4.5E-05 mrem/y (4.5E-07 mSv/y)
DOE limit	occassional	500 mrem/y (5 mSv/y)
	prolonged	100 mrem/y (1 mSv/y)

("Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities," 9-3-85)

2. Air Pathway Only

a. Maxiumum estimated dose to an individual		1.4E-07 mrem/y (1.4E-09 mSv/y)
b. Maximum estimated dose to any organ		5.8E-08 mrem/y (5.8E-10 mSv/y)
DOE limit	individual	25 mrem/y (0.25 mSv/y)
	organ	0.75 mrem/y

("Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities," 9-3-85)

Natural Exposure to Average Member of U. S. Public

1. All Pathways	3.0E+02 mrem/yr (3.0 mSv/yr)
2. Air Pathway (radon)	2.0E+02 mrem/yr (2.0 mSv/yr)

("Health Effects of Exposure to Low Levels of Ionizing Radiation -BEIR V" National Academy Press, Washington DC, 1990)

Nonradioactive wastes discharged to uncontrolled areas are limited to liquids released to sanitary sewage systems and to surface water drainage systems. No intentional releases of any liquid pollutants are made to uncontrolled areas. Sanitary sewage from all facilities at the SSFL site is treated at on-site sewage plants. Sludge from the sewage plant digesters is hauled by a commercial trucking firm to an approved disposal site. During 1989, this sludge was sampled 23 times as a part of the routine disposal process. Analysis by gamma spectroscopy of the samples identified no unnaturally occurring radionuclides in the sludge. The outfall from the plant for Area IV flows into retention pond R-2A, located toward the southern boundary of the SSFL site. The surface water drainage system of SSFL, which is composed of catch ponds and open drainage ditches, also drains to retention pond R-2A. Water from the pond may be reclaimed as industrial process water or released, as necessary, off-site into Bell Creek, a tributary of the Los Angeles River. The pond water is sampled monthly for radioactivity. It is also sampled at discharge for both radioactive and nonradioactive pollutants as required by the discharge permit (NPDES CA0001309) issued to Rocketdyne Division by the California Regional Water Quality Control Board. In addition, an automatic water sampler takes samples from the discharge stream channel (Bell Creek) whenever water is present.

Results of environmental monitoring for 1989 are presented in detail and evaluated in Section III, which deals with radioactive materials and reports results of analyses for gross alpha and beta radioactivity and also plutonium isotopes in soil. The maximum value determined for each type of analysis is reported in the tables and shows no significant elevation over the averaged values. Measurements of radionuclide components in atmospheric emissions provide the basis for calculation of public dose commitment. The sampling and analytical methods used in the environmental monitoring program for radioactive materials are described in Section IV. Treatment and handling of effluents is described in Section V. This section also provides facility descriptions and estimates the general population dose attributable to Rocketdyne operations. Additional environmental information of concern to DOE is presented in Section VI, including the NPDES permit for release of water

from SSFL. A comparison of 1989 radioactivity results with the results from previous years appears in Appendix A. Appendix B provides a summary of the Environmental Monitoring Program Quality Control. References are listed in Appendix C. The external distribution of this report comprises Appendix D, and a table of alternative units for radiological data is shown in Appendix E.

During 1989, two minor locations of radioactive environmental contamination were cleaned up. These were the areas identified as the Old Conservation Yard, and the T064 Side Yard. The Old Conservation Yard involved a sediment deposit on a paved area, approximately 20 ft square, with Cs-137 amounting to approximately 100 pCi/g. This was cleaned up by scraping up the sediment and packaging it for disposal as radioactive waste. At the T064 Side Yard, some soil that had been contaminated with mixed fission products to levels of a few hundred pCi/g was excavated and packaged for disposal.

Quality assurance measures incorporated into the environmental monitoring program include participation in DOE-sponsored programs such as the Environmental Dosimeter Intercomparison Program and the DOE Environmental Measurements Laboratory Quality Assessment Program (EML-QAP). In 1989, Environmental Monitoring participated in two EML-QAP sample analysis sets (QAP XXX and XXXI). Analysis of the QAP results indicates that accuracy in measuring radioactivity in the sample media provided for the intercomparison is reasonably good. In addition to participation in these programs, laboratory analyses of split and replicate samples are routinely evaluated for the reproducibility of sample radioactivity measurements of water and soil gross radioactivity. Control charts of counting system radiation response are maintained. These data are periodically evaluated to determine the correlation between sample sets and trends in background.

CLEAN AIR ACT

Operations at SSFL are regulated under the Clean Air Act (CAA). The CAA has resulted in regulations that set air quality standards and require state implementation plans, national emissions standards for hazardous air

pollutants, new source performance standards, and monitoring programs in an effort to achieve air quality levels that protect the public health and welfare. National Ambient Air Quality Standards (NAAQS) have been set for the following criteria pollutants: sulfur dioxide (SO_2), particulates, nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), hydrocarbons (HCs) or VOCs, and lead (Pb). National Emission Standards for Hazardous Air Pollutants (NESHAPs) have been promulgated for beryllium, mercury, benzene, vinyl chloride, equipment that uses volatile hazardous air pollutants, and radionuclides and asbestos. Permits, licenses, and reporting procedures are required under federal law for a variety of pollutant sources, in addition to any applicable state or regional requirements. The United States Environmental Protection Agency (EPA) can designate that a state implement and enforce the requirements of CAA, and the state can adopt regulations equal to or more stringent than the federal standards.

The SSFL is located within the Ventura County Air Pollution Control District (VAPCD) and must comply with Ventura air quality regulations. The Ventura County regulations incorporate by reference the NESHAP regulations as codified under the CAA.

No violations of the Clean Air Act occurred during 1989.

Clean Water Act

The Clean Water Act (CWA) regulates such items as pretreatment standards for industrial discharges to municipal treatment facilities, the preparation of Spill Prevention Control and Countermeasure (SPCC) plans, the National Pollution Discharge Elimination System (NPDES) for regulation of point source discharges to navigable waters, and self-inspection/self-monitoring requirements for point source discharges.

SSFL wastewater discharges are regulated under the California Water Code (Division 7) as administered by the California Regional Quality Control Board (RWQCB). The state's water discharge program incorporates the regulations and

guidelines of the CWA. The waste discharge requirements under the RWQCB program serves as an NPDES permit. The facility's NPDES permit (No. CA001309) was issued in June 1982 and was recently reissued and was effective until August 10, 1989, but continues in effect pending RWQCB review. To date, a new permit and new waste discharge requirements have not been developed by the Regional Board.

No violations of the Clean Water Act occurred during 1989.

Resource Conservation and Recovery Act

The primary purpose of the Resource Conservation and Recovery Act (RCRA) is the regulation of all aspects of solid and hazardous waste management from generation to ultimate disposal. The Act includes definitions and procedures for identifying hazardous wastes and requirements of manifesting.

Under the state's current classification, the USEPA and the state had dual enforcement authority. California has not yet been granted final authorization for ensuring that ETEC facilities are in compliance with hazardous waste regulations. The state's regulations are in the California Code of Regulations (CCR), Title 22, Division 4, Environmental Health.

An ROV was issued in August of 1989 as a result of an RCRA inspection that was conducted by the DHS. (See section on Current Issues and Actions.)

Comprehensive Environmental Response, Compensation and Liability Act of 1980 and Superfund Amendments and Reauthorization Act of 1986

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) was established to provide for the liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous waste sites. The Superfund Amendments and Reauthorization Act (SARA) revised and extends the authorities established under CERCLA. CERCLA requires that all hazardous releases be promptly reported to the National Response Center and that a preliminary assessment be

undertaken as promptly as possible. The person in charge of the facility is responsible for ensuring that proper notification is provided. Potential subsequent actions include immediate (emergency) removals, planned removals, and remedial action. SARA establishes new authorities for emergency planning and preparedness, community right-to-know reporting, and toxic chemical release reporting.

No violations of CERCLA occurred in 1989.

Current Issues and Actions

Clean Air Act

a) VAPCD conducted two routine semi-annual inspections on 3/22/89 and 11/15/89. No violations were cited relative to DOE operations.

b) Nine asbestos notifications were submitted to VAPCD in 1989 for Area IV/ETEC. The following dates and buildings are: 2/6/89 - T/353; 5/22/89 - T/028 and T/374; 6/6/89 - T/027; 6/26/89 - T/003; 6/1/89 - T/814; 8/31/89 - T/055; 8/23/89 - T/814; 10/30/89 - T/463; 11/8/89 - T/009.

Clean Water Act

a) The California RWQCB visited Area IV/ETEC on the following dates and reasons:

   1) 1/24/89 - surface impoundments (non-Area IV);

   2) 5/23/89 - Toxic Pit Cleanup Act (TPCA) and NPDES;

   3) 7/13/89 - Area IV/ETEC site survey.

b) TPCA determination on the ponds in the former sodium disposal facility were under discussion by the Board.

c) A one-time fee is paid to the Sanitation district in San Bernardino County, California, for nonhazardous sewage treatment plant sludge bottoms. Rockwell subcontracts a licensed hauler to perform this task.

The Resource Conservation and Recovery Act

DHS conducted RCRA inspections for all of SSFL on 6/19/89, 6/20/89, and 6/28/89. An ROV was issued in August 1989 as a result of this inspection. Thirteen counts were noted of which two were directly related to Area IV. The two counts were subsequently dropped upon review of the responses that Rocketdyne provided to DHS.

A reinspection was conducted on 12/19/89 and a joint RCRA inspection was conducted on 11/7/89 with Ventura County. An independent site visit by DHS on 2/16/89 was conducted for non-Area IV surface impoundment.

EPA Region IX visited the site on 6/26/89 and 7/12 and 7/13/89 to perform soil and groundwater sampling for radioactivity and chemicals.

Comprehensive Environmental Response, Compensation and Liability Act of 1980 and Superfund Amendments and Reauthorization Act of 1986

a) A Preliminary Assessment/Site Investigation (PA/SI) review of the SSFL was assembled by EPA Region IX on 7/19/89. Based upon the EPA's recommendation, solvent usage data was forwarded to the EPA in December 1989. This will be an ongoing activity throughout 1990.

b) Submission of SARA Title III, Section 312, Hazardous Materials Inventory, and Section 313, toxic release reporting for 1989 are scheduled for 3/1/90 and 7/1/90, respectively. As of this date, Section 312 was submitted to the agencies on time. The actual report is available upon request.

Environmental Permits

Air

Permit No.	Facility	Atmospheric Pollutant	Tons/Year
0226	T133	Particulate Matter	0.60
0271	SCTI	ROC's	9.46
		NOx	140.06
		Particulate Matter	3.05
		SOx	0.60
		Carbon Monoxide (CO)	37.44
0290	T463 (eclipse boiler)	ROC's	0.01
		NOx	0.05
		Particulate Matter	0.01
		SOx	0.01
		CO	0.01
1124	MSTF	ROC's	0.04
		NOx	1.52
		Particulate Matter	1.40
		SOx	3.24
		CO	1.16
1344	Areas I, II, and III Stripping Towers	ROC's	0.11
0271-110	Steam Valve Testing System	Authority to Construct	

No operation resulted in emissions exceeding these limits.

Water

NPDES Effluent Permits

Discharge exceedences occurred 9 March, 14 March, and 11 April 1989 from both R-2A and Perimeter ponds. Monitoring indicated pH levels of 9.4, 10.0, and 9.2, respectively, which exceeded Rocketdyne's NPDES permit level of 9.0 at R-2A and Perimeter ponds. Additionally, the settleable solids levels on 17 February, 9 August and 24 August 1989 at the R-2A discharge ponds exceeded the 0.3 ml/l permitted level. Furthermore, the fish bioassay value on 27 September 1989 was below the permitted value of 90% for R-2A discharge.

The renewal for this permit, CA00001309 (RWQCB), is still in the review process.

RCRA

PA ID No.	Facility	Status	Comments
CAD 000629972	T133 and T029	Part B still in DOHS review - operating under existing permit	On 2/16/89, 10-20 gallons of NaOH solution was released within bermed area during transfer operation
CA 3890090001	RMDF	Part A mixed water permit submitted on 3/23/89	Part B in progress
CA 3890090001	ETEC/AI	Hazardous waste generator	Wastes managed then transported and disposed offsite within 90 days
CA 1800090010 and CAD 093365435	NASA, Area II Rockwell, Areas I and III	Part A in review by DHS	ISD applications for removal of solvent contaminated groundwater by stripping towers

Below is a current list of underground storage tanks in Area IV:

TABLE II-2
UNDERGROUND STORAGE TANKS (AREA IV)

Location	Description	Contents	Size	Year Installed	Status	Owner	Operator
T020	Steel Vaulted	RA H20	3,000 gal	1970	Sensor Installed	Rockwell	Rockwell
T020	Steel	Diesel	5,000 gal	1959	Removed 8/3/89	Rockwell	Rockwell
T022	S.S. Vaulted	RA H20	8,000 gal	1978	Sensor Installed	DOE	Rockwell
T022	S.S. Vaulted	RA H20	200 gal	1958	Sensor Installed	DOE	Rockwell

TABLE II-2
UNDERGROUND STORAGE TANKS (AREA IV) (Cont'd)

Location	Description	Contents	Size	Year Installed	Status	Owner	Operator
T023	S.S. Vaulted	RA H2O	220 gal	1976	Sensor Installed	DOE	Rockwell
SCTL	S.S. Vaulted	MET NA	12,000 gal	1958	Sensor Installed	DOE	Rockwell
SCTL	S.S. Vaulted	MET NA	10,000 gal	1958	Sensor Installed	DOE	Rockwell
T032	S.S. Vaulted	MET NA	5,500 gal		Sensor Installed	DOE	Rockwell
T059	S.S. Vaulted	MET NA	12,000 gal		Sensor Installed	DOE	Rockwell
T356	S.S. Vaulted	MET NA	13,000 gal		Sensor Installed	DOE	Rockwell
T356	S.S. Vaulted	MET NA	10,000 gal	1975	Sensor Installed	DOE	Rockwell
T356	S.S. Vaulted	MET NA	10,000 gal	1974	Sensor Installed	DOE	Rockwell
T356	S.S. Vaulted	MET NA	10,000 gal	1965	Sensor Installed	DOE	Rockwell
T366	S.S. Vaulted	MET NA	12,000 gal	1975	Sensor Installed	DOE	Rockwell
T462	S.S. Vaulted	MET NA	36,000 gal	1974	Sensor Installed	DOE	Rockwell
T462	S.S. Vaulted	MET NA	35,000 gal	1978	Sensor Installed	DOE	Rockwell

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III. ENVIRONMENTAL RADIOLOGICAL PROGRAM RESULTS

A. RADIOACTIVE MATERIALS--1989

The average radioactivity concentrations in on-site soil, surface and site supply water, and in ambient air for 1989 are presented in this section. Soil, retention pond sediment, and surface water are sampled at stations located within the boundaries of the Rocketdyne sites, on-site. Also, ambient air is continuously sampled for evaluation of long-lived radioactivity, and ambient radiation levels are monitored with thermoluminescent dosimetry. The soil sampling stations are sampled quarterly, and selected stations pertinent to the previously licensed NMDF are sampled semiannually for plutonium.

Prior to 1989, sampling stations, referred to as "off-site" stations, were located on Rockwell property and other private property adjacent to but up to 10 miles distant from the licensed facilities. In addition, up to 1986 vegetation samples from both the on-site and off-site stations were analyzed for radioactivity content. Review of the data from analysis of these samples at that time indicated that the results of those measurements were not contributing significantly to evaluation of the environmental impact of Rocketdyne's operations. None of the vegetation adjacent to the Rocketdyne facilities is significantly involved in any food chain, and the soil and water data from the on-site stations are adequate to determine environmental effects of the Rockwell activities and the effectiveness of the environmental controls in effect.

The selection of sampling locations is based upon 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. Surface runoff waters at the SSFL site flow through several natural watercourses and collect in a large-capacity retention pond. 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 permit a long-term historical record of radioactivity in the environment. For water, these measurements permit direct comparison with the screening limits established by EPA for suppliers of drinking water. Specific analyses are done for plutonium in soil (Table III-2) and for radionuclides in the ventilation effluent samples (Table V-1). Detailed analyses of the atmospheric discharge samples permits more accurate estimates of dose for the air pathway.

As part of a widening search for radioactivity, in an attempt to find significant contamination associated with the SSFL site, several special surveys were performed. Soil and water samples were taken by EPA-Las Vegas; air, vegetation (food), soil, and water were sampled by the DHS-Environmental Management Branch; soil samples were taken from the vicinity of the RIHL by NRC; mud was taken from the deepest bottom of Pond R-2A by Rocketdyne, and water, soil, and rock samples were taken by Groundwater Resources Consultants for the characterization of the natural radioactivity present in the environment at SSFL.

The results of these surveys are shown in the appropriate parts of this section.

The presentation of routine monitoring data in the tables includes the annually averaged data for each sample type and the maximum radioactivity level detected for a single sample from the annual set. The single maximum sample value is reported because of its significance in indicating the occurrence of a major episode or an area-wide incident of radioactive material deposition. None of the maximum observed values, which generally occurred during the fall-winter period of the year, show a great increase over the annually averaged values beyond inherent variability (refer to Tables III-2 through III-7). The ambient air sampling data, which show no greatly increasing or decreasing trends for the year, can be described as generally constant, with some increase in airborne radioactivity occurring through the third and fourth quarters.

The results of the gross radioactivity measurements in soil (Table III-1) show no significant difference between samples.

Samples of soil were taken by EPA-Las Vagas from several areas of known radioactive contamination. The results are shown below:

	Activity (pCi/g		
Sodium Burn Pit	Upper Pond	Upper Pond (duplicates)	Lower Pond
H-3	0.59	0.05	----
K-40	9.76	10.10	28.81
Cs-137	0.90	0.94	0.93
Tl-208	0.81	0.76	1.55
Pb-212	0.54	0.73	1.90
Pb-214	0.19	0.40	1.31
Bi-214	0.28	0.42	0.87
Ra-226	0.56	0.38	1.29
Ac-228	0.79	0.77	1.62

RMDF Leach Field

K-40	31.05
CS-137	1.02
Tl-208	1.58
Pb-212	1.88
Pb-214	1.11
Bi-214	1.41
Ra-226	1.27
Ac-228	2.15

T064 Side Yard

	Sample 1	Sample 2	Rocketdyne
K-40	29.33	31.67	16.99
Cs-137	331.4	367.0	150.7
Tl-208	1.67	1.67	1.15
Pb-212	1.56	1.57	0.92
Pb-214	1.27	1.32	0.89
Bi-214	1.49	1.67	--
Ra-226	1.25	1.43	--
Ac-228	1.92	2.40	--

The significance of the tritium (H-3) in soil is unclear. However, water from this area will be analyzed for tritium in the future. All the other radionuclides detected, with the exception of Cs-137, are naturally occurring and are found at levels consistent with those expected in the natural environment. The Cs-137 concentrations found in the Sodium Burn Pit and the RMDF Leach Field slightly exceed those found from global fallout, but are low compared to levels that would indicate a need for cleanup (on the order of 15-30 pCi/g). The EPA samples from T064 were taken from an area that was being cleaned up at the time of sampling. The sample from the T064 Side Yard that was analyzed by Rocketdyne was taken concurrently with the EPA samples, but was not a true split. However, the EPA results for the natural radionuclides also appear to be somewhat high, in approximately the same ratio as the Cs-137 activities.

An inspector from NRC, Region V, took soil samples at and around the RIHL in an effort to determine if any Special Nuclear Material (SNM, licensed for use at the RIHL by the NRC) was present in the environment. The results of these analyses, and the split-sample analyses by Rocketdyne were as shown in the following listing.

Location	Radionuclide Activity	NRC	Rocketdyne
1. Surface Outside Hot Storage Room	K-40	---	19.5
	Cs-137	0.068	0.072
	U-235	0.038	0.059
	U-238	0.90	1.03
2. Six inches Deep from Fission Gas Tank Pit	K-40	---	17.8
	Cs-137	0.020	---
	U-235	---	0.054
	U-238	0.71	0.93
3. Surface by Loading Dock	K-40	---	17.9
	Cs-137	1.9	3.65
	U-235	0.047	0.066
	U-238	0.73	1.04
4. Surface Runoff Channel NE of Liquid Waste Facility	K-40	---	18.5
	Cs-137	0.28	0.46
	U-235	0.031	0.062
	U-238	0.63	1.01
5. Surface Runoff Channel SE of Liquid Waste Facility	K-40	---	18.5
	Cs-137	0.37	0.51
	U-235	0.027	0.049
	U-238	0.63	0.84
6. Surface Runoff Channel SE of RIHL	K-40	---	21.8
	Cs-137	0.92	1.46
	U-235	---	0.070
	U-238	---	1.20
7. Surface of Site Boundary at Bell Creek	K-40	---	22.5
	Cs-137	0.18	0.30
	U-235	---	0.063
	U-238	0.80	1.00
8. Surface of Site Boundary West of RIHL	K-40	---	21.7
	Cs-137	0.17	0.21
	U-235	0.065	0.052
	U-238	1.1	0.89

NRC did not analyze for K-40. In Sample 6, NRC found an indication of Co-60 at 0.032 pCi/g. Rocketdyne did not. Since the concentrations of uranium found by the NRC analyses are typical of natural radioactivity, and the U-235/U-238 ratios are close to that expected for natural uranium (0.046), and since no Am-241 (associated with plutonium) was found, NRC concluded that no SNM had reached the environmental areas sampled.

This conclusion is particularly significant in that several of the samples clearly show residual Cs-137, and Samples 1 and 3 were taken from areas being cleaned at the time of the sampling. It is also well supported by the Rocketdyne results for U-238 and U-235, which are derived from the gamma-spectrometry data with the assumption that this is natural activity in equilibrium with its daughters. If this were not the case, these results would underestimate the U-238 and U-235 activities. Rocketdyne actually reports somewhat greater U-238 and U-235 activities, due largely to the drying of the soil in our processing prior to the gamma analysis.

Soil samples were taken by DHS-Environmental Management Branch from the runoff channel north of the Sodium Burn Pit, and from an area near the excavated RMDF Sanitary Leach Field. These samples were analyzed by EPA-Las Vegas and showed:

Radionuclide	Activity (pCi/g)	
	Sodium Burn Pit	RMDF Leach Field
K-40	20.6±0.5	22.5±0.5
Cs-137	0.05±0.02	0.07±0.02
Ra-226	1.6±0.1	0.8±0.1
Ra-228	1.0±0.1	1.2±0.2

The K-40 is a natural constituent of rocks and soil at SSFL and is generally seen in these concentrations. The Cs-137 is a fission product that is found globally in concentrations similar to the low levels found here, as the result of atmospheric testing of nuclear weapons. The Ra-226 and Ra-228 are daughters in the U-238 and Th-232 chains, respectively, and represent the natural concentration of these materials.

In the late summer, Pond R-2A, which has collected surface runoffs and processed sewage effluent from the Area IV facilities where nuclear operations were conducted in the past, was emptied of water, allowing access to the

deepest bottom. Mud from this bottom was analyzed by U.S. Testing Co. (Richland Division). These analyses showed:

Radionuclide	Activity (pCi/g)
Sr-90	1.71E-01
Pb-210	1.65E+00
Po-210	1.65E+00
Ra-224	1.72E+00
Ra-226	1.2E+00
Ra-228	2.31E+00
Th-228	1.69E+00
Th-230	1.35E+00
Th-232	1.51E+00
U-234	1.0E+00
U-235	7.08E-03
U-238	9.8E-01
Np-237	3.07E-03
Pu-238	-1.61E-05
Pu-239/240	3.92E-03

None of the artificial radionuclides (Sr-90, Np-237, Pu-238, Pu-239/240) show any increase over values found widespread in the natural environment, while the natural radionuclides (Pb-210, Po-210, Ra-226, Th-230, U-234, U-238 from the U-238 decay chain; Ra-224, Ra-228, Th-228, Th-232 from the Th-232 decay chain; and U-235) show concentrations typical of natural soils at SSFL.

TABLE III-1

SOIL RADIOACTIVITY DATA--1989

Area	Activity	Number of Samples	Gross Radioactivity (pCi/g) Annual Average Value and Dispersion	Gross Radioactivity (pCi/g) Maximum Observed Value* and Month Observed
On-site (quarterly)	Alpha	56	29.7 ± 7.6	51.0 (October)
	Beta	56	26.9 ± 2.2	32.3 (October)
Pond R-2A mud No. 55	Alpha	4	33.3 ± 3.9	38.5 (October)
	Beta	4	26.3 ± 1.5	28.2 (July)
Bell Creek upper stream bed soil No. 62	Alpha	4	32.4 ± 5.6	38.7 (October)
	Beta	4	26.1 ± 0.8	27.3 (July)

*Maximum value observed for single sample.

To achieve much higher detection sensitivity for plutonium than gross alpha measurements can provide, soil samples are collected and sent to an independent testing laboratory for specific plutonium analysis. This analysis is performed by leaching individual soil samples with acid, then treating the leachate chemically to separate and concentrate any plutonium present. In this way, minute quantities of plutonium, such as that distributed globally by testing of nuclear weapons, can be detected and quantitatively measured by alpha spectroscopy. The results are shown in Table III-2. Alpha spectroscopy permits identification of ^{239}Pu + ^{240}Pu, predominantly from weapons tests, and ^{238}Pu, partly from the destructive reentry of a Transit satellite over the Indian Ocean in April 1964.

For comparison with these results, published data from soil tests in nearby Burbank, California, in 1970-71 show a plutonium concentration of approximately 0.002 pCi/g for ^{239}Pu + ^{240}Pu and approximately 0.00006 pCi/g for ^{238}Pu. The data in Table III-2 show no significant increases in on-site soil plutonium relative to the Burbank values (which are the only nearby data available) and no significant variation in soil plutonium concentrations for the 1989 sample sets.

The detected gross radioactivity in soil is due to various naturally occurring radionuclides present in the environment, to radioactive fallout of dispersed nuclear weapons materials, and fission product radioactivity produced by past atmospheric tests of nuclear weapons. A minor amount presumably remains from the Chernobyl reactor accident. No atmospheric nuclear weapons tests or other releases with global effects were announced during 1989. Naturally occurring radionuclides include ^{7}Be, ^{40}K, ^{87}Rb, ^{147}Sm, and the uranium and thorium series (including radon and daughters). The radionuclide composition of local area surface soil has been determined to be predominantly ^{40}K, natural thorium, and natural uranium, both in secular equilibrium with daughter nuclides. Fission-produced radionuclides, principally ^{137}Cs and ^{90}Sr are rarely detected in the environment. Radioactivity in aged fallout consists primarily of the fission produced ^{90}Sr-^{90}Y, ^{137}Cs, and ^{147}Pm, and also ^{234}U and ^{239}Pu. Gamma spectrometric analysis of composited ambient air samples collected during 1989 detected the

TABLE III-2

SOIL PLUTONIUM RADIOACTIVITY DATA--1989

Sample Location	19 July 1989 Survey Results		5 December 1989 Survey Results	
	^{238}Pu (pCi/g)	$^{239}Pu + ^{240}Pu$ (pCi/g)	^{238}Pu (pCi/g)	$^{239}Pu + ^{240}Pu$ (pCi/g)
S-56	0.0001 ± 0.0001	0.0014 ± 0.0002	-0.0001 ± 0.0001	0.0010 ± 0.0002
S-57	0.0004 ± 0.0001	0.0049 ± 0.0005	0.0002 ± 0.0002	0.0054 ± 0.0006
S-58	0.0001 ± 0.0001	0.0025 ± 0.0003	0.0002 ± 0.0002	0.0042 ± 0.0005
S-59	0.0002 ± 0.0016	0.0077 ± 0.0006	0.0001 ± 0.0002	0.0031 ± 0.0004
S-60	-0.0001 ± 0.0001	0.0026 ± 0.0003	0.0001 ± 0.0001	0.0019 ± 0.0003
S-61*	-0.0001 ± 0.0002	0.0001 ± 0.0001	0.0001 ± 0.0001	0.0004 ± 0.0002

*Off-site location

cosmogenic radionuclide ^{7}Be, plus additional natural radionuclides of terrestrial origin, the natural uranium and thorium series, and ^{40}K. Relative amounts of these radionuclides were approximately 73% ^{40}K, 25% ^{7}Be, and the remainder due to the natural uranium series and natural thorium series. The value for ^{7}Be is representative for the mixture only at the time of measurement since the physical half-life is extremely short compared with those of the other radionuclides detected, and, therefore, most of its activity has decayed before measurement.

Supply water is sampled monthly at De Soto and at two widely separated SSFL site locations. Activity levels in this water are screened by use at gross alpha and beta analyses. The average supply water radioactivity concentration for each site is presented in Table III-3. Supply water used at De Soto is supplied by the Los Angeles Department of Water and Power. Supply water used at the SSFL site is obtained partly from the Ventura County Water District No. 17, which also supplies nearby communities, and from local well water. Six on-site water wells were operated at various times during FY 1989 to reduce the consumption of the Ventura County water. The well water proportion in the blend averaged about 53% for the year, for a total well water consumption of about 3.8×10^{5} m^{3} (1.0×10^{8} gal).

TABLE III-3

SUPPLY WATER RADIOACTIVITY DATA--1989

Area	Activity	Number of Samples	Gross Radioactivity (10^{-9} µCi/ml) Average Value and Dispersion	Gross Radioactivity (10^{-9} µCi/ml) Maximum Value* and Month Observed
De Soto (monthly)	Alpha	12	1.67 ± 0.70	2.61 (January)
	Beta	12	4.43 ± 0.97	6.95 (January)
SSFL (monthly)	Alpha	24	2.19 ± 1.38	4.26 (October)
	Beta	24	4.04 ± 0.95	5.90 (January)

*Maximum value observed for single sample.

A shallow standpipe, connected to a french drain at foundation level, is being used for sampling of groundwater adjacent to the underground reactor test vault in Building 059. (This standpipe was installed during a construction modification to a currently deactivated Space Nuclear Auxiliary Power, SNAP, reactor test facility.) Water in the standpipe is sampled as part of the groundwater management, for the purpose of detecting any transfer of activation product radioactivity from the containment to the outside environment. Results of these analyses for 43 samples taken during 1989 are:

	Activity (uCi/ml) Gross Alpha	Gross Beta
Mean	4.3E-10	6.5E-09
Standard Deviation	5.6E-10	4.4E-09
Maximum	1.7E-09	1.8E-08
Date of Maximum	10 Oct 90	14 Jul 90

Gamma spectrometric analysis, with a minimum detection limit for ^{60}Co of about 5×10^{-7} µCi/ml, has not identified any specific unnatural radionuclides in the water; thus, the observed activity is attributed to dissolved radioelements of natural origin in the soil bed.

During a special inspection of SSFL Area IV by EPA Region IX in July 1989, a sample of water taken from the Building 059 french drain showed 1890 ± 538 (2 sigma) pCi/L of tritium (H-3). Since Rocketdyne had stated during the developing controversy over the quality of our environmental management at SSFL that no radioactive contamination had been detected in the groundwater, this report created considerable concern. This water, and other groundwater samples, had been previously and extensively sampled and analyzed by gamma-spectroscopy and gross alpha and gross beta counting. These analyses had shown no elevated or unnatural radioactivity, but are not suitable for the detection of tritium. Further sampling of the groundwater near Building 059, using both a special electrolytic enrichment technique prior to liquid scintillation counting for tritium and the standard procedure for measurement of tritium in water showed concentrations higher than naturally occurring tritium in surface water (roughly 30 pCi/L) ranging from 145 to 699 pCi/L. These levels are far below the limits established by the U.S. NRC (10 CFR 20, Appendix B) and the State of California (CCR17, Appendix A) for tritium in water released to an unrestricted area, 3,000,000 pCi/L, and the limit established by DOE in February 1990 (DOE Order 5400.5) of 2,000,000 Pci/L for ingested water, and the U.S. EPA and State of California drinking water standards (applicable to suppliers of water taken from surface sources and supplied to more than 30,000 customers) of 20,000 pCi/L. (No gamma emitters were found in this water by the analytical laboratory used by EPA.)

The possible production of tritium in the concrete surrounding the SNAP reactor in Building 059 was considered during the planning in 1973 for decontamination of this facility. This production results from absorption of neutrons escaping from the reactor during operation and their capture in lithium that is naturally present in the granite aggregate of the concrete. The expected amounts were so low, and so low compared to other activation

products, that it was not considered necessary to specifically analyze for tritium in this project. This decision is supported by a provision in the Federal and State regulations on radioactivities that permits a material to be considered "not present" if its concentration is less than 0.1 of the Maximum Permissible Concentration (a concentration of 300,000 pCi/L in this case). Nevertheless, because of the concern generated by the EPA finding, increased sampling and analysis for tritium have been instituted.

A major investigation of the occurrence of natural radioactivity in the groundwater and soil and rock at SSFL was recently completed by Groundwater Resources Consultants, Inc. ("Area IV Radiological Investigation Report--Santa Susana Field Laboratory--Rockwell International Corporation--Rocketdyne Division," March 23, 1990). These studies addressed gross alpha and gross beta radioactivities, gamma emitters, and, in some cases, uranium and plutonium isotopes. One unusual finding in this survey was a concentration of tritium in groundwater from a deep well (RD-23) in the Building 886 Sodium Disposal facility amounting to 589 $\pm$ 267 pCi/L. There is no known or suspected source of tritium in this area. While the amount found is well below the State of California regulatory limit of 3,000,000 pCi/L (and even below the limit for drinking water of 20,000 pCi/L), further analysis for tritium will be performed, because of the unreliability of individual sample results for tritium at such low concentrations.

A sample of water taken by DHS-Environmental Management Branch from a well on the Sage Ranch to the northeast of Area I, and analyzed by EPA-Las Vegas showed:

Gross Alpha	9 $\pm$ 5 pCi/L
Gross Beta	10 $\pm$ 3 pCi/L
Tritium	<500 pCi/L

These levels are typical of uncontaminated well water in this area.

As discussed earlier, 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 III-4.

TABLE III-4

SSFL SITE RETENTION POND AND SITE RUNOFF WATER RADIOACTIVITY DATA 1989

Area	Activity	Number of Samples	Gross Radioactivity Concentration ($\times 10^{-9}$ µCi/ml) Annual Average Value and Dispersion	Maximum Value[a] and Month Observed	Percent of Samples With Activity <LLD[b]
Pond No. 6 (Monthly)	Alpha	12	1.23 ± 1.12	3.19 (November)	100
	Beta	12	4.74 ± 0.73	5.83 (November)	0
Pond No. 12 (R-2A) (Monthly)	Alpha	12	1.69 ± 0.81	2.69 (January)	75
	Beta	12	4.78 ± 1.23	6.99 (January)	0
Upper Bell Creek No. 17 (Seasonal)	Alpha	20	1.38 ± 1.11	3.93 (October)	88
	Beta	20	4.91 ± 0.81	5.89 (August)	0

[a]Maximum value observed for single sample.

[b]Lower limit of detecting for water: Approximately 0.4 x 10^{-9} µCi/ml alpha; 1.1 x 10^{-9} µCi/ml beta.

Comparison of the radioactivity concentrations in water from the ponds with that of the supply water shows no significant differences in either alpha or beta activity. Similarly, comparisons between on-site soil samples and those of upper Bell Creek stream bed (presented in Table III-1) show no significant differences, indicating no long-term deposition of radioactivity from SSFL.

Water released from Pond R-2A was also sampled by DHS-Environmental Management Branch and analyzed by EPA-Las Vegas. This showed:

Gross Alpha	8 ± 4 pCi/L
Gross Beta	8 ± 3 pCi/L
Tritium	<500 pCi/L

These results are consistent with natural activity in the supply water and show no indication of radioactive contamination.

Radioactivity concentration guide values used for comparisons for licensed operations are those concentration limits adopted by the Nuclear Regulatory Commission (NRC) and the State of California as maximum permissible concentration (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 Derived Concentration Guides (DCG) for air and ingested water presented in DOE Order 5400.5 are used, although this Order was not in effect during 1989. (The issue date for this Order is 2/8/90; from 9/3/85, with the replacement of part of DOE Order 5480.1, Chapter XI, there were no authorized DOE limits on public air and water radioactivity. Rather, control was based on limitation of effective dose equivalent, including both internal and external contributions to the dose.)

The MPC/DCG values are dependent on the radionuclide and its behavior as a soluble or an insoluble material. For comparison with results of environmental and effluent monitoring, the single lowest value for the various radionuclides present is selected rather than a derived concentation limit for the mixture. Accordingly, for SSFL site surface water, the guide values of 5×10^{-6} µCi/ml alpha activity corresponding to ^{239}Pu for licensed facilities and 3×10^{-8} for DOE operations, and 3×10^{-7} µCi/ml beta activity corresponding to ^{90}Sr for licensed facilities and 1×10^{-6} for DOE operation are used. The SSFL site surface water and the ambient air radioactivity concentration guide values selected for each site are the most restrictive limits for those radionuclides currently in use at Rocketdyne facilities and should not be taken to indicate the actual identification of these radionuclides in the samples.

Ambient air sampling for long-lived particulate alpha and beta radioactivity is performed continuously by automatic sequential samplers located at De Soto and SSFL. Air is drawn through glass fiber filters, which are analyzed for retained long-lived radioactivity after a minimum 120-h decay period that eliminates naturally occurring short-lived particulate radioactivity (most radon daughters). The average concentrations of ambient air alpha and beta radioactivity for 1989 are presented for the various sampler locations in Table III-5. Gross alpha and beta radioactivity analyses are performed on a weekly basis to assure timely detection of any increased concentrations in the air. The exhaust effluent filter samples are composited (separately for each exhaust stack) and analyzed for specific radionuclides by U.S. Testing Co. (Richland Division). This specific concentration data permits more realistic estimates of offsite doses. This was also done for three ambient air samples at the Sodium Burn Pit, the RMDF Pond, and the T100 weekly sampler. These results are shown in Table III-6.

TABLE III-5

AMBIENT AIR RADIOACTIVITY DATA--1989

Area	Activity	Number of Samples	Gross Radioactivity Concentrations--µCi/ml: Annual Average Value and Dispersion	Maximum Value[a] and Date Observed	Percent of Guide[b]	Percent Less Than LLD[c]
De Soto (2 locations)	Alpha	516	(1.9 ± 2.8)E-15	30.4 (10/17)	0.06	99
	Beta		(33.2 ± 22.3)E-15	158.0 (10/17)	0.01	64
SSFL Area IV Bldg 011	Alpha	346	(2.1 ± 2.9)E-15	12.4 (11/14)	3.5	99
	Beta		(31.8 ± 23.7)E-15	151.8 (12/21)	0.11	69
SSFL Area IV Bldg 093	Alpha	346	(2.0 ± 2.9)E-15	14.2 (07/10)	3.3	99
	Beta		(31.7 ± 19.9)E-15	104.3 (11/14)	0.11	66
SSFL Area IV Bldg 100	Alpha	356	(2.3 ± 2.5)E-15	10.3 (11/13)	3.8	99
	Beta		(34.3 ± 22.6)E-15	127.0 (12/21)	0.11	64
SSFL Area IV Bldg 363	Alpha	364	(2.4 ± 2.6)E-15	14.3 (12/04)	4.0	99
	Beta		(32.9 ± 20.9)E-15	126.6 (12/21)	0.11	64
SSFL Area IV Burn pit	Alpha	160	(3.1 ± 2.8)E-15	18.8 (11/08)	5.2	97
	Beta		(44.4 ± 28.5)E-15	123.2 (10/12)	0.15	52
SSFL Area IV RMDF pond	Alpha	105	(3.7 ± 3.1)E-15	13.0 (12/17)	18.6	96
	Beta		(51.1 ± 28.8)E-15	127.0 (12/20)	0.57	40
SSFL Area II Security Bldg Bldg 207	Alpha	363	(2.4 ± 2.9)E-15	14.2 (11/12)	4.0	98
	Beta		(35.5 ± 23.4)E-15	147.9 (11/13)	0.12	65
SSFL Area III Sewage plant Bldg 600	Alpha	364	(2.3 ± 2.7)E-15	11.5 (11/07)	3.8	98
	Beta		(33.4 ± 22.6)E-15	138.0 (12/21)	0.11	66

[a]Maximum value observed for single sample.

[b]Guide De Soto site: 3×10^{-12} µCi/ml alpha, 3×10^{-10} µCi/ml beta; 10 CFR 20 Appendix B, CAC 17. SSFL site: 6×10^{-14} µCi/ml alpha, 3×10^{-11} µCi/ml beta; 10 CFR 20 Appendix B, CAC 17, and 2×10^{-14} µCi/ml alpha, 9×10^{-12} µCi/ml beta, DOE Order 5500.5 (2/8/90).

[c]LLD = 9.1×10^{-15} µCi/ml alpha; 3.8×10^{-14} µCi/ml beta.

(To convert these concentrations to Bq/ml, multiply by 3.7 + 04.)

TABLE III-6

Radioactivity Concentrations
in Ambient Air

Location	Sodium Burn Pit (7/22-12/31)	RMDF Pond (9/15/-12/31)	T100 (1/1-12/31)
Radionuclide (radiation type)	Average Concentration (uCi/ml)		
Be-7 (β)	2.8 E-14	6.8 E-14	1.2 E-14
K-40 (β)	1.6 E-14	3.3 E-14	1.0 E-14
Sr-90 (β)	2.0 E-16	7.2 E-17	2.5 E-16
Cs-137 (β)	-3.2 E-16	-3.2 E-16	1.3 E-16
Po-210 (α)	1.4 E-14	1.4 E-14	1.2 E-14
Th-228 (α)	1.6 E-16	1.9 E-16	4.2 E-11
Th-230 (α)	3.5 E-17	2.7 E-17	2.0 E-17
Th-232 (α)	4.4 E-17	1.8 E-17	8.6 E-18
U-234 (α)	7.2 E-17	8.5 E-17	2.9 E-17
U-235 (α)	6.0 E-18	1.2 E-17	2.0 E-18
U-238 (α)	5.4 E-17	8.5 E-17	2.2 E-17
Pu-238 (α)	3.4 E-18	1.0 E-17	4.0 E-19
Pu-239/240 (α)	3.7 E-18	1.9 E-18	2.0 E-19
Am-241 (α)	3.4 E-17	9.2 E-18	8.0 E-19

The guide value of 6×10^{-14} µCi/ml for SSFL site ambient air alpha activity is due to contamination remaining from work with unencapsulated plutonium (the DOE value is 2×10^{-14}). The value of 3×10^{-11} µCi/ml for beta activity is due to the presence of ^{90}Sr in fission product contamination from previous work with irradiated nuclear fuel at the SSFL site (the DOE value is 9×10^{-12}). The guide value of 3×10^{-12} µCi/ml for De Soto ambient air alpha activity is due to prior (licensed) work with unencapsulated depleted uranium. The guide value of 3×10^{-10} µCi/ml for beta activity is for ^{60}Co, for which the ambient air beta activity guide is appropriate since it is the most restrictive limit for any beta-emitting radionuclide currently in use at De Soto. It should be noted that the apparently higher concentrations relative to the Guide shown for the RMDF Pond sampler are solely due to the lower Guide values (DCG) implemented in 1990 by DOE. This is the only ambient air sampler located in the DOE territory at SSFL. Guide value percentages are not presented for soil data, since none have been established, except in special cases.

Figure 5 is a graph of the weekly averaged long-lived alpha and beta ambient air radioactivity concentrations for De Soto and SSFL during 1989. These results clearly show that the major contributions to airborne radioactivity at SSFL are the natural radionuclides Be-7, K-40, and Po-210, blowing in the wind. All other radionuclides, particularly the artificial radionuclides that might be expected to originate in Rocketdyne operations, are lower by several orders of magnitude. Since much of the Be-7 (53-day half-life) and Po-210 (138-day half-life) decay before analysis, the results significantly underestimate the concentrations of the natural radionuclides.

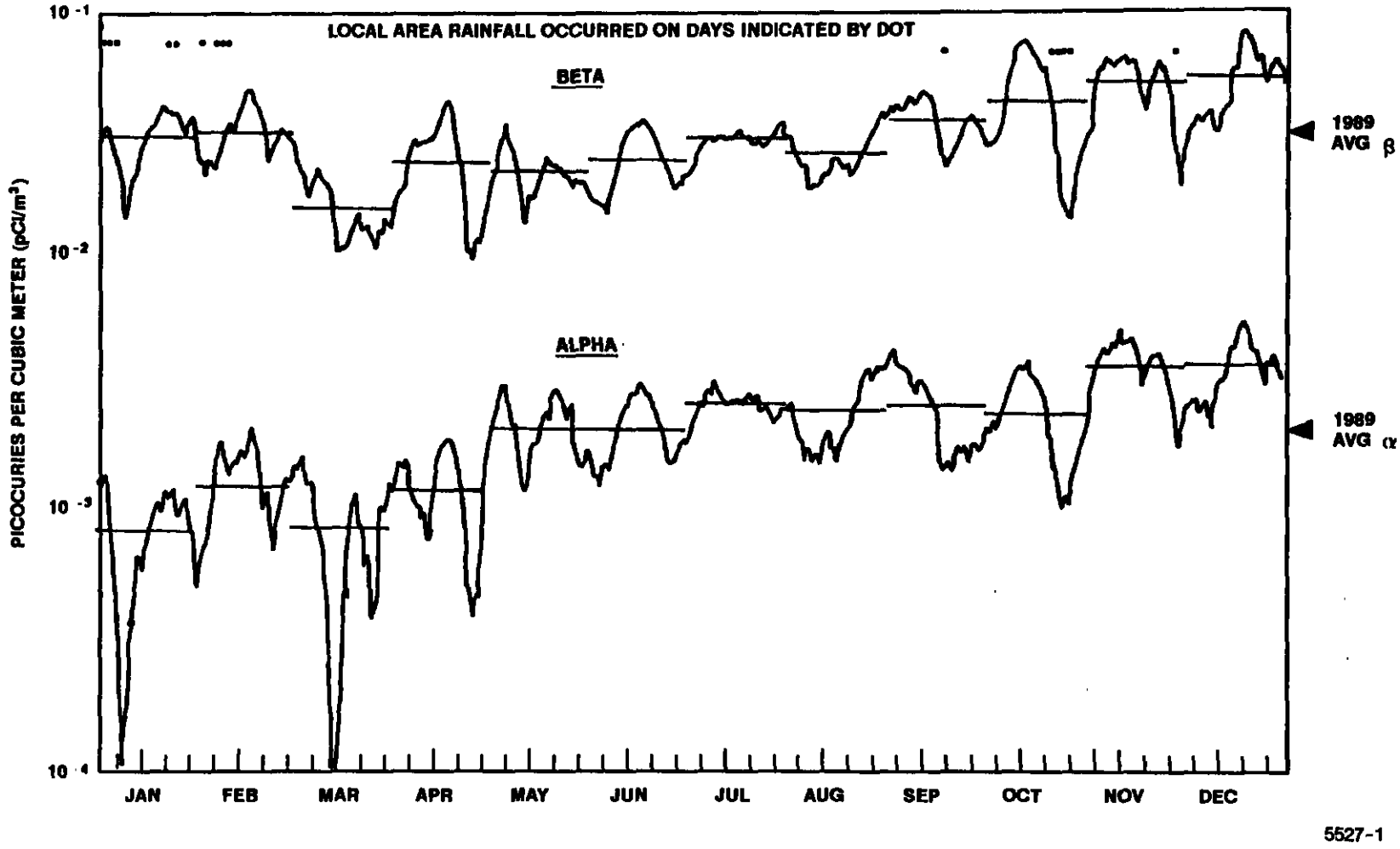

Figure 5. Weekly, Monthly, and Annual Averaged Long-Lived Airborne Radioactivity at the De Soto and Santa Susana Field Laboratories Sites--1989

For comparison with the limits on airborne radioactivity in an unrestricted area, the lowest limits (MPCs from 10CFR20 and CCR17 for the Sodium Burn Pit and T100, and the DCG from DOE Order 5400.5 (2/8/90) for the RMDF Pond) for the alpha (α) and beta (β) emitters found in the air are:

MPC	Alpha	6E-14 (Pu-239/240)
	Beta	3E-11 (Sr-90)
DCG	Alpha	2E-14 (Pu-239/240)
	Beta	9E-12 (Sr-90)

The daily data were mathematically smoothed in a moving weekly average of daily data for the year. The average alpha and beta radioactivity concentrations for each month are indicated by horizontal bars. The graph shows an abrupt decrease in airborne radioactivity during March and April which is a result of the movement of a series of intense rain storms into the Southern California area. By the end of June, activity returned to previous levels and continued to be generally constant or slightly increasing during the remainder of 1989. 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. Radionuclides detected by gross alpha and beta analysis of air samples collected during 1989 include ^{7}Be and ^{40}K plus several naturally occurring radionuclides from the uranium and thorium series. While the data for airborne alpha activity are nearly all below the Lower Level of Detection for a single sample, averaging values from nine daily air samples over seven consecutive days and over calendar months reveal the long-term behavior of this activity.

Vegetation

Although routine sampling and analysis of native vegetation was dropped from the environmental monitoring program at the end of 1985, in recognition of its lack of value at the SSFL site, some occasional analyses are performed.

Twenty different plants were sampled along the North Slope-Leach Field area of the RMDF and throughout the Sodium Burn Pit. These were analyzed (without prior washing, since total radioactivity was to be measured, not just uptake) for gross beta activity with the results shown in Table III-7.

The averages of these values are 155 pCi/g for the ash activity and 16.3 pCi/g for the equivalent dry weight. These compare closely with the average of 135 pCi/g dry weight for 144 samples taken on-site in 1985, and analyzed after washing dust and dirt from the plants.

While Sample 1 shows elevated ash activity, this is not true for the equivalent dry weight activity. The results show no evidence of radioactive contamination.

Avocados and oranges are grown on the Sage Ranch, northeast of the Area I (easternmost) part of SSFL. These were sampled by DHS-Environmental Management Branch and analyzed by EPA-Las Vegas with the following results:

	K-40 pCi/g wet
Avocado watered with well water	3.2
Avocado watered with municipal water	2.7
Oranges	2.1

Only K-40 was detected. The Minimum Detectable Levels quoted by the laboratory are:

K-40	0.12
Co-60	0.01
Cs-137	0.01
Ra-226	0.02
Ra-228	0.03

No indication of contamination was found.

TABLE III-7

LOCATION AND PLANT TYPE	BETA ACTIVITY pCi/g ash	dry
#1 North of T/022 on NORTH SLOPE plateau-Acacia	355.67	30.32
#2 N of NE RMDF corner fence post on plateau near LEACH FIELD-Mulefat	211.37	16.99
#3 N of RMDF NE fence post near LEACH FIELD-Green & Furry	185.84	20.36
#4 NW shoulder plateau N of T/022 NORTH SLOPE-California Laurel Sumac	98.71	14.97
#5 N of T/022 near N edge of plateau NORTH SLOPE-Wire Bush	69.69	7.03
#6 N of T/022 on plateau NORTH SLOPE-Little Green Lace	180.81	15.40
#7 N edge of 883 BURN PIT-Agave	166.24	2.73
#8 Green Weed from middle of lower pond BURN PIT-Salvia	232.46	36.47
#9 N of NE post on plateau RMDF-Wire Bush	105.57	11.45
#10 N of NE fence post on plateau RMDF-Creosote	160.62	15.19
#11 Near W shoulder with NE containment RMDF-Toyon	137.22	22.39
#12 NW corner of lower pond BURN PIT-Salvia	201.00	28.47
#13 N edge of T/883 BURN PIT-Telegraph Weed	171.29	14.81
#14 E Side of Upper Pond BURN PIT-Salvia	167.02	24.15
#15 Within lower pond BURN PIT- Wild Oats	94.54	10.45
#16 NE of lower pond BURN PIT-wild Oats	53.81	6.33
#17 W side of upper pond BURN PIT-Salvia	40.36	6.25
#18 SE corner of lower pond BURN PIT-Salvia	146.65	29.34
#19 Lower pond BURN PIT-Mustard	50.94	7.42
#20 NE of lower pond-Wild Mustard (dry)	58.88	5.72

Wildlife

At the recommendation of a reviewer from EPA-Las Vegas, an effort has been started to collect samples of wildlife for analysis for radioactivity. During 1989, a dead deer was found, and parts of it were sent to U.S. Testing Company (Richland Division) for several types of radiometric analyses. The results are shown below:

Material	Radionuclide	Activity Concentration pCi/g ±2 sigma
bone	Pu-239-240	less than blank ±0.0006
bone	Pu-238	less than blank ±0.0009
bone	Sr-90	0.375 ±0.071
bone	Cs-137	less than blank ±067
bone	gamma spectrometry showed no other significant activity	
muscle water	H-3	0.286 ±0.164
liver water	H-3	0.101 ±0.154
liver tissue	K-40	1.56 ±0.31
liver tissue	Cs-137	0.002 ±0.006
liver tissue	gamma spectrometry showed no other significant activity	

These results show no indication of radioactive contamination.

A special air sampling was performed in October by the Environmental Radiation Management Unit of the State of California Department of Health Services, assisted by Lawrence Livermore National Laboratory (LLNL). Three pairs of air samplers were operated: one pair at the Sodium Burn Pit at SSFL, one pair at Firehouse 46 in Santa Susana (Susana Knolls), and one pair at Calabasas High School at Old Topanga Canyon Road and Mulholland Highway. The filter samples were analyzed by gamma-spectrometry at LLNL and sent to the U.S. EPA Environmental Monitoring Laboratory (Las Vegas) for a more complete analysis. (The results of the EPA analysis have not yet been received.)

The analysis at LLNL indicated some naturally occurring uranium daughter activity, but insufficient time had elapsed for a full ingrowth of the radon daughters. The activities specifically tested and the results are shown below:

Location	Activity (μCi/ml)	K-40	Cs-137
SSFL Sodium Burn Pit (1)	0.13	<1.00E-02	<1.75E-04
SSFL Sodium Burn Pit (2)	0.16	<2.93E-03	<7.81E-05
Firehouse 46 (1)	0.14	<1.00E-02	<2.00E-04
Firehouse 46 (2)	0.13	<1.00E-02	<1.83E-04
Calabasas High School (1)	0.14	<9.33E-04	4.31E-03
Calabasas High School (2)	0.14	<4.00E-03	<1.59E-04

As shown, the major long-lived activity in the local air is Be-7 (53-day half-life) which is continually produced by cosmic-ray interactions in the atmosphere. While a very low concentration of Cs-137 was detected in one sample from Calabasas High School, the other sample did not show detectable activity.

Rocketdyne installed a permanent air sampler at the Sodium Burn Pit prior to this special sampling (on July 22) and has continued its operation through the year. During the special sampling period (October 6-13), activity collected by this sampler showed:

gross alpha	3.3E-15 µCi/ml
gross beta	86.0E-15 µCi/ml

Filter samples from this location, for the period from its installation through the end of the year, were composited and analyzed for specific radionuclides by U.S. Testing Company (Richland Division) as shown in Table III-6.

Monitoring of ambient radiation is performed with thermoluminescent dosimeters (TLDs). Each dosimeter set uses two calcium fluoride (CaF_2:Mn) low background, bulb-type chip dosimeters. The dosimeter sets are placed at locations on or near the perimeters of the De Soto, SSFL, and Canoga sites. Each dosimeter, sealed in a light-proof energy compensation shield, is installed in a sealed plastic container mounted about 1 m above ground at each location. The dosimeters are exchanged and evaluated quarterly. During the year, 27 on-site TLD monitoring locations were used. Five additional dosimeter sets, placed at locations up to 10 miles from the sites, are similarly evaluated to determine the local area off-site ambient radiation level, which averaged 9.6 µR/h for 1989. Table III-8 presents the quarterly and annual radiation exposures, the equivalent annual exposures, and exposure rates determined for each dosimeter location. (In previous reports, an effort was made to reduce the variability of the results due to the significant differences in altitude, and therefore in the cosmic ray contribution to the total exposure. However, this adjustment appears to have created confusion and uncertainty, rather than improved understanding, and so has not been shown for this year.)

The Radiologic Health Section of the State of California Department of Health Services provides packages containing calcium sulfate ($CaSO_4$) dosimeters for independent monitoring of radiation levels in this area. These dosimeters are placed in field deployment containers used for the bulb dosimeters. The State dosimeters are returned to the Radiologic Health Section for evaluation by their vendor laboratory. Data for these TLDs, placed at eight Rocketdyne dosimeter locations, both on-site and off-site, are shown in Table III-8. The comparison between exposure rates determined by Rocketdyne

TABLE III-8

DE SOTO, SSFL, AND CANOGA SITES--AMBIENT RADIATION DOSIMETRY DATA--1989

TLD Location		Quarterly Exposure (mR) Q-1	Q-2	Q-3	Q-4	Annual Exposure (mR)	Annual Average Exposure Rate uR/hr Rocketdyne	State DHS
De Soto	DS-1	23	17	22	15	77	8.8	
	DS-2	15	16	19	16	66	7.5	9.0
	DS-3	24	17	33	15	89	10.2	
	DS-4	24	17	21	16	78	8.9	
	DS-5	19	15	23	18	75	8.6	
	DS-6	26	14	31	19	90	10.3	10.0
	DS-7	28	16	21	19	84	9.6	
	DS-8	30	12	43	10	95	10.8	9.1
Mean value		24	16	27	16	82	9.4	
SSFL	SS-1	25	17	26	17	85	9.7	
	SS-2	26	26	28	20	100	11.4	
	SS-3	23	21	48	20	112	12.8	10.8
	SS-4	25	24	22	25	96	11.0	
	SS-5	25	18	24	27	94	10.7	11.3
	SS-6	23	23	42	20	108	12.3	
	SS-7	28	15	35	13	91	10.4	10.4
	SS-8	32	16	27	14	89	10.2	
	SS-9	31	19	28	18	96	11.0	
	SS-10	27	22	29	17	95	10.8	
	SS-11	31	28	46	26	131	15.0	17.2
	SS-12	35	28	53	21	137	15.6	
	SS-13	27	20	35	27	109	12.4	
Mean value		28	21	34	20	103	11.8	
Canoga	CA-1	22	14	25	14	75	8.6	
	CA-2	25	13	30	11	79	9.0	
	CA-3	21	15	25	12	73	8.3	
	CA-4	24	27	24	12	87	9.9	
	CA-5	22	12	17	10	61	7.0	
	CA-6	27	13	33	16	89	10.2	
Mean value		24	16	26	13	77	8.8	
Off-site	OS-1	26	17	25	15	85	9.7	10.5
	OS-2	23	(21)[a]	33	19	96[b]	11.0	
	OS-3	21	13	22	11	82	9.4	
	OS-4	23	15	32	13	75	8.6	
	OS-5	20	20	15	8	81	9.2	
Mean value		23	16	25	13	84	9.6	

[a]Missing dosimeter. Assumed value in ( ).
[b]Adjusted to full year to compensate for missing dosimeter.

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and the State is quite good and differences are within normally expected experimental variations. On the average, measurements by Rocketdyne and the State DHS agree within 2%.

During the third quarter of 1989, TLD exposure data was somewhat higher than expected for the on-site and off-site dosimeters. The higher results were noted for both off-site and on-site dosimeters. The data reported for 1989 include a correction for self-irradiation as recommended by the U.S. DOE Environmental Measurements Laboratory. This correction tends to reduce the exposure estimates.

Table III-8 shows that radiation exposures and equivalent annual exposure rates monitored on-site are nearly identical to levels monitored at the five widely separated 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 100 mR/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 850-ft ASL (above sea level) at the Canoga facility to a maximum of about 1900-ft ASL at SSFL.

Supplementary measurements of ambient radiation levels with high-pressure ion chamber (HPIC) monitors are made at two locations at the SSFL site. The HPIC values for 1989 were equivalent to annual exposures of 87 mR for the Building 207 monitor and 97 mR for the Building 363 monitor. These values are in good agreement with results for nearby TLD locations for the year.

Annual average exposure rates (μR/hr) are shown in this table as measured by Rocketdyne and independently by the State of California using a different type of TLD. The agreement is good and confirms that exposures to radiation on-site do not differ greatly from natural background radiation.

Quality Assurance

Rocketdyne participates in the DOE Quality Assessment Program (QAP) operated by the Environmental Measurements Laboratory in New York. During 1989, two sets of samples were distributed: QAP XXX and QAP XXXI. The summary listings from these sets are shown as attachments to this section. While these comparisons involve sample types, geometries, and analyses that are not part of the routine procedures at the Rocketdyne laboratory, review of these results and those of the other laboratories shows a similar or better quality in most cases.

ATTACHMENT TO SECTION III

COMPARATIVE RESULTS

QAP XXX

Date	Type	Lab	Isotope	Ser	Reported Value	Reported % Error	EML Value	Ratio Rp/EML	Ratio +/-
89 04	AIR	CS	BE 7	1	0.149E+04	4	0.195E+04	0.76	0.05
89 04	AIR	CS	BE 7	2	0.142E+04	6	0.195E+04	0.73	0.06
89 04	AIR	CS	CO 60	1	0.150E+03	4	0.126E+03	1.19	0.08
89 04	AIR	CS	CO 60	2	0.137E+03	7	0.126E+03	1.09	0.10
89 04	AIR	CS	SB 125	1	0.505E+02	15	0.968E+02	0.52	0.08
89 04	AIR	CS	SB 125	2	0.462E+02	23	0.968E+02	0.48	0.11
89 04	AIR	CS	CS 134	1	0.189E+03	4	0.158E+03	1.20	0.08
89 04	AIR	CS	CS 134	2	0.180E+03	6	0.158E+03	1.14	0.10
89 04	AIR	CS	CS 137	1	0.192E+03	3	0.189E+03	1.02	0.06
89 04	AIR	CS	CS 137	2	0.171E+03	5	0.189E+03	0.90	0.07
89 04	AIR	CS	CE 144	1	0.358E+03	4	0.327E+03	1.09	0.08
89 04	AIR	CS	CE 144	2	0.301E+03	8	0.327E+03	0.92	0.09
89 04	SOIL	CS	K 40	1	0.208E+02	6	0.241E+02	0.86	0.06
89 04	SOIL	CS	CS 137	1	0.172E+02	1	0.208E+02	0.83	0.03
89 04	VEGETN	CS	K 40	1	0.240E+02	7	0.261E+02	0.92	0.07
89 04	VEGETN	CS	CS 137	1	0.165E+01	6	0.160E+01	1.03	0.07
89 04	WATER	CS	MN 54	1	0.311E+00	10	0.300E+00	1.04	0.13
89 04	WATER	CS	CO 57	1	0.817E+00	3	0.880E+00	0.93	0.06
89 04	WATER	CS	CO 60	1	0.882E+00	5	0.940E+00	0.94	0.07
89 04	WATER	CS	CS 134	1	0.247E+01	3	0.273E+01	0.90	0.05
89 04	WATER	CS	CS 137	1	0.247E+01	2	0.255E+01	0.97	0.06

QAP XXXI

89 09	AIR	CS	BE 7	1	0.916E+02	6	0.123E+03	0.74	0.05
89 09	AIR	CS	MN 54	1	0.393E+01	13	0.417E+01	0.94	0.14
89 09	AIR	CS	CO 60	1	0.936E+01	9	0.817E+01	1.15	0.11
89 09	AIR	CS	CS 134	1	0.108E+02	9	0.933E+01	1.16	0.11
89 09	AIR	CS	CS 137	1	0.377E+01	13	0.358E+01	1.05	0.15
89 09	AIR	CS	CE 144	1	0.800E+01	18	0.708E+01	1.13	0.23
89 09	SOIL	CS	K 40	1	0.491E+03	14	0.561E+03	0.88	0.13
89 09	SOIL	CS	CS 137	1	0.564E+03	3	0.642E+03	0.88	0.04
89 09	VEGETN	CS	K 40	1	0.112E+04	10	0.129E+04	0.87	0.10
89 09	VEGETN	CS	CS 137	1	0.391E+02	16	0.479E+02	0.82	0.14
89 09	WATER	CS	MN 54	1	0.658E+02	7	0.650E+02	1.01	0.11
89 09	WATER	CS	CO 57	1	0.128E+03	2	0.135E+03	0.95	0.08
89 09	WATER	CS	CO 60	1	0.161E+03	4	0.155E+03	1.04	0.10
89 09	WATER	CS	CS 134	1	0.684E+02	7	0.683E+02	1.00	0.11
89 09	WATER	CS	CS 137	1	0.699E+02	6	0.683E+02	1.02	0.10

IV. ENVIRONMENTAL MONITORING PROGRAM

A. DESCRIPTION

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. Except for specific analyses for plutonium in soil, specific radionuclides in environmental samples are not routinely identified because of the extremely low radioactivity levels normally detected. Gross alpha and beta radiation analyses are performed for screening purposes on all other environmental samples. Facility atmospheric effluent sample filters for 1989 were composited for specific radiochemistry analysis by U.S. Testing Company.

The environmental monitoring program was initiated in 1952 at Rocketdyne's predecessor division, which was then located in Downey, California. At that time, a program of soil and vegetation sample collection and analysis was begun to study environmental effects from the nuclear research and development conducted there. This program was designed with the primary purpose of adequately surveying environmental radioactivity to ensure that company nuclear operations would not contribute significantly to local radioactivity. Any program changes have reflected this 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, where other nuclear installations were planned and eventually built and operated. The Downey area survey was terminated when nuclear activities were relocated to Canoga Park in 1955. 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 upon 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 releases of radioactivity 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. As an overcheck, however, off-site samples were taken and analyzed for radioactivity for the third and fourth quarters of 1989. Those results are summarized in the text of this report. Table A-1 in Appendix A shows that the 1989 averaged values for soil activity compares well with values for prior years. Locations of sampling stations are shown in Figures 6 through 9 and listed in Table IV-1.

Occasional gamma-spectral analyses of bulk samples such as soil, water, and ambient air sample collection 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 ^{40}K, and ^{7}Be produced by cosmic ray interactions in the atmosphere.

In addition to environmental monitoring, work area 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 hazardous material can occur.

Environmental sampling stations located within the De Soto and SSFL boundaries are referred to as "on-site" stations. The De Soto and SSFL locations are sampled quarterly to determine the concentration of radioactivity in typical surface soil. Soil is also sampled on-site (SSFL) and off-site semi-annually for plutonium analysis. Water samples are obtained monthly at both

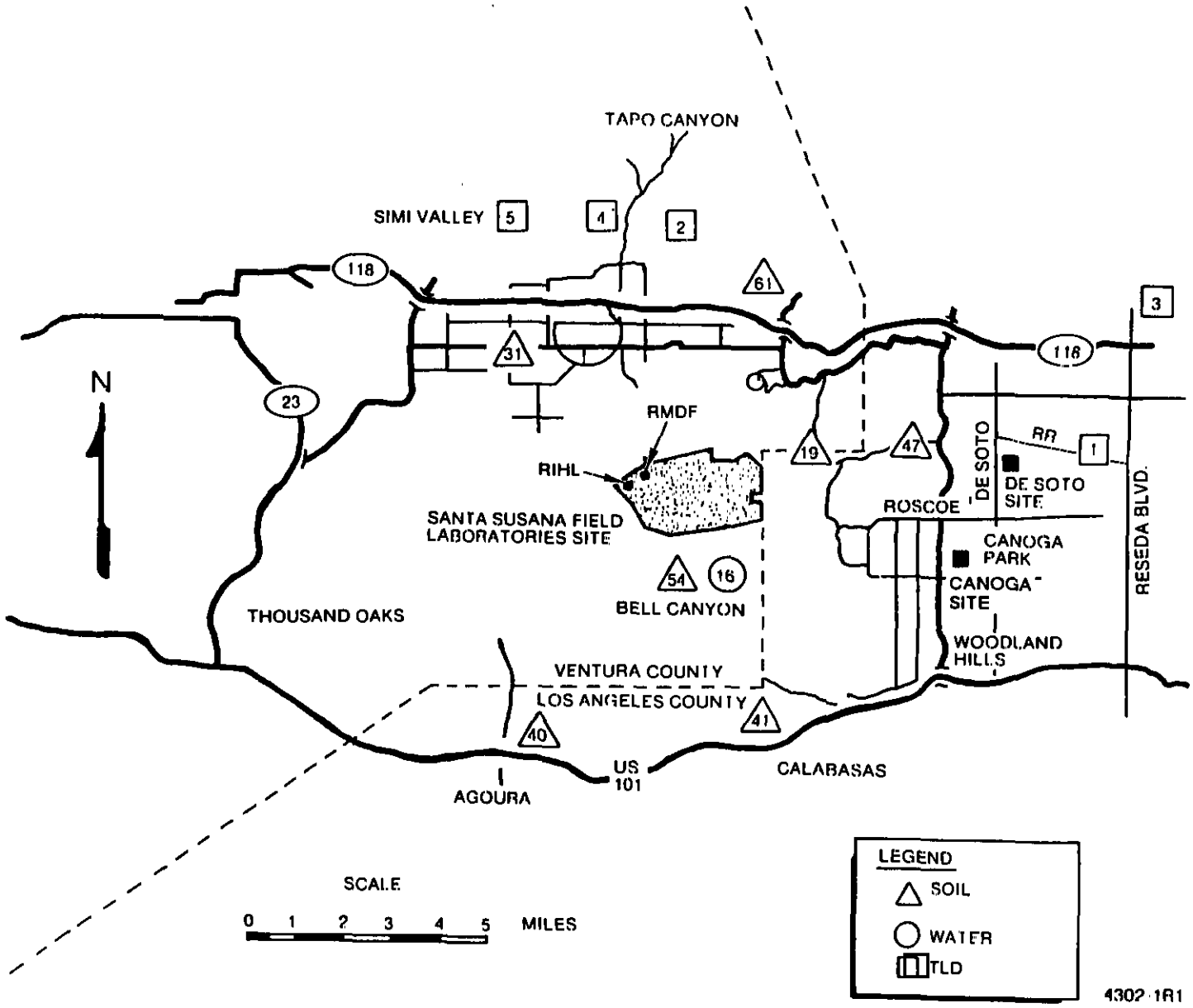

Figure 6. Map of Canoga Park, Simi Valley, Agoura, and Calabasas Sampling Stations

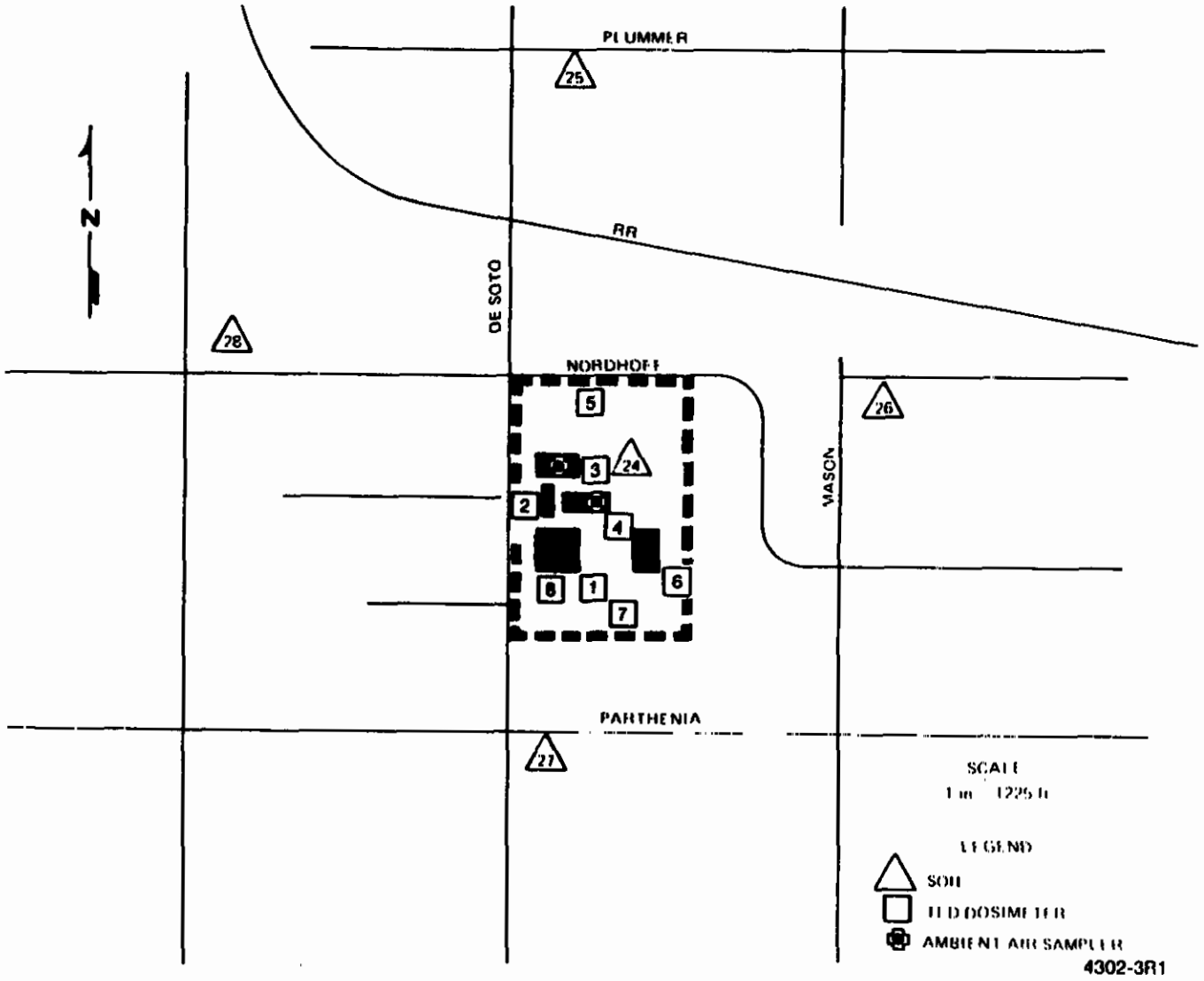

Figure 7. Map of De Soto Site and Vicinity Sampling Stations

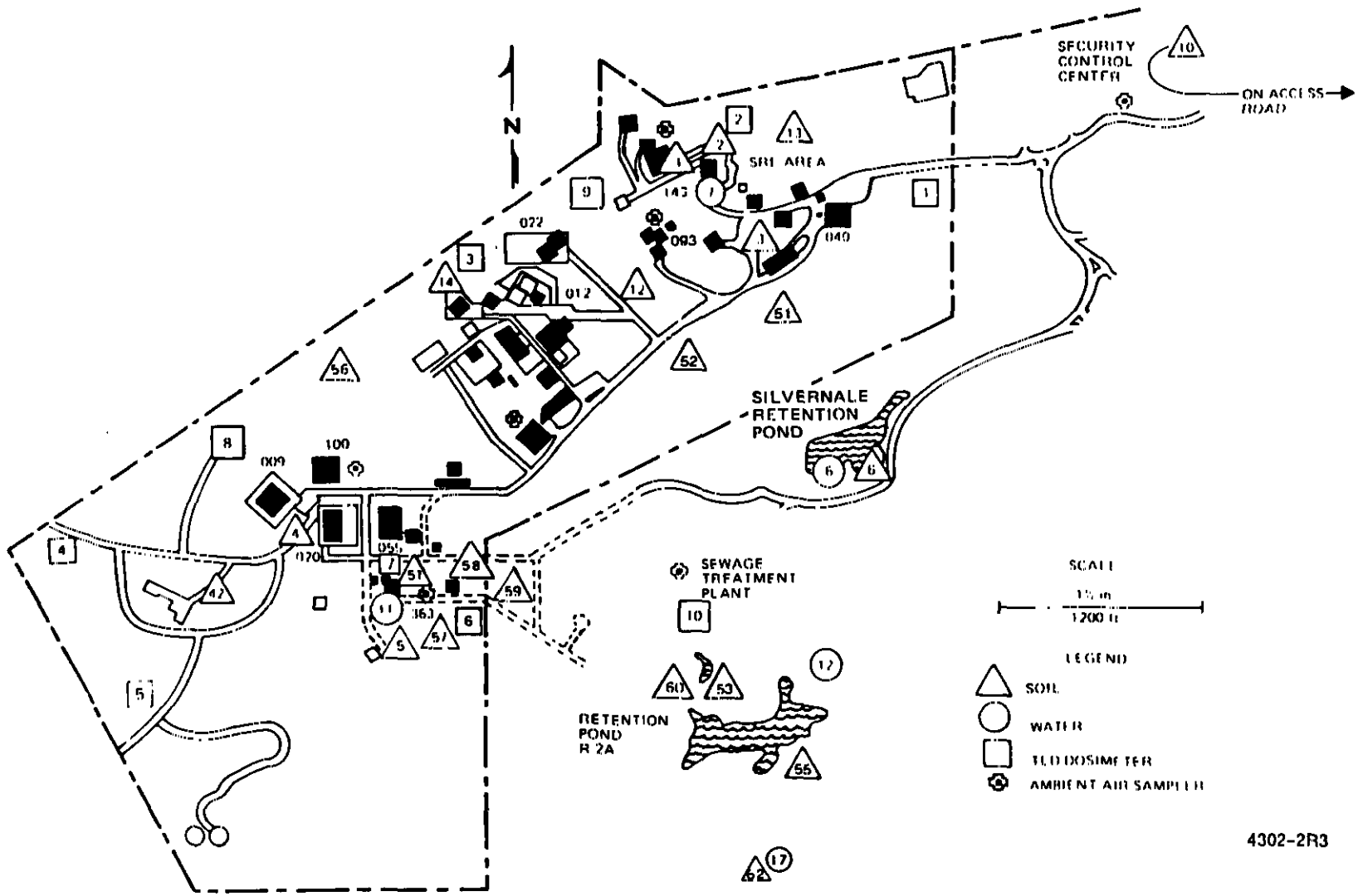

Figure 8. Map of Santa Susana Field Laboratories Site Sampling Stations

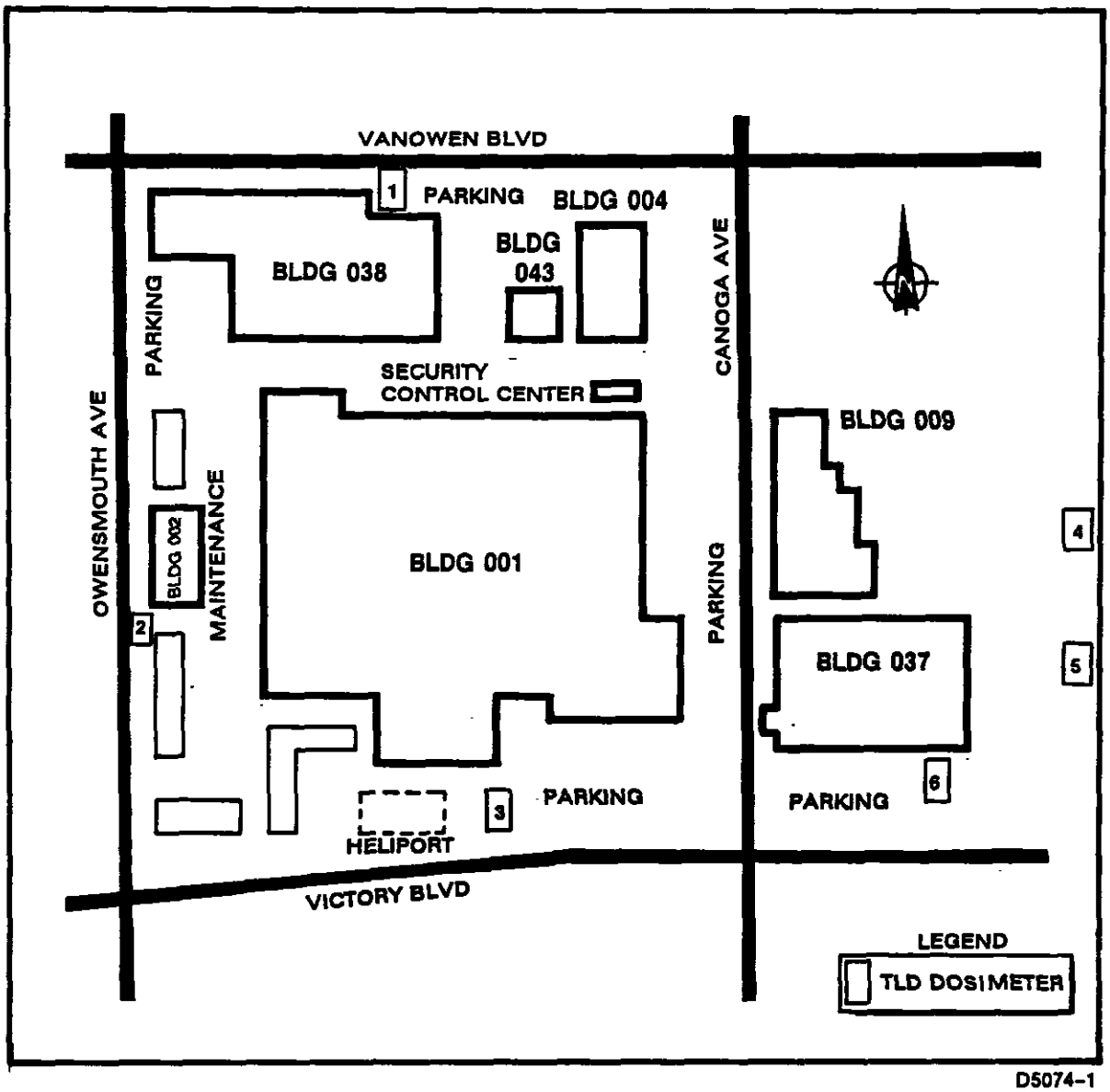

Figure 9. Map of Canoga Site TLD Locations

TABLE IV-1

SAMPLING LOCATION DESCRIPTION
(Sheet 1 of 4)

Station	Location	Frequency of Sampling*
S-1	SSFL Site, Building 143, southeast side	(Q)
S-3	SSFL Site, Building 064, north parking area	(Q)
S-4	SSFL Site, Building 020, at west fence	(Q)
S-5	SSFL Site, Building 363, east parking area	(Q)
S-6	SSFL Site, Silvernale Interim Retention Pond, south side	(Q)
S-12	SSFL Site, Building 093, at driveway	(Q)
S-14	SSFL Site, Below RMDF (T 621) at T 024	(Q)
S-24	De Soto Site, Building 104, east side	(Q)
S-25	De Soto Avenue and Plummer Street, southeast corner	(Q)
S-42	SSFL Site, Building 886, at former sodium disposal facility	(Q)
S-52	SSFL Site, Burro Flats Drainage Control Sump, G Street and 17th Street	(Q)
S-55	SSFL Site, Pond R-2A (Pond Bottom Mud), north side	(Q)
S-56	SSFL Site, F Street and 24th Street	(S)
S-57	SSFL Site, J Street, south of Building 055 exhaust stack	(S)
S-58	SSFL Site, Building 353, south of road	(S)
S-59	SSFL Site, Test Area STL-4, entrance, west side	(S)
S-60	SSFL Site, Pond R-2A, northwest side	(S)
S-61	Simi Valley, east end of Alamo Avenue near Flannagan Drive	(S)
S-62	SSFL Site, near south boundary, Bell Creek Weir, Well 9	(Q)
W-6	SSFL Site Silvernale Interim Retention Pond, south side	(M)
W-7	SSFL Site Domestic Water, Building 003, washroom faucet	(M)
W-11	SSFL Site Domestic Water, Building 363, washroom faucet	(M)
W-12	SSFL Site, Pond R-2A, north side	(M)
W-13	De Soto Site, Building 104, washroom faucet	(M)
A-1	De Soto Site, Building 102 roof	(D)
A-2	De Soto Site, Building 104 roof	(D)
A-3	SSFL Site, Building 100, east side	(D)

TABLE IV-1

SAMPLING LOCATION DESCRIPTION
(Sheet 2 of 4)

Station	Location	Frequency of Sampling*
A-4	SSFL Site, Building 011, west side	(D)
A-5	SSFL Site, Building 600, Sewage Treatment Plant, north side	(D)
A-6	SSFL Site, Building 207, Security Control Center, north side	(D)
A-7	SSFL Site, Building 093, west side	(D)
A-8	SSFL Site, Building 163, Box Shop at east side	(D)
A-9	SSFL Site, Building 363, west side	(D)
A-10	SSFL Site, Building 886, at former Sodium Disposal Facility	(D)
A-11	SSFL Site, RMDF Pond	(D)
A-12	SSFL Site, Building 100, east side - 7-day sampler	(168 h)
On-Site--De Soto - Ambient Radiation Dosimeter Locations (TLD)		
DS-1	De Soto Site, south of Block House	(Q)
DS-2	De Soto Site, northwest corner of Building 101 (State of California TLD Location Number 2)	(Q)
DS-3	De Soto Site, southeast corner of Building 102	(Q)
DS-4	De Soto Site, northeast corner of SPEL II Laboratory Building 113	(Q)
DS-5	De Soto Site, northeast corner of Building 102	(Q)
DS-6	De Soto Site, east boundary, southeast corner of Building 105 (State of California TLD Location Number 1)	(Q)
DS-7	De Soto Site, north of Building 106	(Q)
DS-8	De Soto Site Guard Post 4, southwest corner of Building 101 (State of California TLD Location Number 7)	(Q)
On-Site--SSFL - Ambient Radiation Dosimeter Locations (TLD)		
SS-1	SSFL Site, west of emergency trailer, Building 114	(Q)
SS-2	SSFL Site, SRE Retention Pond	(Q)
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)
SS-5	SSFL Site, southwest boundary at property line gate	(Q)

TABLE IV-1

SAMPLING LOCATION DESCRIPTION
(Sheet 3 of 4)

Station	Location	Frequency of Sampling*
On-Site--Canoga - Ambient Radiation Dosimeter Locations (TLD)		
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 on HPIC monitor (State of California TLD Location Number 8)	(Q)
SS-8	SSFL Site, Sodium Disposal Facility north boundary	(Q)
SS-9	SSFL Site, Radioactive Materials Disposal Facility, northeast boundary at Building 133	(Q)
SS-10	SSFL Site, Building 600, Sewage Treatment Plant	(Q)
SS-11	SSFL Site, RMDF northwest property line boundary (State of California TLD Location Number 9)	(Q)
SS-12	SSFL Site, RMDF northwest property line boundary	(Q)
SS-13	SSFL Site, RMDF northwest property line boundary	(Q)
CA-1	Canoga Site, northeast corner of Building 038	
CA-2	Canoga Site, southwest corner of Building 002	
CA-3	Canoga Site, south of Building 001 near street entrance	
CA-4	Canoga Site, east of Building 009 on boundary fence	
CA-5	Canoga Site, east of Building 037 on boundary fence	
CA-6	Canoga Site, southeast corner of Building 037	
Off-Site (TLD)		
OS-1	Off-site, Northridge, approximately Oakdale Avenue and Lassen Street (State of California TLD Location Number 5)	(Q)
OS-2	Off-site, Simi Valley, approximately Tapo Canyon and Walnut Streets	(Q)
OS-3	Off-site, San Fernando Valley, Northridge, approximately Plummer Street and Vanalden Avenue	(Q)
OS-4	Off-site, Simi Valley, approximately Tapo Canyon and Walnut Streets	(Q)

TABLE IV-1

SAMPLING LOCATION DESCRIPTION
(Sheet 4 of 4)

Station	Location	Frequency of Sampling*
Off-Site (TLD)		
OS-5	Off-site, Simi Valley, approximately east Los Angeles Avenue and Stow Street (State of California TLD Location Number 6)	(Q)
HPI-1	High-Pressure Ion Chamber (HPIC) Ambient Radiation Monitor at Building 207, north side	(C)
HPI-2	High-Pressure Ion Chamber (HPIC) Ambient Radiation Monitor at Building 363, north side	(C)

Codes:

Sample Type		*Frequency		Location	
S	Soil	D	Daily	CA	Canoga
W	Water	M	Monthly	DS	De Soto
A	Air	Q	Quarterly	SS	SSFL
TLD	Thermoluminescent Dosimeter	S	Semiannual		
		C	Continuous		

De Soto and SSFL from supply water sources and retention ponds and screened for significant activity by gross alpha and beta analysis. Continuous ambient air sampling at several on-site locations provides information concerning long-lived airborne particulate radioactivity. On-site ambient radiation monitoring using thermoluminescent dosimetry (TLD) measures environmental radiation levels at the Canoga, De Soto, and SSFL sites and also at several off-site locations.

B. SAMPLING AND SAMPLE PREPARATION

1. Soil

Soil is analyzed for any significant increase in radioactive deposition by fallout from airborne radioactivity. Since soil is naturally radioactive and has been contaminated by atmospheric testing of nuclear weapons, a general background level of radioactivity exists. The data are monitored for increases beyond the natural variability of this background. For most radionuclides, gross alpha and beta radioactivity measurements are adequate for this purpose. Chemically specific analyses are performed for plutonium to provide improved sensitivity. For all cases in which radioactive contamination is known or suspected, the specific radionuclides are analyzed. This may involve gamma-spectrometry, radiochemistry, or liquid scintillation counting.

Surface soil types available for sampling range from decomposed granite to clay and loam. Samples are taken from the upper 1 cm of undisturbed ground surface for gross radioactivity analysis and to a depth of 5 cm for plutonium analysis. The soil samples are packaged in paper containers and returned to the laboratory for analysis.

Sample soil preparation for gross radioactivity determination consists of transferring samples to Pyrex beakers and drying them in a muffle furnace at about 450°C for 8 h. After cooling, the soil is sieved to eliminate pebbles. Two-gram aliquots of the sieved soil are weighed into stainless-steel planchets. The soil is wetted in the planchet with alcohol, evenly distributed to obtain uniform sample thickness, dried, and counted for alpha and beta radiation.

Soil plutonium analysis is performed using a chemically specific method by a certified independent testing laboratory according to the guidelines specified in the U.S. NRC Regulatory Guide 4.5 titled "Measurements of Radionuclides in the Environment--Sampling and Analysis of Plutonium in Soil."

2. Water

Surface and supply water samples are obtained monthly at the De Soto and SSFL sites and from upper Bell Creek during periods of off-site discharge. The water is drawn into 1-liter polyethylene bottles and transferred to the laboratory.

Five-hundred-millliliter volumes of water are evaporated to dryness in crystallizing dishes at about 90°C. The residual dissolved solids are redissolved with distilled water diluted nitric acid, transferred to planchets, dried under heat lamps, and counted for alpha and beta radiation.

3. Ambient Air

Air sampling is performed continuously at De Soto and SSFL with air samplers operating on 24-h sampling cycles. Airborne particulate radioactivity is collected on glass fiber filters which are automatically changed daily at the end of each sampling period (midnight). The samples are counted for alpha and beta radiation following a minimum 120-h decay period. The volume of a typical daily ambient air sample is about 25 m^3.

C. COUNTING AND CALIBRATION

Environmental soil, water, and ambient air samples are counted for alpha and for beta radiation with a low background gas flow proportional counting system. The system is capable of simultaneously counting both alpha and beta radiation. The sample-detector configuration provides a nearly 2π geometry. The thin-window detector is continually purged with argon/methane counting gas. A preset time mode of operation is used for all samples. The Lower Limits of Detection shown in Table IV-2 are those for a single sample determined by

TABLE IV-2

LOWER LIMITS OF DETECTION (LLDs)

Sample	Activity		
Soil	Alpha	(3.2 ± 1.8) 10^{-6} µCi/g	(118.4 ± 66.6 Bq/kg)
	Beta	(3.7 ± 2.0) 10^{-7} µCi/g	(136.9 ± 74 Bq/kg)
Water	Alpha	(4.0 ± 1.9) 10^{-10} µCi/ml	(0.0148 ± 0.007 Bq/l)
	Beta	(1.1 ± 1.2) 10^{-9} µCi/ml	(0.0407 ± 0.044 Bq/l)
Air	Alpha	(9.1 ± 2.4) 10^{-15} µCi/ml	(0.0003 ± 0.0001 Bq/m^3)
	Beta	(3.8 ± 1.4) 10^{-14} µCi/ml	(0.0013 ± 0.0004 Bq/m^3)

using typical values for counting time, system efficiencies for detecting alpha and beta radiation, background count rates (approximately 0.05 cpm alpha and 1.0 cpm beta), and sample size. These Lower Limits of Detection, for single samples, are calculated according to U.S. NRC Regulatory Guide 4.16, and assure a 95% probability that the indicated activity would result in a measurement value that would be identified as "above background."

Counting system efficiencies are determined routinely with ^{99}Tc, ^{36}Cl, ^{230}Th, and ^{235}U, standard sources and with ^{40}K, in the form of standard reagent-grade KCl, which is used to simulate soil, and with soil containing known amounts of highly enriched uranium. The activities of the standard sources are traceable to the National Institute of Standards and Technology (NIST, formerly NBS).

Self-absorption standards for beta counting are made by dividing sieved KCl into samples that increase in mass from 100 to 3000 mg. The samples are placed in planchets of the type used for environmental samples and are counted. The ratio of sample activity to the observed net count rate for each sample is plotted as a function of sample mass and a smooth curve is drawn through these points. The correction factor (ratio) corresponding to the mass of environmental samples is then obtained from the graph. The product of the correction factor and the net sample count rate yields the sample activity (dpm). This method has been proven usable by applying it to various-sized

aliquots of uniformly mixed environmental samples and observing that the resultant specific activities fell within the expected statistical counting error, showing the absence of any systematic bias.

Since the observed radioactivity in environmental samples primarily results from natural sources and is at low concentrations, constituent radionuclides are not identified for each sample. However, collected samples are composited for gamma spectrometry of accumulated sample materials. The detection of significant levels of radioactivity would lead to an investigation of the radioactive material involved, the sources, and possible causes.

5140Y/bes

V. RADIOACTIVE EFFLUENT MONITORING PROGRAM

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 Buildings 020 (RIHL) and 021-022 (RMDF) at SSFL, and Building 104 at the De Soto complex.

A. TREATMENT AND HANDLING

The only potential release of radioactivity to uncontrolled areas is by way of discharge to the atmosphere. No contaminated liquids are discharged to unrestricted areas.

The level of radioactivity contained in all atmospheric effluents is reduced to the lowest practical value by passing the effluents through certified high-efficiency particulate air (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 Buildings 020 and 021-022 provide automatic alarm capability in the event of the release of particulate activity from Building 020 and Buildings 021-022. The HEPA filters used for filtering atmospheric effluents are at least 99.97% efficient for particles 0.3 μm in diameter. Particle filtration efficiency increases for particles above and below this size.

The average concentration and total radioactivity in atmospheric effluents to uncontrolled areas are shown in Table V-1. The effectiveness of the air cleaning systems is evident from the fact that the atmospheric effluents are less radioactive than is the ambient air. The total shows that no significant quantities of radioactivity were released in 1989.

TABLE V-1

(SHEET 1 OF 3)

ATMOSPHERIC EFFLUENTS TO UNCONTROLLED AREAS

DE SOTO 104 -- 1989

EFFLUENT VOLUME, CUBIC METERS	3.959e7
LOWER LIMIT OF DETECTION, LLD	
GROSS ALPHA (UCI/ML)	3e-16
GROSS BETA (UCI/ML)	3.1e-16
AIR VOLUME SAMPLED, CUBIC METERS	21898
ANNUAL AVERAGE CONCENTRATION IN EFFLUENT	
GROSS ALPHA (UCI/ML)	1.8e-15
GROSS BETA (UCI/ML)	2.1e-15
MAXIMUM OBSERVED CONCENTRATION	
GROSS ALPHA (UCI/ML)	2.1e-14
GROSS BETA (UCI/ML)	1.6e-14
ACTIVITY RELEASED, MICROCURIES	
GROSS ALPHA	.072
GROSS BETA	.084

RADIONUCLIDE-SPECIFIC DATA

RADIONUCLIDE	HALF-LIFE (YEARS)	ACTIVITY DETECTED PCI	ANNUAL RELEASE MICROCURIES	ANALYSIS LLD PCI	RELEASE LLD UCI	AVERAGE CONCENTRATION UCI/ML	MPC UCI/ML
BE-7	.146	0	.0000	76	.137	1.0E-14	NATURAL
K-40	1260000000	74.3	.1343	150	.271	3.6E-15	NATURAL
CO-60	5.26	0	.0000	11	.020	0	3E-10
SR-90	27.7	1.2	.0022	6	.011	2.6E-16	3E-11
CS-137	30	0	.0000	10	.018	9.1E-16	5E-10
PO-210	.38	7.11	.0129	.2	.000	2.9E-15	NATURAL
U-234	247000	59	.1067	.1	.000	1.9E-17	4E-12
U-235	710000000	1.81	.0033	.1	.000	8.3E-17	4E-12
U-238	4510000000	.672	.0012	.1	.000	1.1E-17	3E-12
PU-238	86.4	0	.0000	.2	.000	1.0E-18	7E-14
PU-239/240	24390/6580	0	.0000	.2	.000	2.6E-18	6E-14
AM-241	458	.0526	.0000	.1	.000	8.3E-19	2E-13

NATURALLY OCCURRING RADIONUCLIDES ARE INCLUDED FOR INFORMATION.
THESE ACTIVITIES HAVE NOT BEEN USED IN DOSE ESTIMATES.

MAXIMUM PERMISSIBLE CONCENTRATIONS (MPC) FOR MOST RESTRICTIVE FORM OF RADIONUCLIDE AS SPECIFIED IN CCR 17, APPENDIX B.

TABLE V-1

(SHEET 2 OF 3)

ATMOSPHERIC EFFLUENTS TO UNCONTROLLED AREAS

SSFL/RIHL -- 1989

EFFLUENT VOLUME, CUBIC METERS	4.617e8
LOWER LIMIT OF DETECTION, LLD	
GROSS ALPHA (UCI/ML)	3e-16
GROSS BETA (UCI/ML)	3.1e-16
AIR VOLUME SAMPLED, CUBIC METERS	32082
ANNUAL AVERAGE CONCENTRATION IN EFFLUENT	
GROSS ALPHA (UCI/ML)	3.1e-17
GROSS BETA (UCI/ML)	9.0e-15
MAXIMUM OBSERVED CONCENTRATION	
GROSS ALPHA (UCI/ML)	1.3e-15
GROSS BETA (UCI/ML)	3.4e-14
ACTIVITY RELEASED, MICROCURIES	
GROSS ALPHA	.145
GROSS BETA	4.17

RADIONUCLIDE-SPECIFIC DATA

RADIONUCLIDE	HALF-LIFE (YEARS)	ACTIVITY DETECTED PCI	ANNUAL RELEASE MICROCURIES	ANALYSIS LLD PCI	RELEASE LLD UCI	AVERAGE CONCENTRATION UCI/ML	MPC UCI/ML
BE-7	.146	336	4.8355	76	1.094	1.0E-14	NATURAL
K-40	1260000000	116	1.6694	150	2.159	3.6E-15	NATURAL
CO-60	5.26	0	.0000	11	.158	0	3E-10
SR-90	27.7	8.5	.1223	6	.086	2.6E-16	3E-11
CS-137	30	29.1	.4188	10	.144	9.1E-16	5E-10
PO-210	.38	93.7	1.3485	.2	.003	2.9E-15	NATURAL
U-234	247000	.599	.0086	.1	.001	1.9E-17	4E-12
U-235	710000000	0	.0000	.1	.001	0	4E-12
U-238	4510000000	.356	.0051	.1	.001	1.1E-17	3E-12
PU-238	86.4	.033	.0005	.2	.003	1.0E-18	7E-14
PU-239/240	24390/6580	.083	.0005	.2	.003	2.6E-18	6E-14
AM-241	458	.0266	.0005	.1	.001	8.3E-19	2E-13

NATURALLY OCCURRING RADIONUCLIDES ARE INCLUDED FOR INFORMATION.
THESE ACTIVITIES HAVE NOT BEEN USED IN DOSE ESTIMATES.

MAXIMUM PERMISSIBLE CONCENTRATIONS (MPC) FOR MOST RESTRICTIVE FORM OF RADIONUCLIDE AS SPECIFIED IN 10 CFR 20, APPENDIX B AND CCR 17, APPENDIX A.

TABLE V-1

(SHEET 3 OF 3)

ATMOSPHERIC EFFLUENTS TO UNCONTROLLED AREAS

SSFL/RMDF -- 1989

APPROXIMATE EFFLUENT VOLUME, CUBIC METERS	3.47e8
APPROXIMATE LOWER LIMIT OF DETECTION, LLD	
GROSS ALPHA (UCI/ML)	3e-16
GROSS BETA (UCI/ML)	3.1e-16
APPROXIMATE AIR VOLUME SAMPLED, CUBIC METE	3164
ANNUAL AVERAGE CONCENTRATION IN EFFLUENT	
GROSS ALPHA (UCI/ML)	3.2e-16
GROSS BETA (UCI/ML)	1.8e-14
MAXIMUM OBSERVED CONCENTRATION	
GROSS ALPHA (UCI/ML)	2.5e-15
GROSS BETA (UCI/ML)	1.4e-13
ACTIVITY RELEASED, MICROCURIES	
GROSS ALPHA	.112
GROSS BETA	6.36

RADIONUCLIDE-SPECIFIC DATA

RADIONUCLIDE	HALF-LIFE (YEARS)	ACTIVITY DETECTED PCI	ANNUAL RELEASE MICROCURIES	ANALYSIS LLD PCI	RELEASE LLD UCI	AVERAGE CONCENTRATION UCI/ML	DCG UCI/ML
BE-7	.146	0	.0000	75	.634	0	NATURAL
K-40	1260000000	145	1.5915	150	1.646	4.6E-15	NATURAL
CO-60	5.26	228	2.5026	11	.121	7.2E-15	8E-11
SR-90	27.7	7.96	.0874	6	.066	2.5E-15	9E-12
CS-137	30	104	1.1415	10	.110	3.3E-15	4E-10
PO-210	.38	12.1	.1328	.2	.002	3.8E-16	NATURAL
U-234	247000	.433	.0048	.1	.001	1.4E-17	9E-14
U-235	710000000	.0352	.0004	.1	.001	1.1E-18	1E-13
U-238	4510000000	.419	.0046	.1	.001	1.3E-17	1E-13
PU-238	86.4	0	.0000	.2	.002	0	3E-14
PU-239/240	24390/6580	1	.0000	.2	.002	3.2E-17	2E-14
AM-241	458	0	.0000	.1	.001	0	2E-14

NATURALLY OCCURRING RADIONUCLIDES ARE INCLUDED FOR INFORMATION.
THESE ACTIVITIES HAVE NOT BEEN USED IN DOSE ESTIMATES.

DERIVED CONCENTRAION GUIDES (DCG) FOR MOST RESTRICTIVE FORM
OF RADIONUCLIDE AS SPECIFIED IN DOE ORDER 5400.5 (2/8/90).

The isotopic composition of the radioactivity deposited on the nuclear facility exhaust air sampling filters, composited for the year, is presented in Table V-1. The table shows that the majority of the collected activity is caused by the naturally occurring radionuclides, Be-7, K-40, and Po-210. The beryllium-7 (produced by cosmic ray interactions in the atmosphere) that is collected on the RIHL filter is due to the use of unfiltered bypass (ambient) air taken into the main exhaust system from the outside. The presence of polonium-210 is also a result of naturally occurring elements in the uranium-238 decay chain in this bypass air. The potassium-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. 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, μCi.

B. FACILITY DESCRIPTIONS

1. De Soto Site

a. Building 104--California State Licensed Activities

Operations at Building 104 that may generate radioactive effluents consist of research studies in applied physics and physical chemistry. Only atmospheric effluents are released from the building to uncontrolled areas. Major quantities of radionuclides present are limited to ^{60}Co and ^{137}Cs in encapsulated form.

2. Santa Susana Field Laboratories Site

a. Building 020 (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 atmospheric effluents are released from the building to uncontrolled areas. During 1989, only decontamination of the facility was done. No radioactive liquid waste is 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 ^{137}Cs, ^{90}Sr, and ^{147}Pm as mixed fission products.

b. Buildings 021 and 022 (RMDF)--DOE Contract Activities

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 atmospheric effluents are released from the building to uncontrolled areas. No radioactive liquid waste is released from the facility. Contamination from nuclear fuel and decontamination operations contains uranium and plutonium plus ^{137}Cs, ^{90}Sr, and ^{147}Pm as mixed fission products, and ^{60}Co and ^{152}Eu activation products.

3. Canoga Site

a. Several Major Manufacturing Facilities Engaged in DOD and NASA Activities

Manufacturing quality assurance inspection by X-ray and source radiography techniques involving sealed Ir-192 sources is performed at the Canoga complex. Some limited State-licensed research work requiring the incidental

use of small quantities of radioactive materials including charged-particle activated steel, Cf-252, and Ru-106 is also done there. No nuclear activities are conducted at the Canoga complex.

C. ESTIMATION OF GENERAL POPULATION RADIATION DOSE ATTRIBUTABLE TO ROCKETDYNE OPERATIONS--1989

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 for summer season weather conditions would generally be under a subsidence inversion into an atmosphere that is typical of slight neutral to lapse conditions. Nocturnal cooling inversions, although present, are relatively shallow. During the summer, a subsidence inversion is present almost every day. The base and top of this inversion usually lie below the elevation of the SSFL site. Thus, any atmospheric release from the SSFL site under this condition would result in Pasquill Type D lofting diffusion conditions above the inversion and considerable atmospheric dispersion, prior to any diffusion through the inversion into the Simi or San Fernando Valleys. In the winter season, the Pacific high-pressure cell shifts to the south and the subsidence inversion is usually absent. The surface airflow is then dominated by frontal activity moving easterly through the area, resulting in high-pressure systems in the Great Basin region. Frontal passages through the area during winter are generally accompanied by rainfall. Diffusion characteristics are highly variable depending on the location of the front. Generally, a light to moderate southwesterly wind precedes these frontal passages, introducing a strong onshore

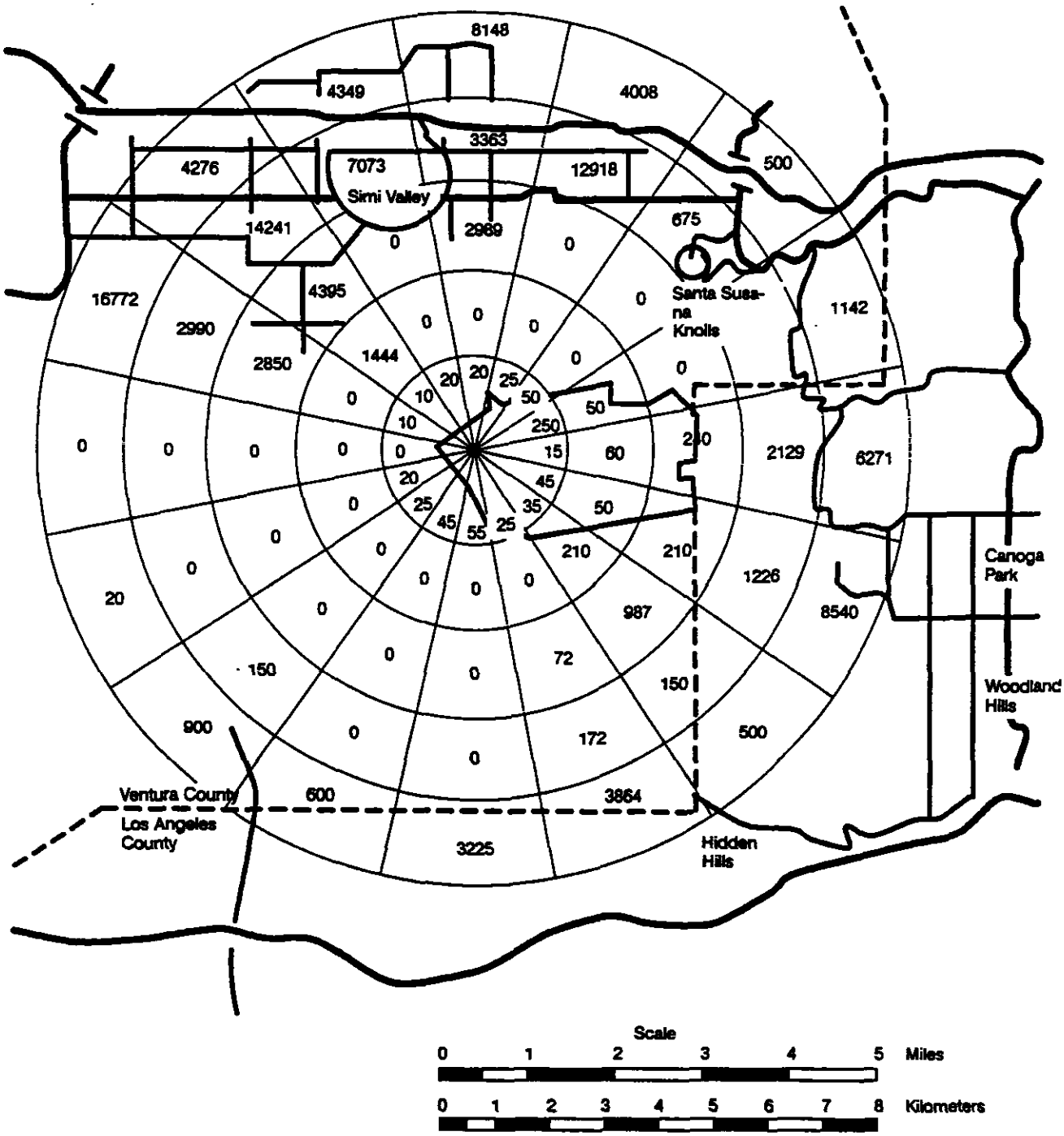

Figure 10. Santa Susana Field Laboratories Site-Centered Demography to 8 km, Showing Number of Persons Living in Each Grid Area. (Daytime Employment for SSFL.)

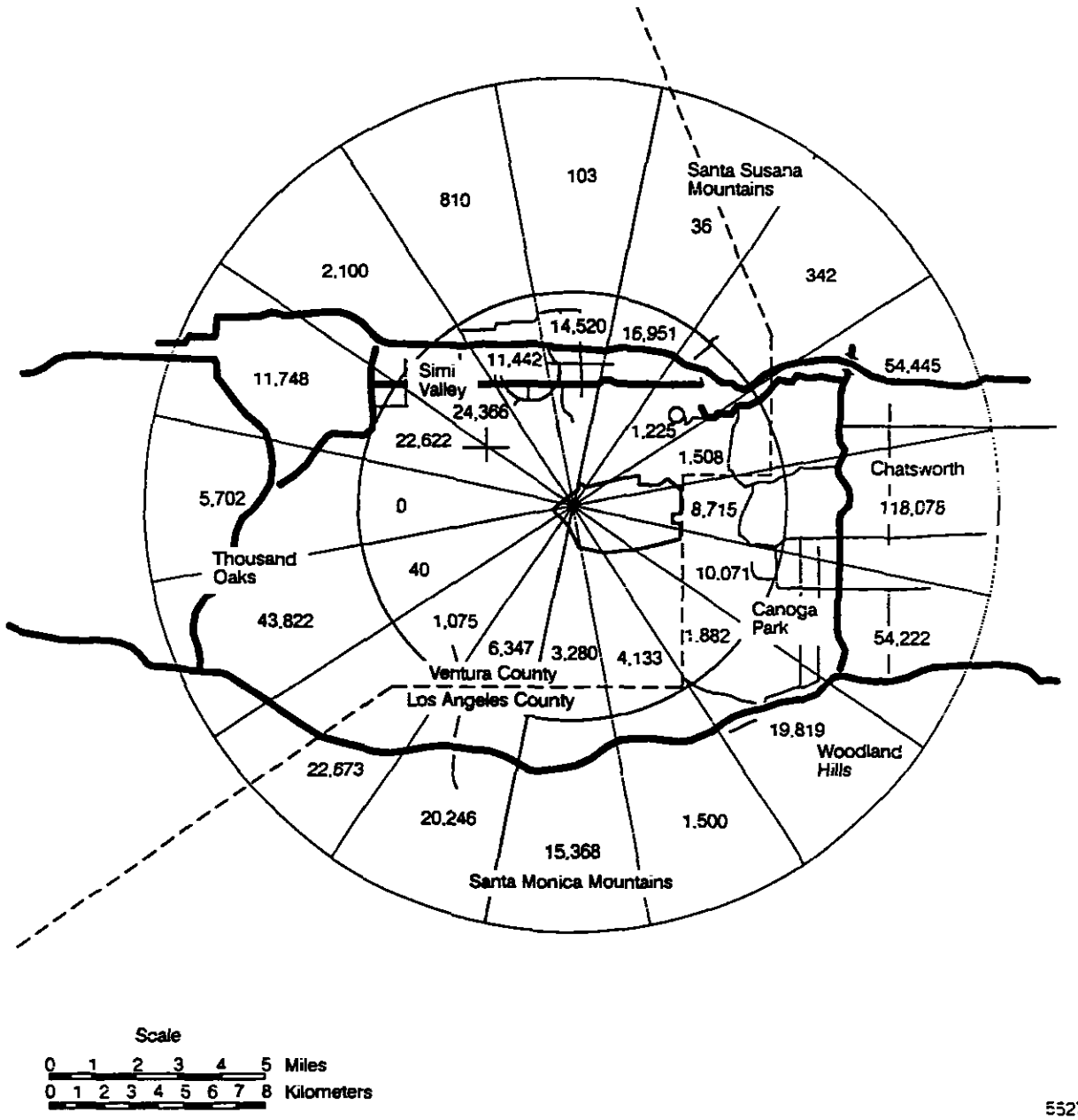

Figure 11. Santa Susana Field Laboratories Site-Centered Demography to 16 km, Showing Number of Persons Living in Each Grid Area

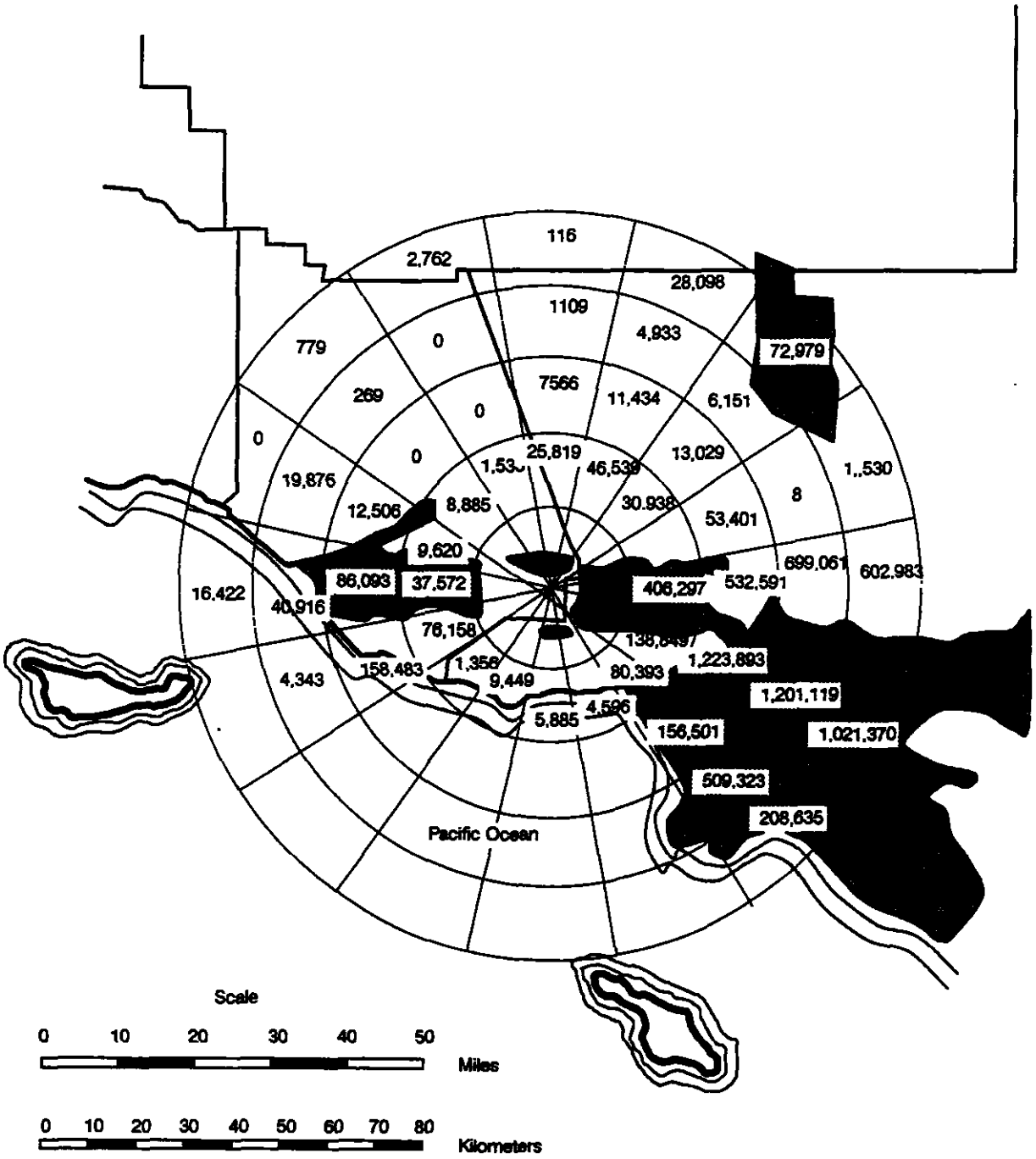

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Figure 12. Santa Susana Field Laboratories Site-Centered Demography to 80 km, Showing Number of Persons Living in Each Grid Area
(heavily populated areas are shown by shading)

flow of marine air and producing lapse rates that are slightly unstable. Wind speeds increase as the frontal systems approach, enhancing diffusion. The diffusion characteristics of the frontal passage are lapse conditions with light to moderate northerly winds. Locally, average wind speeds for the various stability categories range from 0 to about 4.4 m/s with the greatest frequency occurring for winds from the north to northwest sectors. Figures 10 through 12 show local population distribution estimates that were projected for 1989, based on the 1980 federal census and on direct observation of nearby residential areas around the SSFL site and out to 80 km for 16 sectors.

The downwind concentration of radioactive material emissions to the atmosphere during 1989 from each of the three major Rocketdyne nuclear facilities has been calculated with the AIRDOS-PC computer code using site-specific input data including local area windspeed, directional frequency, and stability (using Burbank Airport data) 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 V-2. The internal dose calculations in Table V-3 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. 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. The estimated doses are far below the applicable limits of DOE, EPA, NRC, and the State of California.

TABLE V-2

ANNUAL AVERAGED PLUME CONCENTRATIONS
OF ATMOSPHERIC EMISSIONS--1989

Facility	Annual Release (μCi)	Distance (m) to		Downwind Concentration (10^{-18} μCi/ml)		
		Boundary	Residence	Boundary	Residence	80 km
DS 104	0.16	187 E	315 SW	0.012	0.0033	0.00007
RIHL	4.3	302 NW	1900 SE	0.23	0.045	0.0007
RMDF	6.5	118 NW	2300 SE	0.079	0.047	0.001

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, shall not exceed 500 mrem/yr for occasional exposures, and 100 mrem/yr for prolonged periods of exposure. For the air pathway only, the limits are 25 mrem/yr for whole body doses, and 75 mrem/yr for any organ doses, as established by EPA. The RMDF boundary to the north of the facility received an estimated "property line" exposure of 36 mrem 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. No members of the general public were present at the site boundary during any significant portion of the year.

The external exposures, above background, are based on the greatest exposure adjusted to a constant altitude (1000-ft ASL) measured by a single dosimeter compared with average adjusted off-site measurements. The mean adjusted value for five off-site dosimeters was 78 mR with a maximum annually observed value for a single location of 97 mR. Boundary dose estimates assume 100% occupancy, whereas the actual presence of persons at the boundary is rare or

TABLE V-3

POPULATION DOSE ESTIMATES FOR ATMOSPHERIC EMISSIONS FROM SSFL FACILITIES--1989

22.5-Degree Sector	Dose to Receptor Population Segment (person-rem)						
	0-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	2.2×10^{-5}	7.7×10^{-8}	7.7×10^{-6}	1.2×10^{-6}	1.1×10^{-7}	7.5×10^{-9}	3.1×10^{-5}
NNW	1.1×10^{-5}	3.7×10^{-7}	2.8×10^{-7}	0	0	1.1×10^{-7}	1.2×10^{-5}
NW	2.1×10^{-5}	8.8×10^{-7}	1.5×10^{-6}	0	1.4×10^{-8}	2.8×10^{-8}	2.3×10^{-5}
WNW	3.4×10^{-5}	9.3×10^{-6}	3.1×10^{-6}	2.1×10^{-6}	2.0×10^{-6}	0	5.1×10^{-5}
W	0	2.6×10^{-6}	6.8×10^{-6}	8.3×10^{-6}	2.1×10^{-6}	5.3×10^{-7}	2.0×10^{-5}
WSW	1.8×10^{-8}	1.1×10^{-5}	6.8×10^{-6}	7.3×10^{-6}	1.1×10^{-7}	0	2.5×10^{-5}
SW	3.5×10^{-7}	3.8×10^{-6}	8.5×10^{-8}	0	0	0	4.2×10^{-6}
SSW	2.6×10^{-7}	4.0×10^{-6}	7.2×10^{-7}	0	0	0	4.8×10^{-6}
S	2.6×10^{-6}	6.3×10^{-6}	9.4×10^{-7}	0	0	0	9.8×10^{-6}
SSE	4.0×10^{-6}	7.4×10^{-7}	8.7×10^{-7}	0	0	0	5.6×10^{-6}
SE	1.7×10^{-6}	9.1×10^{-6}	1.4×10^{-5}	1.5×10^{-5}	2.4×10^{-5}	6.1×10^{-6}	7.0×10^{-5}
ESE	7.6×10^{-6}	2.1×10^{-5}	2.1×10^{-5}	9.7×10^{-5}	5.0×10^{-5}	2.7×10^{-5}	2.2×10^{-4}
E	4.4×10^{-6}	3.1×10^{-5}	4.0×10^{-5}	2.8×10^{-5}	1.9×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
ENE	5.4×10^{-7}	9.8×10^{-6}	1.8×10^{-5}	1.9×10^{-6}	1.5×10^{-10}	1.8×10^{-8}	3.0×10^{-5}
NE	6.2×10^{-7}	8.6×10^{-8}	2.9×10^{-6}	6.4×10^{-7}	1.6×10^{-7}	1.2×10^{-6}	5.6×10^{-6}
NNE	1.4×10^{-5}	1.4×10^{-8}	7.0×10^{-6}	9.4×10^{-7}	2.3×10^{-7}	8.4×10^{-7}	2.3×10^{-5}
Total	1.2×10^{-4}	1.1×10^{-4}	1.3×10^{-4}	1.6×10^{-4}	9.8×10^{-5}	4.6×10^{-5}	6.7×10^{-4}

Average individual dose = 8.0×10^{-8} millirem for the 80-km radius area total population.

5140Y/bes

nonexistent. These data indicate that the derived values, except for the RMDF, do not differ significantly from zero, as shown by the uncertainties being near the reported value, but result from assumptions in the analysis.

The general population person-rem dose estimates are calculated from the demographic distribution and the individual doses generated by AIRDOS-PC. This code uses release rate, wind speed, wind direction and frequency, and stack height parameters as input data. Population dose estimates centered on the SSFL site are presented in Table V-3. 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.

The U.S. EPA regulates airborne releases of radioactivity from DOE facilities under 40 CFR 61, Subpart H (NESHAPs). A form including information pertinent to this regulation is shown as an attachment to this section.

5141Y/bes

U.S. Department of Energy
Air Emissions Annual Report, 40 CFR 61.94
Calendar Year 1989

Site Name: Rockwell International - SSFL

Operations Office Information

Office: Department of Energy
San Francisco Operations
1333 Broadway
Oakland, CA 94612

Address:

Contact: E. Ballard Phone: (415) 273-7967

Site Information

Operator: Rockwell International - Rocketdyne Div

Address: 6633 Canoga Avenue

Canoga Park, CA 91303

Contact: R. J. Tuttle Phone: (818) 700-4439

Description of Site and Radioactive Materials Handled

Radioactive Materials Disposal Facility at the SSFL Site.

Section I
Annual Air Emissions

Radionuclides	Quantity (Ci/yr)
Am-241	1.5×10^{-10}
Co-60	2.5×10^{-6}
Pu-239	1.1×10^{-8}
Sr-90	8.8×10^{-8}
Cs-137	1.1×10^{-6}

Section II
Metholocy for Dose Assessment

N/A

Indicate the methods used in addition to AIRDOS-SPA and RADRISK for evaluating doses from the air emissions

___ Ambient Air Monitoring and Dose Assessment

___ Thermoluminescent Dosimetry and Dose Assessment

___ CAP-88 (AIRDOS/RADRISK with effective dose equivalent)

___ Other (explain) _____

Location of Receptor (for each method, if different)

Distance and direction from release points:
2068 meters to the south

Receptor/Use (i.e. residence, school, business)
Residence

Comments/qualifications:
Straight-line measured distance

Section III
Annual Dose Estimates

a. External and Uniform Internal Irradiation

EPA Air Emission Standard: 25 mrem

Whole body dose equivalent commitment: 4.89×10^{-6} mrem (AIRDOS-PC version 1.0)

b. Internally-Deposited Radionuclides (all air pathways)

EPA Air Emission Standard: 75 mrem

Organ #1 (endosteum) : 1.28×10^{-5} mrem
Organ #2 (lungs) : 7.0×10^{-6} mrem
Organ #3 (gonads) : 5.6×10^{-6} mrem
Organ #4 (red marrow) : 5.3×10^{-6} mrem

c. Effective Dose Equivalent (CAP-88/AIRDOS if available)

EPA Air Emission Standard: 10 mrem ede

Effective Dose Equivalent: 5.67×10^{-6} mrem

d. Other (reference methodology and give appropriate units)

not applicable

Section IV
References/Sources of Additional Information

"Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report - DeSoto and Santa Susana Field Laboratories Sites - 1989," RI/RD 90-132

VI. NONRADIOACTIVE MATERIALS MONITORING--1989 ADDITIONAL ENVIRONMENTAL INFORMATION

Rocketdyne maintains a comprehensive environmental program to ensure compliance with all applicable regulations, to prevent adverse environmental impact, and to restore the environment from historical operations. As a part of this program, Rocketdyne is currently involved in an extensive groundwater remediation program and is currently removing solvent contamination from approximately one million gallons of groundwater per day at SSFL. Most former surface impoundments have been closed and are in the closure approval process with the California Department of Health Services. Contamination resulting from underground storage tanks (UST) has been remediated, and 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 underground storage tank ordinances. 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 ensure the existing environmental problems do not pose a threat to the public welfare or environment. Results from the monitoring program show that contamination at the SSFL is contained on-site and a continuous monitoring program ensures that the contamination does not pose any risk to employees or to the public. All sources of air emissions at SSFL are subject to the provisions of the Clean Air Act as administered through the California Air Resources Board and the Ventura Air Pollution Control District (VAPCD). The VAPCD regulates sources of air emissions and issues permits that generally contain limits on pollutant levels and conditions of operation.

The overall annual groundwater monitoring program at SSFL addresses collection and analysis of groundwater samples and measurement of the water levels for the 147 on-site and 13 off-site wells. The locations of these

wells are shown on the map of SSFL in Figure 13. Groundwater quality parameters and sampling frequency have been determined based on historical water quality data, location of known or potential sources of groundwater contamination, and operational requirements of groundwater extraction and treatment systems. The groundwater monitoring program includes the following parameters, all analyzed using the appropriate EPA methods: volatile organic constituents, base neutrals and acid extractable organic compounds, petroleum hydrocarbons, and trace metals and common ion constituents.

A recent hydrogeologic study at SSFL describes two groundwater systems at the site: a shallow, unconfined system in the alluvial surface mantle (soils) of the Burro Flats area and along the major drainage channels, and a deeper groundwater system in the fractured Chatsworth sandstone (rock). 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, composed of a heterogeneous mixture of gravel, sand, silt, and clay, has estimated hydraulic conductivities ranging from 0.1 to 1000 gal/day/ft^2.

The Chatsworth formation is composed of well-consolidated, massively bedded sandstones with interbedded layers of siltstone and claystone. The layer 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 and is probably controlled by fracture zones.

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 may vary greatly from year to year. Specific pathways of possible contaminant transport are difficult to predict on the basis of on-site well data. The most likely pathways are along fracture zones that trend off-site.

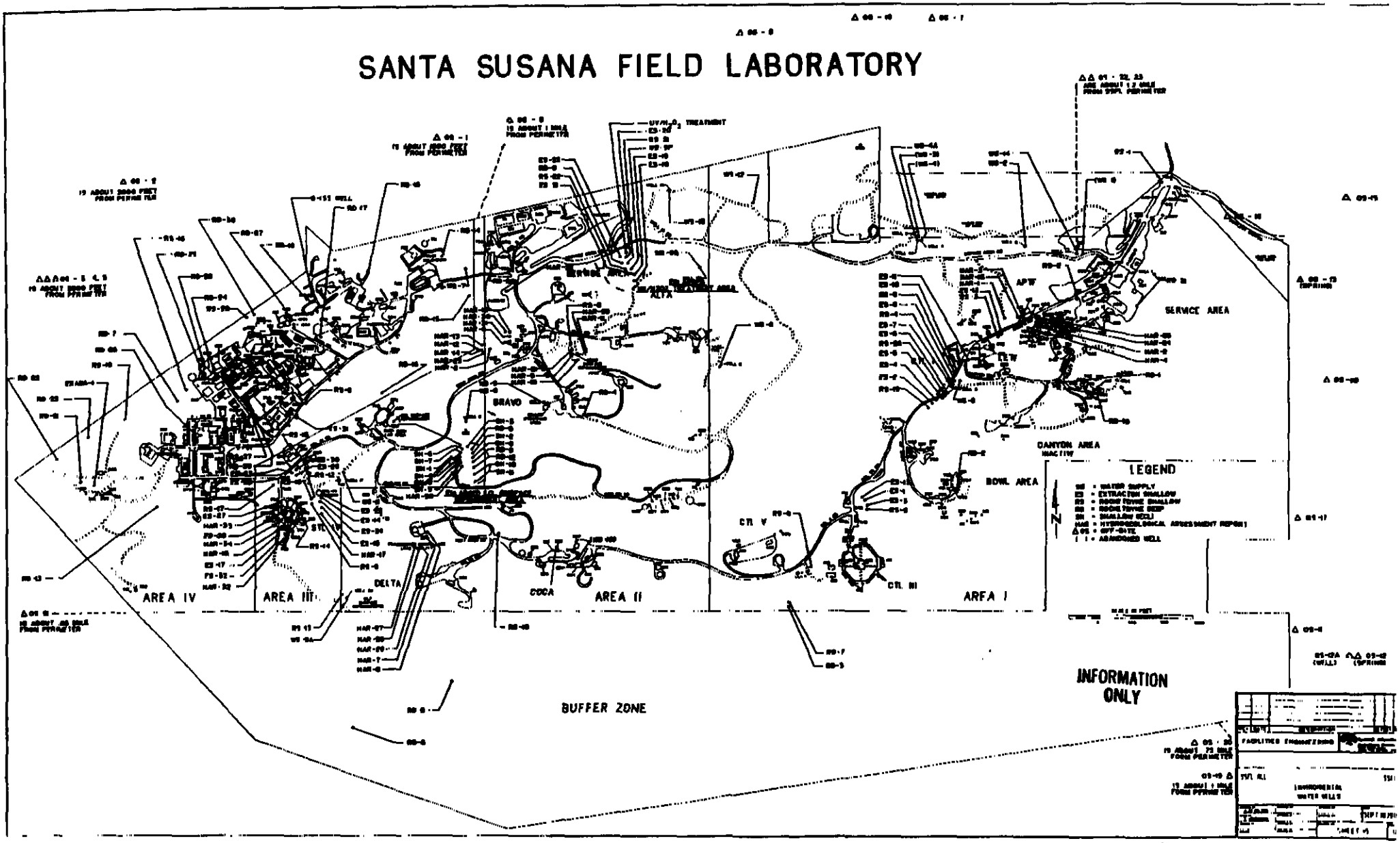

Figure 13. Locations of Wells Used in Groundwater Management Program

Surface water discharges are usually rain induced and analyses are conducted on samples collected in the run-off, as identified in the monitoring plan for the northwest slope of Area IV. Nearly all of the rainfall runoff at SSFL drains to the south and is collected in the surface water system. A very small portion of the site produces minor runoff across the northwest boundary following heavy rains. Catch basins were installed in five runoff channels in the fall of 1989. These locations are shown on the map in Figure 14. The analyses include the metals lead, zinc, chromium, beryllium, arsenic, cadmium, mercury, nickel, and copper (and applicable radionuclides by an outside laboratory). Surface water for the remainder of SSFL is regulated under an NPDES permit.

Soil analyses have been and are site specified 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.

In addition to this aggressive 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 bi-weekly newspaper to promote environmental awareness among all employees.

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.

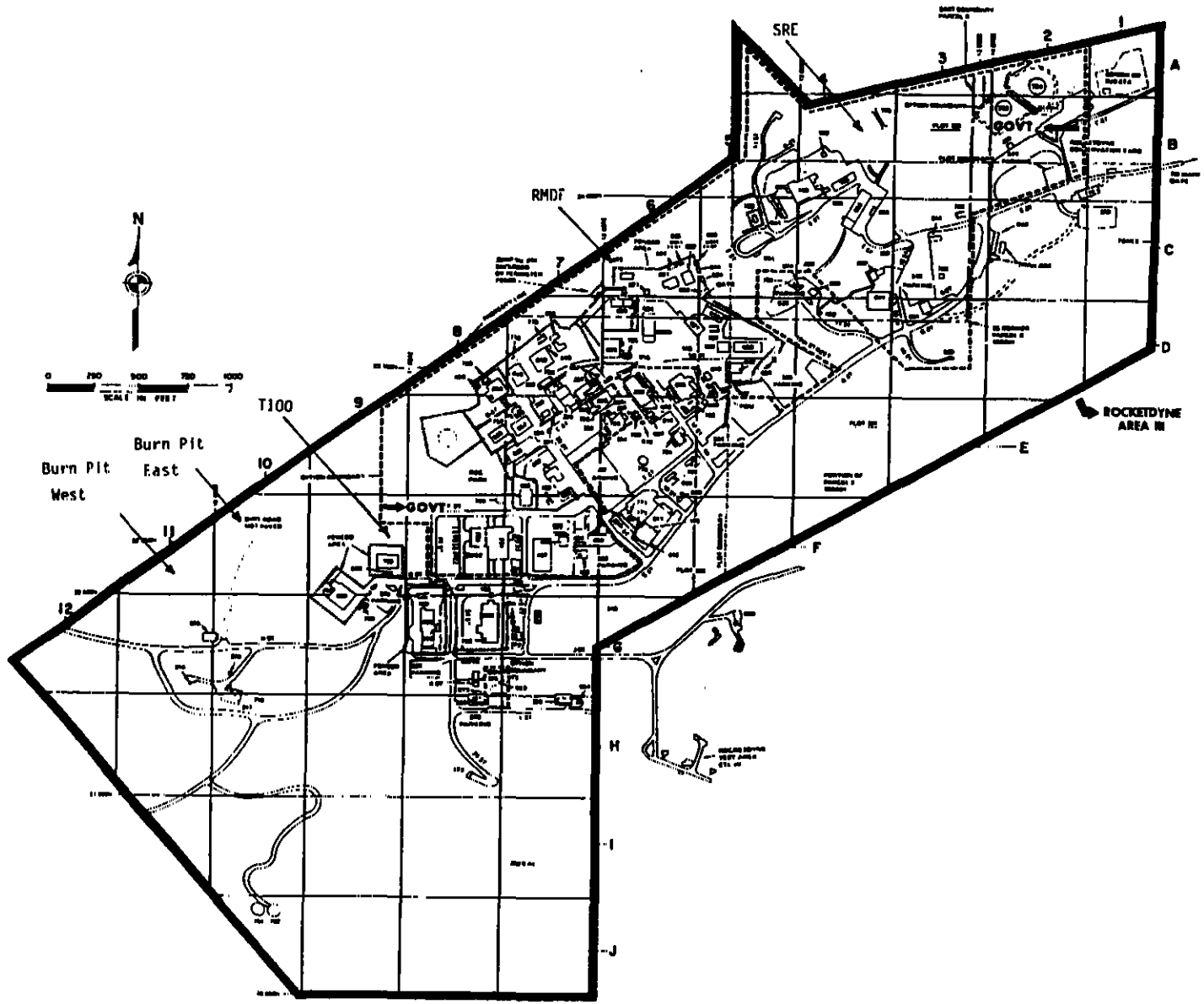

Figure 14. Locations of Rainfall Runoff Collectors
Along Northwest Boundary of SSFL, Area IV

Following release of the DOE Environmental Survey Preliminary Report, the San Fernando Daily News printed a story "Rockwell Site Contaminated," which portrayed SSFL as discharging radioactive and chemical pollutants to the surrounding community. Since that time, Rockwell has aggressively articulated to its employees, the regulatory agencies, and the community, the environmental monitoring programs that are currently active at Rockwell. These information activities have continued throughout the year. As a result of the negative publicity generated by the media, a SSFL work group was formed. The work group, headed by the EPA, was composed of regulatory agencies who oversee the activities at the site. The first public meeting was held in December 1989 to discuss the status of Rockwell and agency activity on the site. More public-oriented programs have been planned for 1990, i.e., site tours, meetings, etc.

The Las Vegas Branch of the EPA and its contractor visited the site on July 12 and 13, 1989, to perform soil and groundwater sampling for radioactivity and chemicals. Soil and groundwater samples were collected and split between Rockwell and EPA. Soil samples were collected from T886, RMDF, and T064. A groundwater sample was collected from T059.

Perchloroethylene, the lone chemical contaminant that has appeared in the water from the T059 french drain standpipe, is analyzed along with the RA parameters (which are governed by established regulatory limits) before discharge or transfer of this water. The December 1989 data for the standpipe exceeded the drinking water standards for perchloroethylene. This water was transported to an on-site DOHS permitted and approved groundwater remediation system.

A report of violation (ROV) was issued to Rocketdyne in August as a result of a RCRA inspection conducted by the DHS which identified some deficiencies in the four areas of the SSFL. Thirteen counts were noted, of which two were directly related to Area IV. These two counts were subsequently dropped upon review of the responses that Rocketdyne provided to the DHS. Submittals of permit renewals for NPDES CA00001309 (Regional Water

Quality Control Board) and RCRA Part B permit applications (DHS) for the Sodium Treatment Facility are still in the review process by the Agencies. A Part A permit application for treatment and storage of mixed hazardous waste was submitted by the March 23, 1989, deadline to EPA and DHS. The Part B portion of the permit has not been called for as of calendar year 1989, but the permit is currently being processed by Rockwell to address items necessary to complete the Part B portion.

Partial soil remediation was conducted at the "Old Conservation Yard" during August of 1989. Approximately 100 yd^3 of fuel hydrocarbon contaminated soil (range of 0-3000 ppm) was removed and transported to USPCI in Utah, a DOE Rocketdyne approved TSD facility. A subsequent work plan to further assess the subsurface soils for chemical contamination in the vicinity of the "Old Conservation Yard" was submitted to the EPA and the members of the SSFL work group. Comments to the work plan were provided back to Rocketdyne by the EPA in February 1990. The Building 100 trench was also included in the above work plan, and comments on this area were provided by the EPA.

An underground storage tank program has been implemented at Rocketdyne Division within the guidelines of California Assembly Bills 2013 and 1362 and under the direction of the State Water Resources Control Board. The bills require all owners of underground tanks to register them with the Control Board and also requires the tank owners to install a leak detection system on all existing tanks. For the new tank installations, secondary containment of the tank and piping are to be installed in addition to the lead detection system. Any underground tank abandonment requires a permit to remove and clean the tank and also to check the underlying soil for past leakage. The Ventura County Environmental Health Department is the local regulatory agency responsible for enforcement of these requirements.

In Area IV, 15 underground storage tanks still exist, 11 of which are storage tanks for metallic sodium.

An update of the Spill Prevention and Control Countermeasure (SPCC) plan was started in 1988. 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. The SPCC plan for SSFL facilities, including ETEC facilities, is currently under review for updating purposes by Rocketdyne Division. Additional comments provided by the Ventura County Health Department have been included into the plan. Final approval of the plan is scheduled for March 1990.

Asbestos control at Rocketdyne is conducted under the requirements of Titles 29, 40, and 49 of the Code of Federal Regulations, 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 (ACM), 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.

Surface Water

A surface water run-off sampling program was developed and implemented in November 1989 for Area IV which is the northwest portion of the SSFL. The locations selected for sampling were the run-off channels past the former Sodium Disposal Facility (2), behind T100, along the north side of RMDF, and the SRE watershed. Slight rainfall, although measurable, occurred on November 26, 1989. However, the collected volume was too small for collection of samples for chemical analyses.

The Rocketdyne Division of Rockwell International Corporation has filed a Report of Waste Discharge with the California Regional Water Quality Control Board and has been granted a National Pollutant Discharge Elimination System

permit to discharge waste water, pursuant to Section 402 of the Federal Water Pollution Control Act. The permit, NPDES No. CA0001309, which became effective September 27, 1976, was renewed with minor changes effective September 17, 1984. This permit covers discharge of overflow and storm runoff from water reclamation retention ponds into Bell Creek. Discharge generally occurs only during and immediately after periods of heavy rainfall or during extended periods of rocket engine testing that release large amounts of cooling water to the ponds. An application to revise the existing NPDES permit and waste discharge requirements was filed by Rocketdyne on December 15, 1988. To date, a new permit and new waste discharge requirements have not been developed by the Regional Board.

Only one of the retention ponds receives influent from the nuclear operating areas (Area IV) of the SSFL site. It is identified as retention pond R-2A, Water Sample Station W-12 in Table VI-1. The other final retention pond is identified as Perimeter Pond (PP).

The influent includes sewage treatment plant outfall, cooling water from various testing operations, and surface runoff water. Grab-type water samples taken at the retention pond prior to a discharge are analyzed by a California State certified analytical testing laboratory for nonradioactive chemical constituents and for radioactivity. The NPDES permits, shown as an attachment at the end of this section, lists specific constituents which are analyzed, as well as their respective limitations in discharged wastewater. Wastewater originating from facilities located throughout the SSFL site is collected at the retention pond. The point of origin of small amounts of most nonradioactive constituents normally found in wastewater is difficult to determine. If excessive amounts of any of these materials were found in wastewater, their origin could be determined from the knowledge of facility operations involving their use. Discharge from these ponds are sampled and analyzed to show compliance with the Permit. The results of these analyses for each discharge are shown in Table VI-1. Only seven exceedancees were experienced during 1989. These were three cases of excess alkalinity (pH, 9-Mar, 14-Mar, and 11-Apr) resulting from a naturally occurring algae bloom,

Table VI-1. Analytical Results for Water Releases
(Sheet 1 of 3)

Rockwell International, Rocketdyne Division
1989 Annual Discharge Analysis Summary
For NPDES Permit CA0001309

Date		23 Jan	4 Feb	17 Feb	9 Mar	14 Mar	30 Mar	11 Apr	20 Apr	11 May	2 Jun	2 Jun	12 Jun
Pond		R-2A	R2-A	R-2A	R-2A	PP	R-2A	R-2A	R-2A	PP	PP	R-2A	R-2A
Discharge No.	Concentration Limits (mg/L except as noted)	1	2	3	4	5	6	7	8	9	10	11	12
Bod 5	30	1.5	2.0	1.6	7.8	6.3	6.2	7.4	2.3	3.3	8.9	5.4	3.9
Boron	1	0.3	1.0	0.5	0.5	0.2	0.3	0.2	0.6	0.2	0.2	0.3	0.3
Chloride	150	64.0	31.0	60.0	54.0	32.0	43.0	62.0	54.0	66.0	70.0	74.0	113.0
Fluoride	1	0.5	0.2	0.6	0.6	0.3	0.4	0.4	0.4	0.6	0.5	0.4	0.2
Grease and oil	15	0.5	<1.0	<1.0	0.4	0.4	<1.0	<1.0	<1.0	<1.0	<1.0	<0.1	1.2
Arsenic	0.05	<0.01	0.0	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
pH (pH units)	6 to 9 pH units	7.6	7.8	7.8	9.4	10.0	9.0	9.2	6.3	8.3	9.0	9.0	8.7
Residual chlorine	0.1	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Settleable solids (ml/L)	0.3 ml/L[1]	<0.1	0.1	1.0	<0.1	0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1
Sulfate	300	99.0	48.0	100.0	85.0	66.0	94.0	196.0	185.0	149.0	205.0	239.0	152.0
Suspended solids	150[1]	8.8	28.8	3.0	16.0	2.5	13.3	14.8	8.0	8.0	12.7	12.7	12.9
Surfactants as MBAS	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Temperature (Celsius)	37.8	9.4	10.5	11.1	19.9	18.8	21.1	19.9	18.8	18.3	22.2	22.2	24.9
Total dissolved solids	950	430.0	220.0	482.0	358.0	267.0	405.0	645.0	704.0	559.0	633.0	712.0	596.0
Toxicity (% fish survival)	90% minimum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Turbidity (NTU)	[2]	5.0	28.0	33.0	8.0	7.0	5.0	6.0	2.0	4.0	6.0	6.0	2.0
Radioactivity--alpha (pCi/L)	5,000 pCi/L[3]	1.0	0.3	4.0	2.0	2.0	2.0	1.0	0.0	2.0	0.7	2.0	2.0
Radioactivity--beta (pCi/L)	300 pCi/L[3]	8.0	5.0	4.0	3.0	3.0	7.0	4.0	9.0	12.0	5.0	4.0	2.0
Radioactivity--tritium (pCi/L)	3,000,000 pCi/L[3]	*	*	*	*	*	*	*	*	*	*	*	*
Rainfall (inches)		1.12	2.66	0.00	0.46	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00
Rainfall runoff (millions of gallons)		2.50	42.00	0.00	10.00	0.00	12.50	0.00	0.00	0.00	0.00	0.00	0.00
Release volume (millions of gallons)		1.31	5.56	0.03	2.81	0.09	1.11	2.81	1.54	2.63	2.01	12.44	4.44

(1) Limitation not required to be met during rainfall.
(2) Waters discharged shall not increase the natural turbidity of the receiving waters at the time of discharge.
(3) Limits specified in Title 17, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30269 of the California Administration Code.

Table VI-1. Analytical Results for Water Releases
(Sheet 2 of 3)

Rockwell International, Rocketdyne Division
1989 Annual Discharge Analysis Summary
For NPDES Permit CA0001309

Date		19 Jun	26 Jun	10 Jul	20 Jul	1 Aug	1 Aug	9 Aug	15 Aug	24 Aug	28 Aug	31 Aug	6 Sep
Pond		R-2A	R-2A	R-2A	R-2A	R-2A	PP	R-2A	R-2A	R-2A	R-2A	R-2A	R-2A
Discharge No.	Concentration Limits (mg/L except as noted)	13	14	15	16	17	18	19	20	21	22	23	24
Bod 5	30	3.0	2.5	1.8	1.0	<5.0	<5.0	<5.0	11.0	<5.0	<5.0	<5.0	<5.0
Boron	1	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Chloride	150	92.0	112.0	131.0	139.0	129.0	121.0	115.0	126.0	135.0	139.0	140.0	134.0
Fluoride	1	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.2	0.1	0.1
Grease and oil	15	<1.0	<0.1	<1.0	<1.0	<1.0	<1.0	<1.0	<0.1	<1.0	<1.0	<1.0	<1.0
Arsenic	0.05	<0.01	<0.01	<0.01	*	*	*	*	*	*	*	*	*
pH (pH units)	6 to 9 pH units	8.3	8.7	8.8	8.2	8.7	8.1	8.4	8.4	8.5	8.0	8.1	8.1
Residual chlorine	0.1	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Settleable solids (ml/l)	0.3 ml/L(1)	<0.1	<0.1	<0.1	0.3	<0.1	0.1	0.4	0.3	0.5	0.2	0.2	0.1
Sulfate	300	165.0	119.0	114.0	103.0	120.0	146.0	158.0	145.0	121.0	132.0	107.0	123.0
Suspended solids	150(1)	9.5	8.8	10.0	29.0	8.2	4.5	27.0	32.0	16.0	9.2	16.0	12.0
Surfactants as MBAS	0.5	0.0	0.0	0.0	0.0	<0.02	<0.02	<0.02	<0.02	0.0	<0.02	<0.02	0.0
Temperature (Celsius)	37.8	22.7	23.3	26.1	29.4	24.9	22.2	25.5	24.9	23.3	24.9	23.3	24.4
Total dissolved solids	950	645.0	627.0	639.0	588.0	618.0	673.0	671.0	644.0	600.0	558.0	569.0	557.0
Toxicity (% fish survival)	90% minimum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	90.0	100.0
Turbidity (NTU)	(2)	5.0	5.0	2.0	13.0	2.5	1.0	12.0	16.0	16.0	5.0	4.0	5.0
Radioactivity--alpha (pCi/L)	5,000 pCi/L(3)	3.0	3.0	2.0	3.0	0.0	0.3	2.0	0.0	1.0	2.0	1.0	3.0
Radioactivity--beta (pCi/L)	300 pCi/L(3)	7.0	5.0	2.0	8.0	3.0	5.0	7.0	9.0	13.0	9.0	7.0	7.0
Radioactivity--tritium (pCi/L)	3,000,000 pCi/L(3)	*	*	*	*	*	*	*	*	*	*	*	*
Rainfall (inches)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rainfall runoff (millions of gallons)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Release volume (millions of gallons)		4.44	4.44	5.22	6.43	6.43	1.93	3.69	4.13	4.67	2.93	1.07	1.49

(1) Limitation not required to be met during rainfall.
(2) Waters discharged shall not increase the natural turbidity of the receiving waters at the time of discharge.
(3) Limits specified in Title 17, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30269 of the California Administration Code.

Table VI-1. Analytical Results for Water Releases
(Sheet 3 of 3)

Rockwell International, Rocketdyne Division
1989 Annual Discharge Analysis Summary
For NPDES Permit CA0001309

Date		13 Sep	15 Sep	18 Sep	22 Sep	27 Sep	13 Oct	14 Nov	28 Nov	15 Dec	20 Dec
Pond		R-2A	R-2A	R-2A	R-2A	R-2A	R-2A	PP	R-2A	PP	R-2A
Discharge No.	Concentration Limits (mg/L except as noted)	25	26	27	28	29	30	31	32	33	34
Bod 5	30	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Boron	1	0.2	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.2	0.2
Chloride	150	131.0	136.0	115.0	129.0	135.0	98.0	118.0	102.0	75.1	64.2
Fluoride	1	0.2	0.2	0.2	0.2	0.2	0.3	0.5	0.4	0.4	0.4
Grease and oil	15	<1.0	<1.0	<1.0	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Arsenic	0.05	*	*	*	*	*	*	*	*	*	*
pH (pH units)	6 to 9 pH units	8.6	8.5	8.1	8.3	8.3	8.6	7.9	8.3	8.2	8.6
Residual chlorine	0.1	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Settleable solids (ml/L)	0.3 ml/L[1]	0.1	0.3	0.2	0.3	0.2	0.1	0.1	<0.1	0.2	<0.1
Sulfate	300	132.0	128.0	130.0	131.0	122.0	177.0	187.0	167.0	169.0	170.0
Suspended solids	150[1]	9.2	12.0	8.2	14.0	8.5	9.0	4.2	12.8	28.3	9.0
Surfactants as MBAS	0.5	<0.02	0.0	0.0	0.1	0.0	0.1	0.0	<0.02	0.0	0.0
Temperature (Celsius)	37.8	24.9	25.5	22.7	23.8	22.2	23.3	17.7	12.2	8.7	10.0
Total dissolved solids	950	668.0	635.0	636.0	668.0	637.0	750.0	742.0	684.0	648.0	612.0
Toxicity (% fish survival)	90% minimum	100.0	100.0	100.0	100.0	60.0	100.0	100.0	90.0	90.0	100.0
Turbidity (NTU)	[2]	2.5	6.0	7.0	7.0	4.5	2.5	2.0	2.5	5.0	2.0
Radioactivity--alpha (pCi/L)	5,000 pCi/L[3]	0.0	4.0	3.0	7.0	0.0	3.0	4.0	1.0	2.0	5.0
Radioactivity--beta (pCi/L)	300 pCi/L[3]	8.0	7.0	7.0	10.0	20.0	7.0	16.0	4.0	8.0	5.0
Radioactivity--tritium (pCi/L)	3,000,000 pCi/L[3]	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Rainfall (inches)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rainfall runoff (millions of gallons)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Release volume (millions of gallons)		1.49	3.77	2.33	4.91	3.27	4.65	2.95	4.95	2.11	3.80

[1] Limitation not required to be met during rainfall.
[2] Waters discharged shall not increase the natural turbidity of the receiving waters at the time of discharge.
[3] Limits specified in Title 17, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30269 of the California Administration Code.

and three cases of excess settleable solids (17-Feb, 9-Aug and 24-Aug). This limit is not imposed for rainfall-related discharges (17-Feb); the summer exceedances resulted from the extreme dryness of the stream bed at the end of summer, leading to a greater suspension of particulate matter by the flowing water. The cause of the low survival of the fish in the bioassay test of 27-Sep was not identified.

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 Regional Water Quality Control Board. (The EPA appointed the California Department of Health Services [Region 3/Burbank] as lead agency in July 1989.) During the past 5 years, a network that now consists of 147 on-site wells has been completed. Eighty-seven of these are in the Shallow Zone, and sixty have been drilled into the Chatsworth Formation, the indurated sandstone that represents the uppermost aquifer underlying the Facility. In 1987, as part of the statewide requirements under the Toxic Pits Cleanup Act, Rocketdyne submitted the Hydrogeological Assessment Report 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 six remedial water treatment systems operating. The combined treatment capacity of these systems is nearly 900,000 gal of solvent-contaminated water per day. The ultraviolet light/hydrogen peroxide treatment unit (UV/H2O2) was activated in January 1990. The five air stripping tower systems include those at the Area I Road (Bowl), Alfa, Bravo, Canyon, and Delta sites. The combined pumping total of these remediation units has resulted in treatment of 129 million gal of

solvent-contaminated water since 1987. The summaries of the water quality results for the treatment systems are included in the bimonthly 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. Notably, the contamination levels have dropped significantly and the contamination, to date, has been contained on-site.

In July and August 1989, 17 deep wells and 2 shallow wells were constructed in Area IV. Plans are in progress to batch the solvent-contaminated waters of these low-producing wells (about 1 gpm) and transport them to the Batch Facility UV/H2O2 Treatment System which is situated at the side of the Area II Service Road. The bulk of the Area IV shallow groundwater is seasonal and dependent upon rain/natural drainage patterns. Groundwater has been encountered consistently in only three shallow zone wells (RS-11, ES-31, and the newest RS well, RS-28). The surface water sampling occurs rarely because it is rain-prompted. Documentation of these rainfall events since November 1989 has been submitted to the Regional Water Quality Control Board (Los Angeles area). Insufficient runoff was collected in 1989 to permit analysis for chemical constituents.

The solvents found in the groundwater include trichloroethylene 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 of 1989. Additional treatment options are being considered, pending DOE funding. These include an air stripping tower unit or a UV/H2O2 unit on-site in Area IV, or newer technologies (treatment using solar radiation) being proposed under DOE contracts.

During 1989, Rocketdyne requested permission of the Brandeis-Bardin organization to drill two additional off-site wells nearer the Area IV border, between Rocketdyne and their property. To date, none of the existing Brandeis-Bardin wells in the direction of the groundwater flow have shown any

evidence of contamination. Brandeis-Bardin is considering the Rocketdyne request for more drilling on their property.

In addition to the wastewater discharge limitations, atmospheric pollutant discharge limitations are imposed by the Ventura County Air Pollution Control District (APCD) Permit 0271 on several natural-gas/oil-fired sodium heaters operated by ETEC for component testing. The limitations for 1989 are 9.46 tons/yr for reactive organic compounds, 140.06 ton/yr for oxides of nitrogen, 3.05 tons/yr for particulates, 0.60 tons/yr for oxides of sulfur, and 37.44 tons/yr for carbon monoxide. These limits were increased by the District to reflect the results of source testing performed by KVB on the H-1 and H-2 heaters. No operations resulted in emissions exceeding these limits. These limits may be modified during 1990 due to planned changes on hardware for H-1, H-2, and H-101 gas-fired boilers. The facility was inspected by the VAPCD in November 1989 as part of its routine semiannual inspection program. No violations were cited relative to DOE operations.

There were no draft or final environmental impact statements or reports, site assessments, or remedial action reports produced during 1988. Additionally, there were actions taken by local authorities relative to CERCLA/SARA activities or Notices of Violation.

5142Y/bes

ATTACHMENT TO SECTION VI
NPDES PERMIT CA0001509

The Board has notified the discharger and interested agencies and persons of its intent to renew waste discharge requirements for this discharge and has provided them with an opportunity to submit their written views and recommendations.

The Board, in a public hearing, heard and considered all comments pertaining to the discharge and to the tentative requirements.

This Order shall server as a National Pollutant Discharge Elimination System permit pursuant to Section 402 of the Federal Water Pollution Control Act, or amendments thereto, and shall take effect at the end of 10 days from the date of its adoption, provided the Regional Administrator, EPA, has not objections.

IT IS HEREBY ORDERED, that Rockwell International Corporation, Rocketdyne Division,

in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, and the provisions of the Federal Water Pollution Control Act and regulations and guidelines adopted thereunder, shall comply with the following:

A. Effluent Limitations

1. The discharge shall be limited to filtered domestic wastewater and industrial wastewater only, as proposed.

2. The discharge of an effluent in excess of the following limits is prohibited:

Constituent	Units	Discharge Limitations Maximum
Total dissolved solids	mg/l	950
	lb/day*	1,267,680
BOD_5 20°C	mg/l	30
	lb/day*	40,035
Oil and grease	mg/l	15
	lb/day*	20,020
Chloride	mg/l	150
	lb/day*	200,160
Sulfate	mg/l	300
	lb/day*	400,320
Fluoride	mg/l	1.0
	lb/day*	1,340
Boron	mg/l	1.0
	lb/day*	1,340
Surfactants (as MDAS)	mg/l	0.5
	lb/day*	667
Residual chlorine	mg/l	0.1

*Based on a total waste flow of 160 million gallons per day.

3. The daily discharge rate shall be obtained from the following calculation for any calendar day:

$$\text{Daily discharge rate} = \frac{8.34}{N} \sum_{1}^{N} Q_i C_i$$

in which N is the number of samples analyzed in any calendar day. Q_i and C_i are the flow rate (MDG) and the constituent concentration (mg/l), respectively, which are associated with each of the N grab samples which may be taken in any calendar day. If a

composite sample is taken, C_i is the concentration measured in the composite sample and Q_i is the average flow rate occurring during the period over which samples are composited.

4. The pH of wastes discharged shall at all times be within the range 6.0 to 9.0.

5. The temperature of wastes discharged shall not exceed 100°F.

6. Wastes discharged shall not contain visible oil or grease, and shall not cause the appearance of grease, oil or oily slick, or persistent foam in the receiving waters or on channel banks, walls, inverts, or other structures.

7. Wastes discharged shall not cause the formation of sludge deposits.

8. Neither the disposal nor any handling of waste shall cause pollution or nuisance.

9. Wastes discharged shall not damage flood control structures or facilities.

10. This discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Regional Board or the State Water Resources Control Board as required by the Federal Water Pollution Control Act and regulations adopted thereunder. If more stringent applicable water quality standards are promulgated or approved pursuant to Section 303 of the Federal Water Pollution Control Act, or amendments thereto, the Board will revise and modify this Order in accordance with such more stringent standards.

11. Wastes discharged shall not increase the natural turbidity of the receiving waters at the time of discharge.

12. Oil, oily material, chemicals, refuse, and other wastes shall not be stored or placed where they could be picked up by rainfall and discharged to surface waters.

13. The wastes discharged shall not contain phenols, mercaptans, or other substances in concentrations which would impart taste, odors, color, foaming or other objectional characteristics to receiving waters.

14. The wastes discharged shall not cause receiving waters to contain any substance in concentrations toxic to human, animal, plant, or fish life.

15. Radioactivity shall not exceed the limits specified in Title 17, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30269. of the California Administrative Code.

16. Domestic wastes discharged to watercourses shall at all times be adequately disinfected. For the purpose of these requirements, the wastes shall be considered adequately disinfected if the median number of coliform organisms at some point in the treatment process does not exceed 2.2 per 100 millilliters and the number of coliform organisms does not exceed 23 per 100 millililiters in more than one sample within any 30-day period. The median value shall be determined from samples taken on seven sampling days each week, at least one sample per sampling day, collected at a time when wastewater flow and characteristics are most demanding on the treatment facilities and disinfection procedures.

17. Domestic wastes discharged to watercourses shall have received treatment equivalent to that of a filtered wastewater.

    Filtered wastewater means an oxidized, coagulated, clarified wastewater which had been passed through natural undisturbed soils

or filter media, such as sand or diatomaceous earth, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 turbidity units and does not exceed 5 turbidity units more than 5 percent of the time during any 24-hour period.

Nothing herein shall be construed to prevent the use of any alternative treatment process(es) provided that they can be demonstrated to the satisfaction of the Executive Officer to achieve compliance with the effluent limitations and requirements.

18. The average final effluent concentrations shall not exceed 15 percent by weight of the average sewage treatment plant influent concentrations of BOD_5 20°C and suspended solids during periods of discharge.

19. Wastes discharged shall not contain heavy metals, arsenic, or cyanide in concentrations in excess of the mandatory limits contained in the current California Department of Health Drinking Water Standards.

20. The toxicity of the effluent shall be such that in a standard 96-hour static or flow-through bioassay in undiluted effluent at least 90 percent of test organisms shall survive at least 90 percent of the time with no single test producing 70 percent of survival.

5142Y/bes

APPENDIX A

COMPARISON OF ENVIRONMENTAL RADIOACTIVITY DATA FOR 1989 WITH PREVIOUS YEARS

This section compares environmental monitoring results for the calendar year 1989 with previous annual data for the purpose of identifying and explaining long-term trends.

The data presented in Tables A-1 through A-4 summarize past annual average radioactivity concentrations. These data show the effects of both the short-lived and long-lived radioactive fallout from nuclear weapons tests and the 1986 Chernobyl accident superimposed on the natural radioactivity inherent in the various sample types.

The data shown for gross alpha activity in samples that are generally thick compared to the range of the alpha particles represent a marked change from earlier reports in the manner of calculating and reporting them. This change reflects the gradual redirection of the monitoring program from monitoring to measurement. Previously, alpha count data had been converted to alpha activity concentrations by using an efficiency factor for a thin electroplated source, and the results were monitored for changes from prior values. This resulted in artificially low numerical values for the alpha activity in several sample media. Starting with the 1984 report, the alpha activity concentrations for these media are reported based on an efficiency factor derived from a sample with distributed alpha activity that is thick relative to the alpha particle range. For screening purposes, this has no effect. However, the values reported more closely represent the actual alpha activity existing in the environment. In calculating the average concentration values, all values, including negative values, are included. This method of uncensored data averaging, recommended by DOE/EP-0023, affords a better estimate of the central value and dispersion of the data. All limits of error reported in the tables are for one standard deviation (1 sigma). Usually, these show the dispersion of the measured values about the mean. These two

changes in data interpretation result in noticeable differences in the data shown in the historical comparisons. It must be recognized that these differences do not reflect changes in environmental radioactivity but merely result from the evolution of the monitoring program.

Over the long period that the environmental program has been in operation, evolutionary changes have been made in order to provide more effective data. In some cases, this is readily apparent in the data. For example, in Table A-1, a small but abrupt increase in the alpha activity reported for soil occurs in 1971. This increase, which is observed in both the on-site and the off-site samples, resulted from use of an improved counting system with a thinner sample configuration. The thinner sample increased the sensitivity of the detector to alpha-emitting radionuclides, which resulted in a higher measured specific sample activity.

Similarly, prior to 1971, total activity in ambient air was measured, combining both alpha and beta activity. In 1971, measurements were begun that allowed separate identification of these two types of radiation.

In 1984, recalibration of the alpha counting method for thick samples was achieved, resulting in determination of the absolute alpha activity in these samples rather than the relative values previously used for monitoring purposes. Comparison of the values for 1988 as determined by the relative method with those for prior years shows no significant difference.

In late 1985, a new automatic low-background gas flow proportional counting system was placed in operation for counting most environmental samples. The new system was used for all sample types that were analyzed during 1988. Gamma spectroscopy is performed with a high-purity germanium detector (HPGe) coupled to a multichannel analyzer (MCA) with programmable radionuclide libraries and efficiency calibrations.

TABLE A-1

SOIL RADIOACTIVITY DATA--1970 THROUGH 1989

Year	On-site Average (pCi/g)			Off-site Average (pCi/g)		
	Number of Samples	Alpha	Beta	Number of Samples	Alpha	Beta
1989*	56	29.7	27	-	-	-
1988*	48	29.1	26	48	25.6	24
1987*	48	27.1	25	48	25.7	24
1986*	48	26.7	26	48	25.1	25
1985*	144	25.2	24	48	26.3	24
1984*	144	25.8	24	48	26.2	23
1983	144	0.61	24	48	0.59	23
1982	144	0.69	25	48	0.68	23
1981	144	0.69	25	48	0.64	23
1980	144	0.60	24	48	0.58	23
1979	144	0.64	25	48	0.50	23
1978	144	0.63	24	48	0.51	24
1977	144	0.56	24	48	0.53	23
1976	144	0.56	25	48	0.56	24
1975	144	0.60	25	48	0.58	24
1974	144	0.60	25	48	0.54	24
1973	144	0.57	25	48	0.51	24
1972	144	0.56	25	48	0.57	24
1971	144	0.55	25	48	0.53	23
1970	144	0.47	27	48	0.48	25

*The change in alpha activity after 1983 is the result of an improved calibration method that provides a true measure of alpha activity in thick samples rather than the relative values used previously. This is discussed in detail in Section III, Part A. Values for 1989 using the prior method would be 0.81 for the on-site average.

5145Y/bes

TABLE A-2

SSFL SITE SUPPLY WATER RADIOACTIVITY DATA--
1970 THROUGH 1989

Year	Number of Samples	Average Alpha (10^{-9} µCi/ml)	Average Beta (10^{-9} µCi/ml)
1989*	24	1.67	4.4
1988*	24	5.40	3.9
1987*	24	5.10	3.6
1986*	24	6.55	3.6
1985*	24	2.05	2.8
1984*	24	3.53	2.9
1983	24	0.12	3.0
1982	24	0.14	3.0
1981	24	0.24	2.8
1980	24	0.22	2.4
1979	24	0.23	2.8
1978	24	0.26	3.0
1977	24	0.25	2.5
1976	24	0.25	2.0
1975	24	0.24	2.3
1974	24	0.24	2.7
1973	24	0.26	3.4
1972	24	0.22	3.7
1971	24	0.28	4.9
1970	24	0.18	5.3

*The change in alpha activity after 1983 is the result of an improved calibration method that provides a true measure of alpha activity in thick samples rather than the relative values used previously. This is discussed in detail in Section III, Part A. The value for 1989 using the prior method would be 0.38.

5145Y/bes

TABLE A-3

ROCKETDYNE DIVISION RETENTION POND RADIOACTIVITY DATA--1970 THROUGH 1989

	Interim Retention Pond Water 6			Final Retention Pond R-2A Water 12		
		Average (10^{-9} µCi/ml)			Average (10^{-9} µCi/ml)	
Year	Number of Samples	Alpha	Beta	Number of Samples	Alpha	Beta
1989*	12	1.23	4.7	12	1.69	4.8
1988*	12	2.04	4.2	12	4.47	4.5
1987*	12	1.75	4.7	12	2.78	4.4
1986*	12	2.51	2.9	12	4.18	3.6
1985*	12	2.06	3.5	12	3.07	3.5
1984*	12	2.07	4.6	12	0.15	4.2
1983	12	0.12	3.6	12	0.13	4.4
1982	12	0.17	3.9	12	0.11	3.9
1981	12	<0.23	4.3	12	<0.25	5.2
1980	12	<0.22	2.9	12	<0.22	3.9
1979	12	<0.25	3.1	12	<0.23	4.5
1978	12	<0.25	4.3	12	<0.25	4.6
1977	12	<0.24	4.3	12	<0.25	5.2
1976	12	<0.24	4.3	12	<0.28	4.4
1975	12	<0.24	4.2	12	<0.31	4.5
1974	12	<0.22	4.2	12	<0.21	4.5
1973	12	<0.23	4.5	12	<0.37	5.6
1972	12	0.22	5.3	12	0.22	5.5
1971	12	0.18	6.2	12	0.16	6.4
1970	12	0.15	6.9	12	0.12	7.4

*The change in alpha activity after 1983 is the result of an improved calibration method that provides a true measure of alpha activity in thick samples rather than the relative values used previously. Values for 1989 using the prior method would be as follows:

Interim retention pond: 0.15
Final retention pond: 0.25

5145Y/bes

TABLE A-4
AMBIENT AIR RADIOACTIVITY CONCENTRATION DATA--1970 THROUGH 1989

	De Soto Average (10^{-12} µCi/ml)			SSFL Average (10^{-12} µCi/ml)		
Year	Number of Samples	Alpha	Beta	Number of Samples	Alpha	Beta
1989	516	0.0019	0.033	2404	0.0025	0.037
1988	680	0.0024	0.034	2397	0.0020	0.031
1987	690	0.0019	0.027	2460	0.0019	0.027
1986	687	0.0029	0.058	2415	0.0028	0.061
1985	544	0.0026	0.044	2450	0.0020	0.040
1984	712	0.0019	0.027	2461	0.0014	0.024
1983	644	0.0024	0.026	2328	0.0010	0.023
1982	727	0.0017	0.026	2347	0.0013	0.022
1981	704	0.0069	0.12	2518	0.0068	0.12
1980	685	0.0065	0.039	2342	0.0064	0.035
1979	697	0.0066	0.021	2519	0.0065	0.020
1978	713	0.0084	0.091	2402	0.0072	0.088
1977	729	0.0066	0.17	2438	0.0066	0.17
1976	719	0.0067	0.096	2520	0.0065	0.11
1975	709	0.0063	0.076	2450	0.0060	0.073
1974	663	0.0056	0.16	2477	0.0057	0.16
1973	715	0.0075	0.041	2311	0.0072	0.038
1972	708	0.0085	0.14	2430	0.0086	0.14
1971*	730	0.0087	0.30	2476	0.0086	0.33
1970	668	-	0.34	2434	-	0.36

*Ambient air alpha radioactivity values were included in the beta values and not reported separately prior to 1971.

5145Y/bes

The ambient radiation monitoring results show a continuing long-term variation that had been apparent in previous years but is unrelated to operations on-site. Independent measurements and intercomparisons support the values measured by the bulb-type dosimeters. With the exception of apparent changes resulting from improvements in analytical methods and interpretation of the data, the soil, water, and air radioactivity results are notably constant over the past 20 years. In particular, environmental radioactivity data for De Soto show no reduction in the measured levels below those that had been observed during the fuel fabrication operations that were discontinued in 1982 confirming that those levels represent natural radioactivity.

APPENDIX B
ENVIRONMENTAL MONITORING PROGRAM QUALITY CONTROL

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

PROCEDURES

Procedures followed include: sample selection; sample collection; packaging, shipment, and handling of samples for off-site analysis; sample preparation and analysis; the use of radioactive reference standards; calibration methods and instrument QA; and data evaluation and reporting.

RECORDS

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

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

Records relating to overall laboratory performance include the results of analysis of quality control samples such as analytical duplicates, interlaboratory cross-check samples and other quality control analyses; use of standard (radioactive) reference materials to prepare working standards; and calibration of analytical balances.

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

1) Reagent Quality--Reagent-grade chemicals and certified grade counting gas used.

2) Laboratory Ventilation--Room air supply is controlled to minimize temperature variance and dust incursion.

3) Laboratory Contamination--Periodic laboratory contamination surveys for fixed and removable surface contamination are performed. Areas are cleaned routinely and decontaminated when necessary.

4) Control Charts--Background and reference source control charts for counting equipment are maintained to evaluate stability and response characteristics.

5) Laboratory Intercomparisons--Rocketdyne participates in the DOE-EML-QAP, and in the DOE Environmental Dosimeter Intercomparison Project.

6) Duplicate Samples--Duplicate samples are obtained monthly at randomly selected environmental sampling locations. Analytical data are statistically evaluated to determine the correlation coefficients for each media type for the annual sample set.

7) Calibration Standards--Counting standard radioactivity values are traceable to the National Institute of Standards and Technology primary standards.

APPENDIX C

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APPENDIX D

EXTERNAL DISTRIBUTION

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APPENDIX E

ALTERNATIVE UNITS FOR RADIOLOGICAL DATA

	In Non-SI Units	In SI Units	Conversion Factor From Non-SI to SI Units[a]
Activity concentrations (environmental)			
Airborne particulates and gas	pCi/m^3	Bq/m^3	3.70E - 02
Liquids (water, milk, etc.)	pCi/ℓ	Bq/ℓ	3.70E - 02
Solids (soil, sediment, vegetation, foodstuff, etc.)	pCi/g	Bq/kg	3.70E - 05
Activity concentrations (effluent)			
Gas (air)	$(\mu Ci/m\ell)^b$	Bq/m^3	3.70E + 10
Liquid	$(\mu Ci/m\ell)^b$	Bq/ℓ	3.70E + 07
Exposure rate (environment)	R/h	C/kg h	2.58E - 04
Absorbed dose	mrad	Gy	1.00E - 05
Dose equivalent	mrem	Sv	1.00E - 05
Dose equivalent rate (commitment)	mrem/year	Sv/year	1.00E - 05

[a]To convert non-SI units to SI units, multiply the non-SI units by the conversion factor.
[b]Adopted because of established convention and use in maximum permissible concentration (MPC) tabulations.

5145Y/bes