ATOMICS INTERNATIONAL ENVIRONMENTAL MONITORING AND FACILITY EFFLUENT ANNUAL REPORT 1977

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ABSTRACT

Environmental and facility effluent radioactivity monitoring at Atomics International(AI) is performed by the Radiation and Nuclear Safety Unit of the Health, Safety, and Radiation Services Department. Soil, vegetation, and surface water are routinely sampled to a distance of 10 miles from AI sites. Continuous ambient air sampling and thermoluminescent dosimetry are per formed on site for monitoring airborne radioactivity and site ambient radiation levels. Radioactivity in effluents discharged to the atmosphere from AI facilities is continuously sampled and monitored to ensure that levels released to unrestricted areas are within appropriate limits, and to identify processes which may require additional engineering safeguards to minimize radioactivity levels in such effluents. In addition, selected nonradioactive constituents in surface water discharged to unrestricted areas are determined. This report summarizes and discusses monitoring results for 1977.

The random variations observed in the environmental monitoring data indicate that no local source of unnatural radioactive material exists in the environs. Additionally, the similarity between on-site and off-site results further indicates that the contribution to general environmental radioactivity due to operations at AI is essentially nonexistent.

The environmental radioactivity reported herein is attributed to natural sources and to fallout of radioactive material from foreign atmospheric testing of nuclear devices.

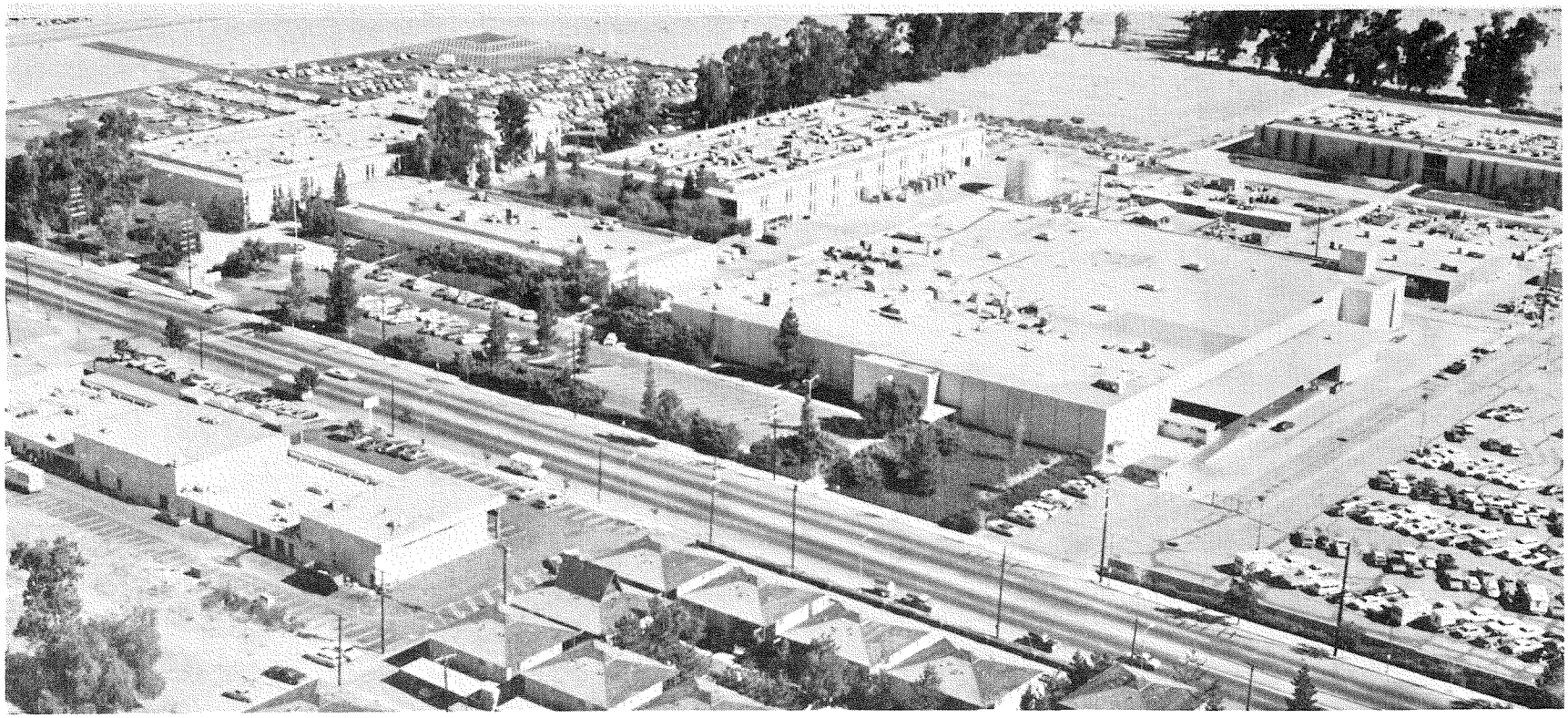

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Figure 1. Atomics International Headquarters

I. INTRODUCTION

The Atomics International (AI) Division of Rockwell International Corporation has been engaged in atomic energy research and development since 1946. The Division is currently working on the design, development, fabrication, and testing of components and systems for central station power plants, on the fabrication of nuclear fuel for test reactors, and on the Decontamination and Disposition of Facilities (D&D) Program. Other programs include the development and fabrication of systems for stack gas SO_2 control, gasification of coal, and solid and liquid waste disposal.

The Division's modern administration, scientific research, and manufacturing facilities (Figure 1) are located in Canoga Park, California, approximately 23 miles northwest of downtown Los Angeles. Certain of the Division's nuclear programs, under licenses issued by the Nuclear Regulatory Commission (NRC) and the State of California, are conducted here. These include: (1) Building 001 containing uranium fuel production facilities, and (2) Building 004 containing analytical chemistry laboratories, and a Co^{60} gamma irradiation facility. The 290-acre Santa Susana Field Laboratories (SSFL), Figure 2, are located in the Simi Hills of Ventura County, approximately 29 miles northwest of downtown Los Angeles. Both Department of Energy (DOE) and Rockwell-owned facilities, as shown in Figure 3, share this site. The SSFL also contain facilities in which nuclear operations, licensed by NRC and the State, are conducted. The licensed facilities include: (1) the Atomics International Hot Laboratory (AIHL), Building 020; (2) the Nuclear Materials Development Facility (NMDF), Building 055; (3) a neutron radiography facility containing the L-85 nuclear examination and research reactor, Building 093; and (4) several X-radiography inspection facilities. The location of these sites, in relation to nearby communities, is shown in Figure 4.

Also included within the SSFL site are an 82-acre, Government-optioned area where DOE-contract activities are conducted, primarily by the non-nuclear Liquid Metal Engineering Center (LMEC). The major operational nuclear installation within the optioned area is the Radioactive Material Disposal Facility (RMDF), Buildings 021 and 022. This facility is used for processing

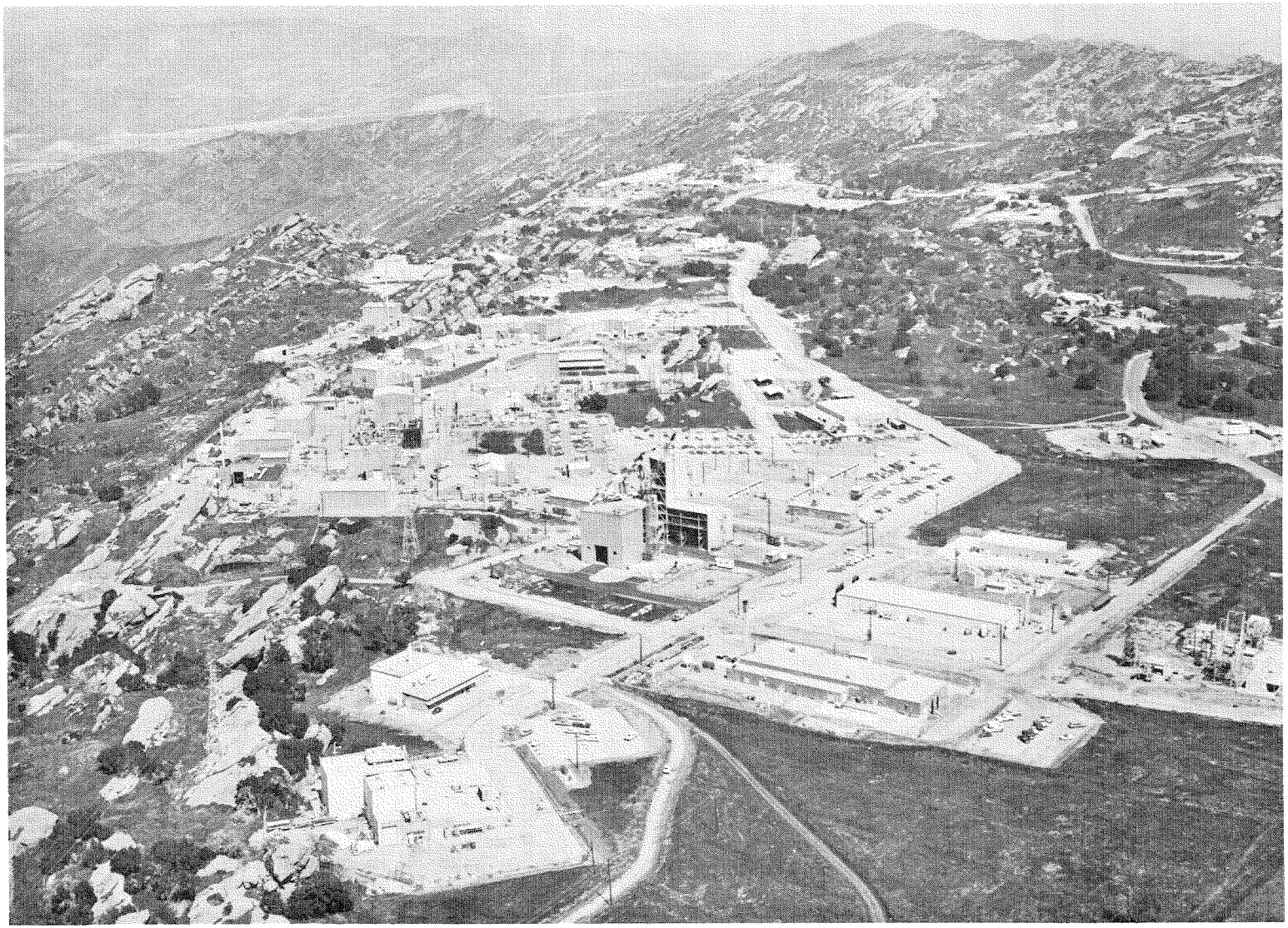

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Figure 2. Atomics International Santa Susana Field Laboratories

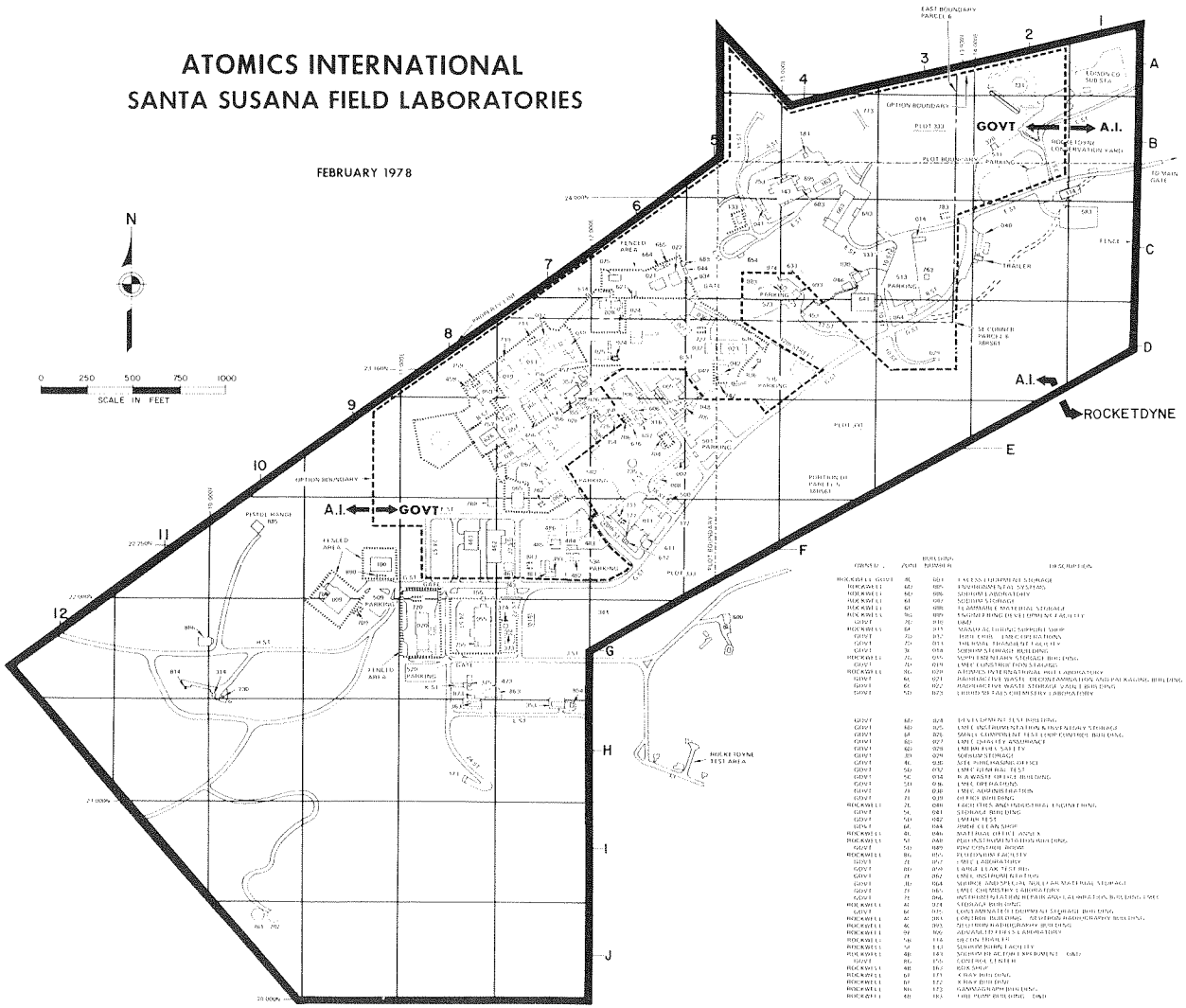

Figure 3. Map of Santa Susana Field Laboratories Facilities

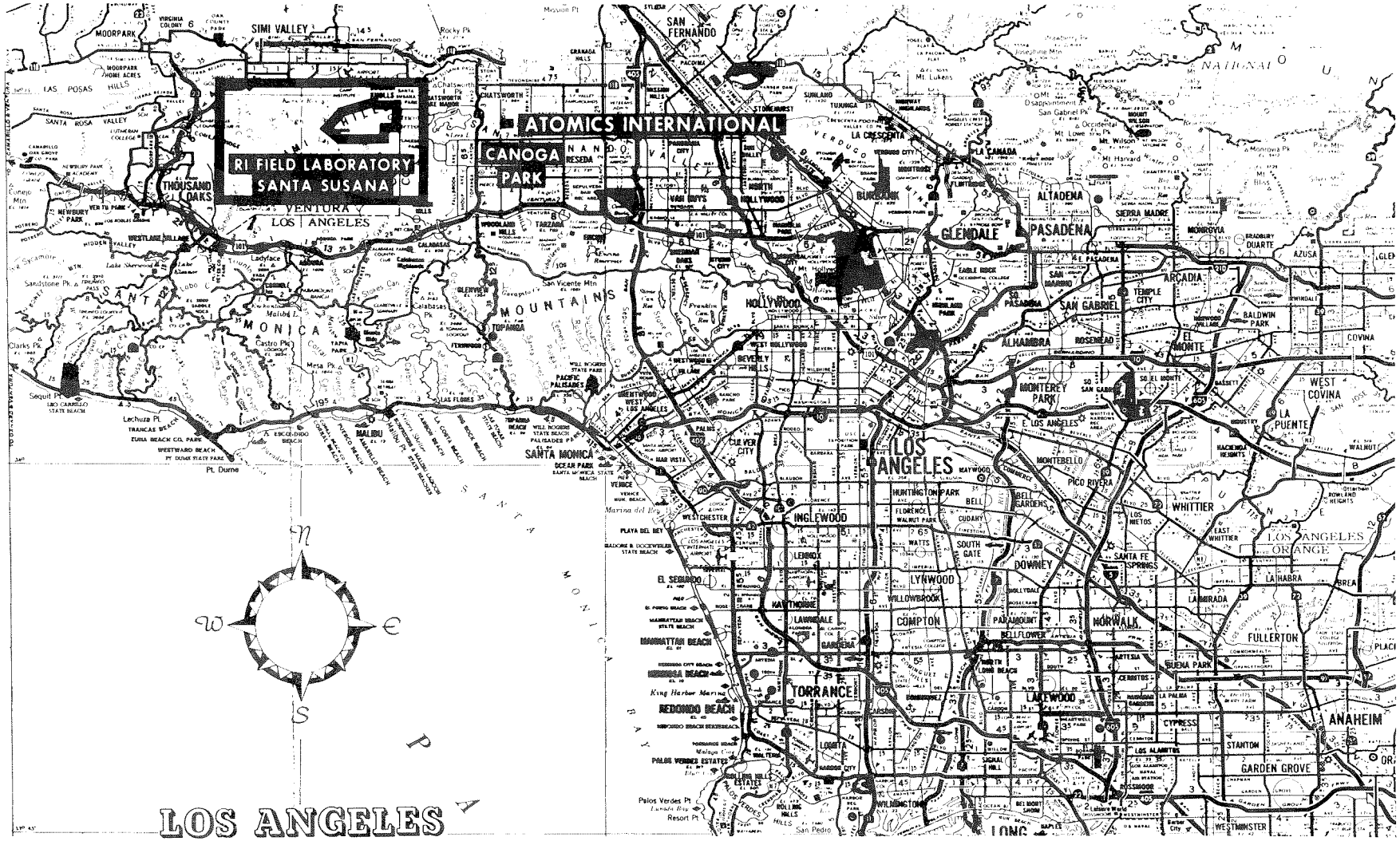

Figure 4. Map of General Los Angeles Area
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wastes generated as a result of the D&D Program, begun in 1975. Several deactivated nuclear reactor and support facilities, all within the optioned area, are affected by the D&D Program. Currently involved are several facilities used for Systems for Nuclear Auxiliary Power (SNAP) reactor test operations, Buildings 010, 024, and 059, and the SRE, Building 143. There is no fissile material located at any of these facilities.

Licensed programs conducted during 1977 included: (1) commercial operation of the L-85 reactor for central station power plant operator training and for neutron radiography inspection of precision forgings, castings, and electronic and explosive devices for manufacturing defects; (2) the operation of the AIHL for nuclear reactor fuel and system component examination and the fabrication of sealed radiation sources; and (3) the operation of nuclear fuel manufacturing facilities for the production of experimental and test reactor fuel involving normal and enriched uranium, and plutonium - uranium oxide mixing operations for carbothermic reduction to (U, Pu) C for advanced fuels development.

The basic policy for control of radiological and toxicological hazards at AI requires that adequate containment of such materials be provided, and, through rigid operational controls, that effluent releases and external radiation levels are reduced to a minimum. The environmental monitoring program provides a measure of the effectiveness of the Division's safety procedures and engineering safeguards incorporated into facility designs. Specific radionuclides in facility effluent or environmental samples, although not routinely identified due to the extremely low radioactivity levels normally detected, may be identified by analytical or radiochemistry techniques if significantly increased radioactivity levels were observed.

In addition to environmental monitoring, work area air and atmospherically discharged effluents are continuously monitored or sampled, as appropriate. This provides a direct measure of the effectiveness of controls and allows remedial action to be taken before a significant release of hazardous material can occur.

Environmental sampling stations that are located within the boundaries of AI sites are referred to as "on-site" stations; those located within a 10-mile radius of the sites are referred to as "off-site" stations. The on-site environs of the Headquarters and SSFL facilities are sampled monthly to determine the concentration of radioactivity in typical surface soil, vegetation, and water. Similar off-site environmental samples are obtained quarterly. Continuously performed on-site and off-site ambient air sampling provides information concerning airborne long-lived particulate radioactivity. A site ambient gamma radiation monitoring program, utilizing thermoluminescent dosimetry (TLD), was begun in 1971.

Nonradioactive wastes released to unrestricted areas are limited to liquids released to sanitary sewage systems and to surface water drainage systems. No intentional releases of liquid pollutants are made to unrestricted areas. Liquid waste generated at the Headquarters site is discharged into the city sewage system. This effluent is sampled for determination of radioactivity. Sanitary sewage from all DOE and AI facilities at the SSFL is treated at an on-site sewage plant. The plant effluent drains into a retention pond, located at the adjoining Rocketdyne Division Santa Susana Field Laboratory (SSFL). The surface water drainage system of the SSFL is composed of catch ponds and open drainage ditches leading to the retention pond that also receives the sewage plant effluent. Water from the pond may be reclaimed as industrial process water, or it may be released off-site into Bell Creek, a tributary of the Los Angeles River. The pond is also monitored at discharge for tritium as required under the NRC Special Nuclear Materials License, SNM-21, and for nonradioactive pollutants by Rocketdyne Division, as required by discharge permits issued to Rocketdyne by the California Regional Water Quality Control Board.

This report summarizes environmental monitoring results for 1977. A comparison of 1977 radioactivity results with previous years appears in Appendix A.

II. ENVIRONMENTAL MONITORING SUMMARY RESULTS

A. RADIOACTIVE MATERIALS – 1977

The sampling and analytic methods used in the environmental monitoring program for radioactive materials are described in Section III.

The average radioactivity concentrations in local soil, vegetation, surface water, and ambient air for 1977 are presented in Tables 1 through 5. In calculating the averaged concentration value for the tables, those individual samples having radioactivity levels less than their minimum detection levels (MDL) are assumed to have a concentration equal to the MDL. This method of data averaging, required by DOE Manual Chapter 0513, affords a significant level of conservatism in the data, as evident in the tables, in that most radioactivity concentrations are reported as "less than" (<) values. Thus, for measurements in which some apparent radioactivity concentrations are below the MDL, the true averaged value is actually somewhat less than the value reported.

The maximum level of radioactivity detected for a single sample is reported because of its significance in indicating the existence of a major episode or area-wide location of radioactive material deposition. Except for ambient air radioactivity, none of the maximum observed values, which occurred randomly during this year, show a great increase over the average values beyond natural variability. The air sample data reflects a September atmospheric nuclear device detonation which resulted in a marked but transient increase in local airborne radioactivity levels.

The results reported in Tables 1 and 2 show no significant difference between on-site and off-site samples. The detected activity is due to a variety of naturally occurring radionuclides, and to radioactive fallout resulting from dispersal of nuclear weapons materials and fission products by atmospheric testing. Naturally occurring radionuclides include Be^{7}, K^{40}, Rb^{87}, Sm^{147}, and the uranium and thorium series (including the inert gas radon and its radioactive daughters). Radioactivity from fallout consists primarily of the fission products Sr^{90} - Y^{90}, Cs^{137}, and Pm^{147}, and also U^{235} and Pu^{239}.

Process water used at the SSFL is obtained from Ventura County Water District No. 8, which also supplies nearby communities, and is distributed on-site by the same piping system previously used when process water was obtained

TABLE 1

SOIL RADIOACTIVITY DATA – 1977

Area	Activity	No. Samples	Gross Radioactivity (μCi/g)	
			Annual Average Value (95% Confidence Level)	Maximum Observed Value*
On Site	α	144	$(5.6 \pm 1.5)\ 10^{-7}$	1.1×10^{-6}
	β	144	$(2.4 \pm 0.09)\ 10^{-5}$	3.1×10^{-5}
Off Site	α	48	$(5.3 \pm 1.5)\ 10^{-7}$	8.5×10^{-7}
	β	48	$(2.3 \pm 0.08)\ 10^{-5}$	2.7×10^{-5}

*Maximum value observed for single sample

TABLE 2

VEGETATION RADIOACTIVITY DATA – 1977

Area	Activity	No. Samples	Gross Radioactivity (μCi/g)		
			Dry Weight Annual Average Value	Ash	
				Annual Average Value (95% Confidence Level)	Maximum Observed Value*
On Site	α	144	$(<3.7 \pm 2.9)\ 10^{-8}$	$(<2.2 \pm 1.7)\ 10^{-7}$	1.1×10^{-6}
	β	144	$(2.3 \pm 0.04)\ 10^{-5}$	$(1.62 \pm 0.03)\ 10^{-4}$	5.87×10^{-4}
Off Site	α	48	$(<5.4 \pm 3.3)\ 10^{-8}$	$(<2.1 \pm 1.6)\ 10^{-7}$	1.0×10^{-6}
	β	48	$(3.3 \pm 0.07)\ 10^{-5}$	$(1.42 \pm 0.03)\ 10^{-4}$	2.57×10^{-4}

*Maximum value observed for single sample

from on-site wells. Conversion was completed during 1969. One on-site water well was reactivated during June to reduce Ventura County domestic water consumption as a water conservation measure due to the local drought conditions. The well water proportion in the blend averaged about 56% for the 6-month period ending in November at which time 100% county water was used again. Pressure is provided by elevated storage tanks.

Water from the system is sampled monthly at two widely separated SSFL locations. The average process water radioactivity concentration is presented in Table 3.

TABLE 3

SSFL PROCESS WATER RADIOACTIVITY DATA – 1977

Area	Activity	No. Samples	Gross Radioactivity (μCi/mℓ)	
			Average Value (95% Confidence Level)	Maximum* Observed Value
AI-SSFL	α	24	$(<2.5 \pm 2.9)\ 10^{-10}$	3.0×10^{-10}
	β	24	$(2.5 \pm 0.7)\ 10^{-9}$	3.6×10^{-9}

*Maximum value observed for single sample

As discussed earlier, surface waters discharged from SSFL facilities and the sewage plant effluent drain southward into a retention pond on Rocketdyne property. When full, the pond may be drained into Bell Creek, a tributary of the Los Angeles River in the San Fernando Valley, Los Angeles County. Pursuant to the requirements of Los Angeles Regional Water Quality Control Board Resolution 66-49 of September 21, 1966, a sampling station for evaluating environmental radioactivity in Bell Canyon was established in 1966. It is located approximately 2.5 miles downstream from the southern Rockwell International Corporation boundary. Samples, obtained and analyzed monthly, include stream bed mud, vegetation, and water. Average radioactivity concentrations in Rocketdyne ponds and Bell Creek samples are presented in Table 4.

Comparison of the radioactivity concentrations in water from the ponds and from Bell Creek with that of the supply water shows no significant variation in either alpha or beta activity.

TABLE 4

BELL CREEK AND ROCKETDYNE SSFL RETENTION POND
RADIOACTIVITY DATA – 1977

Area	Activity	No. Samples	Gross Radioactivity		
			Average Value (95% Confidence Level)	Maximum* Observed Value	% of Guide†
Bell Creek Mud No. 54 (μCi/g)	α	12	$(2.9 \pm 1.0)\ 10^{-7}$	4.5×10^{-7}	NA
	β	12	$(2.2 \pm 0.08)10^{-5}$	2.4×10^{-5}	NA
SSFL Pond Mud No. 55 (μCi/g)	α	12	$(6.3 \pm 1.5)\ 10^{-7}$	8.9×10^{-7}	NA
	β	12	$(2.4 \pm 0.09)10^{-5}$	2.6×10^{-5}	NA
Bell Creek Vegetation No. 54 (μCi/g ash)	α	12	$(<1.9 \pm 1.6)\ 10^{-7}$	3.2×10^{-7}	NA
	β	12	$(1.55 \pm 0.03)\ 10^{-4}$	2.05×10^{-4}	NA
Bell Creek Vegetation No. 54 (μCi/g) dry weight)	α	12	$(<4.8 \pm 4.0)\ 10^{-8}$	1.3×10^{-7}	NA
	β	12	$(3.6 \pm 0.07)\ 10^{-5}$	5.4×10^{-5}	NA
Bell Creek Water No. 16 (μCi/mℓ)	α	12	$(<2.4 \pm 2.9)\ 10^{-10}$	$<2.4 \times 10^{-10}$	<0.006
	β	12	$(1.8 \pm 0.8)\ 10^{-9}$	2.6×10^{-9}	0.6
SSFL Pond Water No. 6 (μCi/mℓ)	α	12	$(<2.4 \pm 2.9)\ 10^{-10}$	$<2.5 \times 10^{-10}$	<0.006
	β	12	$(4.3 \pm 0.8)\ 10^{-9}$	6.4×10^{-9}	1.4
SSFL Pond Water No. 12 (μCi/mℓ)	α	12	$(<2.5 \pm 2.9)\ 10^{-10}$	2.8×10^{-10}	<0.006
	β	12	$(5.2 \pm 0.9)\ 10^{-9}$	1.3×10^{-8}	1.7

*Maximum value observed for single sample.
†Guide: 5×10^{-6} μCi/m$\ell\alpha$, 3×10^{-7} μCi/m$\ell\beta$; 10 CFR 20 Appendix B, CAC 17, DOE Manual Chapter 0524
NA – Not applicable, no Guide value having been established.

The surface water (SSFL) and the ambient air radioactivity Guide values selected for each site are the most restrictive limits for those radionuclides currently in use at AI facilities. The identity of all such radionuclides is known, irrespective of concentration. Accordingly, for SSFL surface water, the Guide value of 5×10^{-6} μCi/m$\ell\alpha$ and 3×10^{-7} μCi/m$\ell\beta$, for Pu^{239} and for Sr^{90}, respectively, is appropriate. The correspondingly most restrictive Guide value for Headquarters wastewater radioactivity discharged to the sanitary sewage system, a controlled area, is 8×10^{-4} μCi/m$\ell\alpha$ and 1×10^{-3} μCi/m$\ell\beta$, for U^{235} and Co^{60}, respectively. These values are established in 10 CFR 20, California Administrative Code Title 17, and DOE Manual Chapter 0524.

The Guide value of 6×10^{-14} μCi/m$\ell\alpha$ for SSFL ambient air radioactivity is due to work with unencapsulated plutonium at this site. The Guide value of 3×10^{-11} μCi/m$\ell\beta$, for Sr^{90}, is due to the presence of fission products in irradiated nuclear fuel at the site. The Guide value of 3×10^{-12} μCi/m$\ell\alpha$ for Headquarters ambient air radioactivity is due to work with unencapsulated uranium (including depleted uranium) at this facility. The Guide value of 3×10^{-10} μCi/m$\ell\beta$ for Co^{60}, for Headquarters ambient air radioactivity is appropriate since it is the most restrictive limit for beta-emitting radionuclides present at the facility. Guide value percentages are not presented for soil or vegetation data since no concentration Guide values have been established.

Ambient air sampling for long-lived particulate alpha and beta radioactivity is performed continuously with automatic sequential samplers at both the Headquarters and SSFL sites. Air is drawn through Type HV-70 filter media which are analyzed, after a minimum 120-h decay period to eliminate the radon particulate daughters, for long-lived radioactivity. The average concentrations of ambient air alpha and beta radioactivity are presented separately in Table 5.

Radioactivity levels observed in environmental samples for 1977, reported in Tables 1 through 5, compare closely with levels reported for recent years. Local environmental radioactivity levels, which result primarily from beta-emitting radionuclides and had shown the effect of fallout during past extensive atmospheric testing of nuclear devices, have decreased, and have been generally constant during the past several years. The effects of continuing, although infrequent, foreign atmospheric nuclear tests continue to be occasionally

TABLE 5

AMBIENT AIR RADIOACTIVITY DATA – 1977

Site Location	Activity	No. Samples	Average Value (95% Confidence Level)	Maximum* Observed Value (daily)	% of Guide†
Headquarters	α§	729	$(<6.6 \pm 7.7)\ 10^{-15}$	3.9×10^{-14}	<0.22
(μCi/mℓ)	β**	729	$(<1.7 \pm 0.2)\ 10^{-13}$	3.0×10^{-12}	<0.057
SSFL	α§	2438	$(<6.6 \pm 7.5)\ 10^{-15}$	3.5×10^{-14}	<0.22
(μCi/mℓ)	β**	2438	$(<1.7 \pm 0.2)\ 10^{-13}$	2.8×10^{-12}	<0.057

*Maximum value observed for single sample.

†Guide: Headquarters, 3×10^{-2} μCi/mℓα, 3×10^{-10} μCi/mℓβ; 10 CFR 20 Appendix B, SSFL, 6×10^{-14} μCi/mℓα, 3×10^{-11} μCi/mℓβ; 10 CFR 20 Appendix B, CAC 17, and DOE Manual Chapter 0524

§MDL = 6.2×10^{-15} μCi/mℓ – Individual daily samples with activity levels of 0 to 6.2×10^{-15} μCi/mℓ are recorded and averaged as 6.2×10^{-15} μCi/mℓ.

**MDL = 1.2×10^{-14} μCi/mℓ – Individual daily samples with activity levels of 0 to 1.2×10^{-14} μCi/mℓ are recorded and averaged as 1.2×10^{-14} μCi/mℓ. Indicated average values are upper limits, since some data were below the minimum detection levels.

observable in daily ambient air radioactivity levels; however, the long-term effects on surface sample radioactivity levels are not discernible. The continued relative constancy in current environmental radioactivity is due primarily to the dominance of naturally occurring radionuclides in the environment and to the longer-lived fission product radioactivity from fallout.

Site ambient radiation monitoring is performed with several types of TLD's. Each dosimeter packet includes a single calcium fluoride (CaF_2:Mn) low background, bulb-type chip dosimeter which produced the data used in this report, a single calcium fluoride (CaF_2:Mn) bare chip dosimeter, and two calcium sulfate ($CaSO_4$:Dy) low background powder-type dosimeters. The additional chip dosimeter is used for continued development of TLD dosimetry programs at AI. The powder dosimeters, supplied and evaluated by a commercial radiation dosimetry laboratory, are used as backup to the low background bulb-type dosimeter. The dosimeter sets are placed at selected locations

(Figures 6 and 7) on or near the perimeters of the AI Headquarters and SSFL sites. Each dosimeter, sealed in a light-proof energy compensation shield, is installed in a polyethylene container mounted ~1 meter above ground at each location. The dosimeters are exchanged and evaluated quarterly. There were 10 on-site TLD monitoring locations used during the year with 3 additional perimeter locations added at Headquarters in November which indicated an equivalent annual dose of 134 mrem for their 9 weeks of exposure. Three additional dosimeter sets, located off-site at locations up to 10 miles from the sites, are similarly evaluated to determine the local area ambient radiation level, which averaged 0.012 mrem/h for 1977. The average radiation dose rate and equivalent annual dose monitored at each dosimeter location are presented in Table 6.

TABLE 6

SITE AMBIENT RADIATION DOSIMETRY DATA – 1977

Dosimeter Location	Average Dose Rate (mrem/h)	Equivalent Annual Dose (mrem)
TLD-1 Headquarters	0.014	125
TLD-2 Headquarters	0.013	114
TLD-3 Headquarters	0.012	108
TLD-4 Headquarters	0.013	118
TLD-5 SSFL	0.014	125
TLD-6 SSFL	0.015	137
TLD-7 SSFL	0.018	125
TLD-8 SSFL	0.016	138
TLD-9 SSFL	0.010	86
TLD-10 SSFL	0.013	117
TLD-11 Off-Site	0.012	105
TLD-12 Off-Site	0.012	108
TLD-13 Off-Site	0.012	106

The table shows that radiation dose rates and equivalent annual doses monitored on-site are nearly identical to levels monitored at three widely separated off-site locations. These data include the natural background radiation component—which exists as a consequence of cosmic radiation, radionuclides in the

soil, and radon and thoron in the atmosphere, in addition to radioactive fallout from nuclear weapons tests. Locally, this is approximately 100 mrem/year. The small variability observed in the data is attributed to differences in elevation and geologic conditions at the various dosimeter locations. Since the data for the on-site and off-site locations are nearly identical, no measurable radiation dose to the general population or to individuals in uncontrolled areas resulted from AI operations.

B. NONRADIOACTIVE MATERIALS – 1977

Processed wastewater and most collected surface runoff discharged from the SSFL drain to Retention Pond R-2A, operated by Rocketdyne. Water samples are taken from the pond and analyzed for various constituents, as required by the Regional Water Quality Control Board, for each discharge to Bell Canyon. The discharges are normally required only as a result of excessive rainfall run-off. As a result, the NPDES concentration limits for turbidity, and suspended and settleable solids do not apply for rainfall-related discharges. The results of analyses for each discharge for 1977, the majority of which were rainfall-related discharges, are presented in Table 7.

TABLE 7

NONRADIOACTIVE CONSTITUENTS IN WASTEWATER DISCHARGED TO UNRESTRICTED AREAS – 1977

(Analysis results for wastewater discharged to Bell Creek on date indicated – Sample Station W-12)

Constituents	January 2*		March 16*		March 25*		May 7*		August 17*		October 20		November 16		November 21		December 2		December 21*		December 28*	
	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide
Total Dissolved Solids (mg/ℓ)	332	34.9	384	40.4	241	25.4	214	22.5	116	12.2	690	72.6	645	67.9	704	74.1	729	76.7	656	69.1	193	20.3
Chloride (mg/ℓ)	70	46.7	74	49.3	37	24.7	31	20.7	12	8.0	74	49.3	105	70.0	133	88.7	106	70.7	103	68.7	17	11.3
Sulfate (mg/ℓ)	72	24.0	103	34.3	37	12.3	48	16.0	35	11.7	199	66.3	196	65.3	166	55.3	227	75.7	220	73.3	30	10.0
Suspended Solids (mg/ℓ)	8	5.3	12	8.0	108	72.0	102	68.0	374	249.0	5	3.3	54	36.0	13	8.7	12	8.0	28	18.7	104	69.3
Settleable Solids (ml/ℓ)	<0.005	<1.7	<0.1	<33.3	<0.1	<33.3	<0.05	<16.7	0.4	133.3	<0.1	<33.3	0.2	66.7	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3	0.1	33.3
BOD (mg/ℓ)	2	3.3	4	6.7	6	10.0	8	13.3	2	3.3	4	6.7	13	21.7	6	10.0	10	16.7	2	3.3	4	6.7
Oil and Grease (mg/ℓ)	3	20.0	2	13.3	2	13.3	1	6.7	0.4	2.7	0	0	<1	<6.7	<1	<6.7	1	6.7	<1	<6.7	<1	<6.7
Turbidity (TU)	2.6	–	3	–	100	–	98	–	150	–	3.4	–	17	–	5.3	–	5.7	–	13	–	55	–
Chromium (mg/ℓ)	0.003	30.0	0.005	50.0	0.009	90.0	0.01	100.0	0.03	300.0	0.002	20.0	0.009	90.0	0.002	20.0	0.002	20.0	0.003	30.0	0.006	60.0
Fluoride (mg/ℓ)	1.0	100.0	0.8	80.0	0.7	70.0	0.5	50.0	0.6	60.0	0.7	70.0	1.0	100.0	0.4	40.0	0.3	30.0	0.6	60.0	0.5	50.0
Boron (mg/ℓ)	0.3	30.0	0.3	30.0	0.2	20.0	0.2	20.0	<1.0	<100.0	0.2	20.0	0.4	40.0	0.3	30.0	0.3	30.0	0.2	20.0	<0.1	<10.0
Residual Chlorine (mg/ℓ)	<0.1	<100.0	<0.05	<50.0	<0.05	<50.0	ND	–	0.02	20.0	<0.02	<20.0	0.03	30.0	0.04	40.0	0.04	40.0	<0.02	<20.0	0.05	50.0
Fecal Coliform (MPN/100 ml)	NA	–	NA	–	NA	–	<2.2	<9.6	7	30.4	2.2	9.6	2.2	9.6	2.2	9.6	2.2	9.6	2.2	9.6	2.2	9.6
Surfactants (mg/ℓ)	0.005		0.06		0.03		0.01		0.1		0.06		0.01		0.06		0.06		0.04		<0.01	
pH	7.9		8.2		8.1		7.9		7.7		8.2		8.2		7.8		7.5		7.4		7.7	

NA – Not available; analysis not requested or not performed.
ND – None detected; level below limit of detection.
*Rainfall Related Discharge

NOTE: Tritium concentrations monitored under an NRC SNM-21 license condition were as follows:

Release Date	Tritium μCi/ml
11-16-77	3.5×10^{-6}
12-02-77	1.0×10^{-5}

A. GENERAL DESCRIPTION

Soil and vegetation sample collection and analysis for radioactivity were initiated in 1952, in the Downey, California, area, where the AI Division was initially located. Environmental sampling was subsequently extended to the proposed SRE site in the Simi Hills in May of 1954. In addition, sampling was begun in the Burro Flats area, southwest of SRE, where other nuclear installations were planned and are currently in operation. The Downey area survey was terminated when the Division relocated to Canoga Park in 1955. The primary purpose of the environmental monitoring program is to survey environmental radioactivity adequately to ensure that AI operations do not contribute significantly to environmental radioactivity. The locations of sampling stations are shown in Figures 5 through 7 and listed in Table 8.

B. SAMPLING AND SAMPLE PREPARATION

1. Soil

Soil is analyzed for radioactivity to monitor for any significant increase in radioactive deposition. 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.

Surface soil types available for sampling range from decomposed granite to clay and loam. Samples are taken from the top 1/2-in. layer of undisturbed ground surface. The soil samples are packaged in plastic containers, and returned to the laboratory for analysis.

Sample preparation consists of transferring the soils to Pyrex beakers, and drying in a muffle furnace at approximately 500 °C for 8 h. After cooling, the soil is sieved to obtain uniform particle size. Two-gram aliquots of the sieved soil are weighed, and transferred to copper 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. Loose soil specific gravity ranges from approximately 1.1 to 1.4 g/cm^3 and averages 1.2 g/cm^3

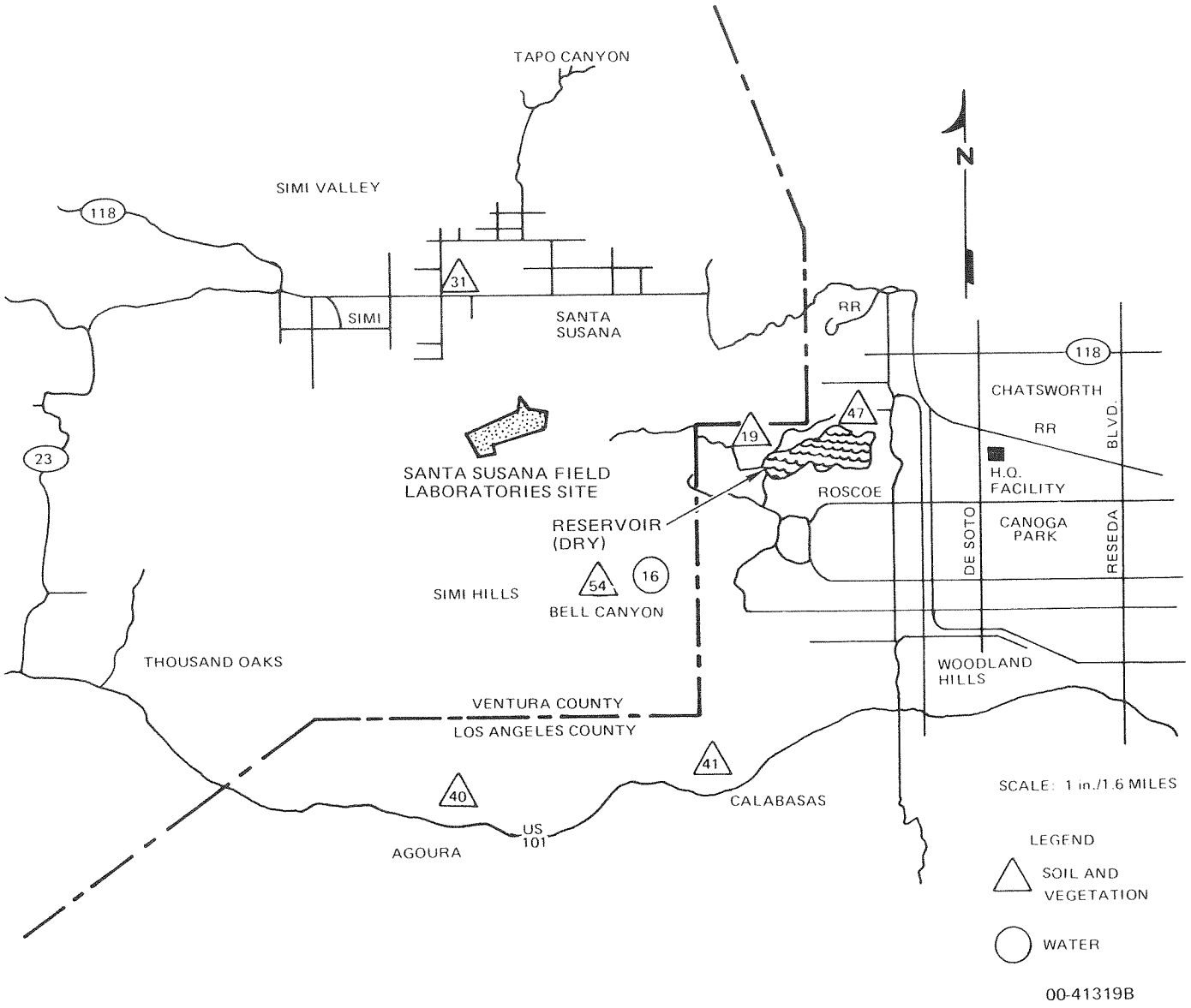

Figure 5. Map of Canoga Park, Simi Valley, Agoura and Calabasas Sampling Stations

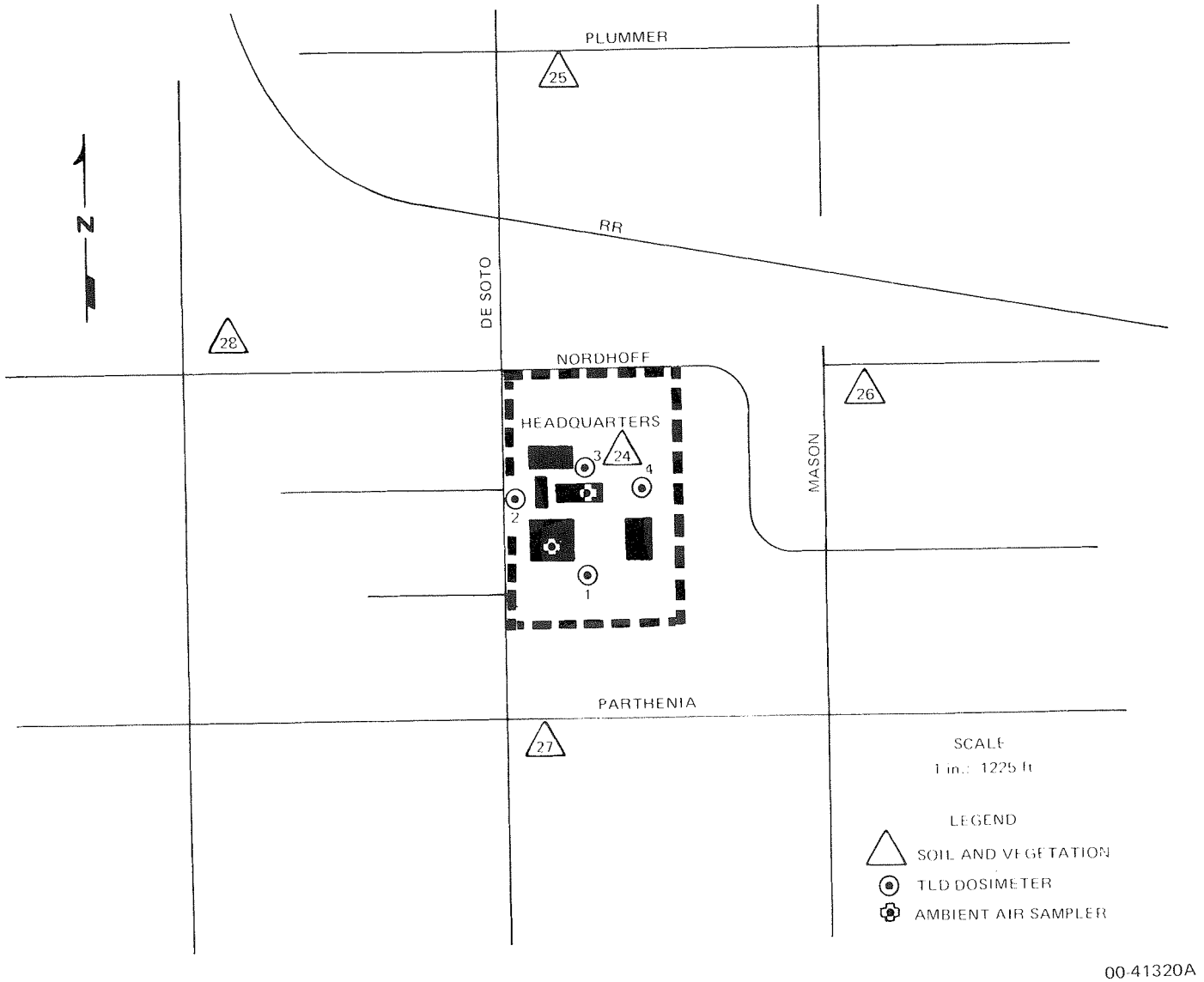

Figure 6. Map of Headquarters Vicinity Sampling Stations

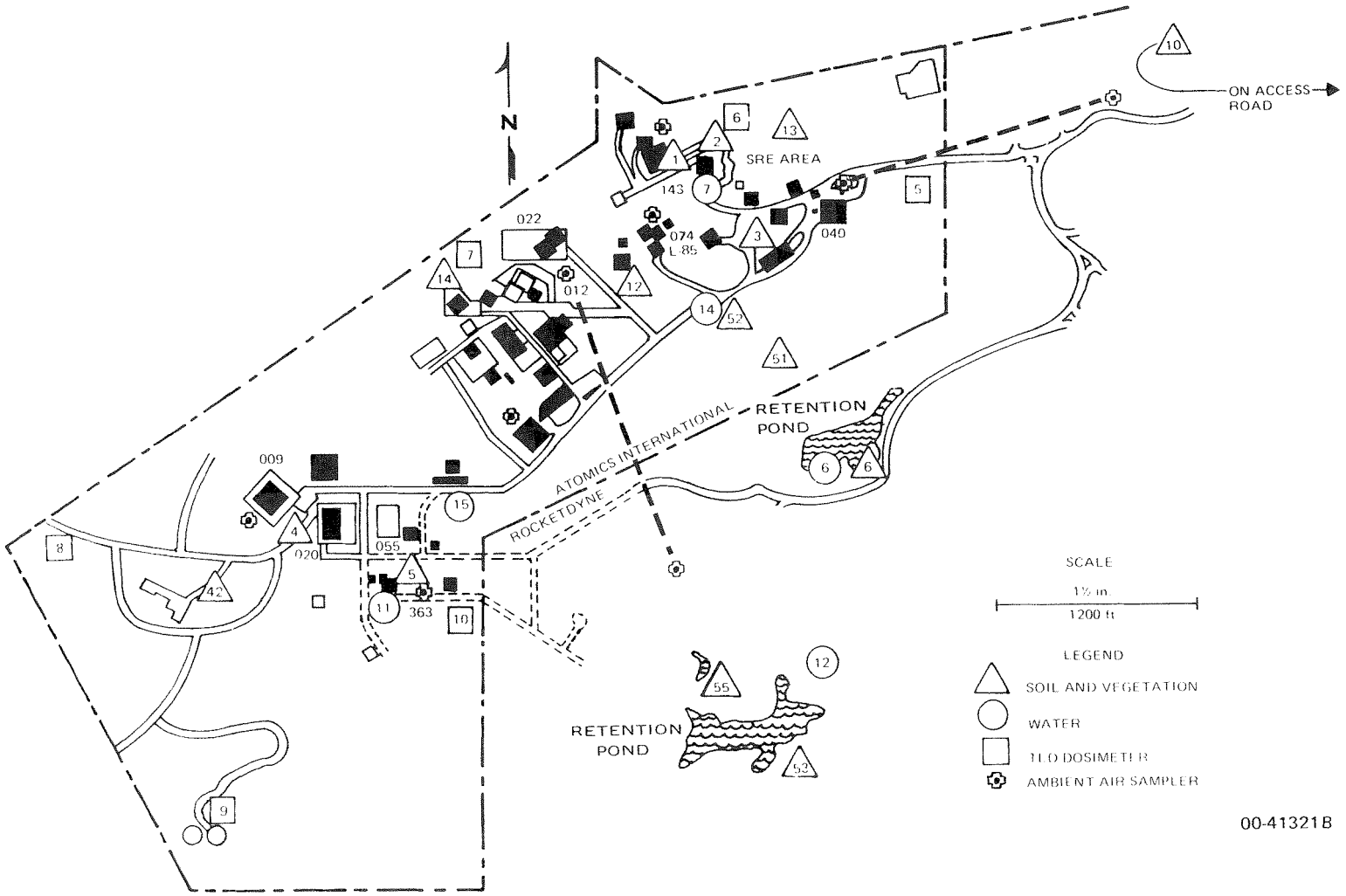

Figure 7. Map of SSFL Sampling Stations

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 1 of 2)

Station	Location
SV-1	SRE Reactor, SSFL
SV-2	SRE Perimeter Drainage Ditch, SSFL
SV-3	Bldg. 064 Parking Lot, SSFL
SV-4	Bldg. 020, SSFL
SV-5	Bldg. 363, SSFL
SV-6	Rocketdyne Retention Pond, SSFL
SV-10	Santa Susana Site Access Road
SV-12	L-85 Reactor, SSFL
SV-13	Sodium Cleaning Pad, SSFL
SV-14	Below Bldg. 021-022, SSFL
SV-19	Santa Susana Site Entrance, Woolsey Canyon
SV-24	Atomics International Headquarters
SV-25	DeSoto Avenue and Plummer Street
SV-26	Mason Avenue and Nordhoff Street
SV-27	DeSoto Avenue and Parthenia Street
SV-28	Canoga Avenue and Nordhoff Street
SV-31	Simi Valley, Alamo Avenue and Sycamore Road
SV-40	Agoura – Kanan Road and Ventura Freeway
SV-41	Calabasas – Parkway Calabasas and Ventura Freeway
SV-42	Nonradioactive Materials Disposal Area, SSFL
SV-47	Chatsworth Reservoir North Boundary
SV-51	Bldg. 029, SSFL
SV-52	Burro Flats Drainage Control Pond, G Street and 17th Street, SSFL
SV-53	Top of Bell Canyon Below Rocketdyne Delta Pond Spillway
SV-54	Bell Creek
S-55	Rocketdyne Retention Pond

SV – Soil and Vegetation Sample Station
S – Soil Sample Station

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 2 of 2)

Station	Location
W-6	Rocketdyne Retention Pond
W-7	Process Water from Bldg. 003, SSFL
W-11	Process Water from Bldg. 363, SSFL
W-12	Rocketdyne Retention Pond R2A
W-16	Bell Creek
A-1	Atomics International Headquarters, Bldg. 001 Roof
A-2	Atomics International Headquarters, Bldg. 004 Roof
A-3	Bldg. 009, SSFL, Grade Level, West Side
A-4	Bldg. 011, SSFL, Grade Level, West Side
A-5	Bldg. 012, SSFL, Grade Level, West Side (Relocated to Bldg. 600 Rocketdyne on August 1, 1977)
A-6	Bldg. 040, SSFL, Grade Level, North Side (Relocated to Bldg. 207 Rocketdyne on August 1, 1977)
A-7	Bldg. 074, SSFL, Grade Level, South Side
A-8	Bldg. 143, SSFL, Grade Level, North Side
A-9	Bldg. 363, SSFL, Grade Level, South Side
TLD-1	Atomics International Headquarters, South of Bldg. 102 on Fence
TLD-2	Atomics International Headquarters, West of Bldg. 001 on Gate to Plant Water Supply Enclosure
TLD-3	Atomics International Headquarters, Guard Post No. 1, Bldg. 201
TLD-4	Atomics International Headquarters, East Fence Gate
TLD-5	Bldg. 113, SSFL
TLD-6	SRE Retention Pond, SSFL
TLD-7	Electric Substation No. 719, SSFL
TLD-8	Property Line Gate, West End of H Street, SSFL
TLD-9	Water Tank No. 701, SSFL
TLD-10	Bldg. 854, SSFL
TLD-11	Off Site, Northridge
TLD-12	Off Site, Simi Valley
TLD-13	Off Site, Northridge

W – Water Sample Station
A – Air Sample Station
TLD – Thermoluminescent Dosimeter Location

2. Vegetation

The analysis of vegetation is performed as an adjunct to the soil analysis and is done to determine the uptake of radioactivity by plants. These plants do not contribute to the human food chain, nor is there significant agriculture or grazing in the immediate neighborhood of either site.

Vegetation samples obtained in the field are of the same perennial plant types, wherever possible; these are usually sunflower or wild tobacco leaves. Vegetation leaves are stripped from plants, and placed in ice cream cartons for transfer to the laboratory for analysis. Ordinarily, plant root systems are not analyzed.

Vegetation samples are first washed with tap water to remove foreign matter, and then thoroughly rinsed with distilled water. Washed vegetation is dried in tared beakers at 100 °C for 24 h for dry weight determination, then ashed in a muffle furnace at approximately 500 °C for 8 h, producing a completely burned ash. One-gram aliquots of pulverized ash from each beaker are weighed, and transferred to copper planchets. The vegetation ash is wetted in the planchet with alcohol, evenly distributed to obtain uniform sample thickness, dried, and counted for alpha and beta radiation. The dry/ash weight ratio is used for the determination of the equivalent dry weight gross radioactivity concentration value.

3. Water

Surface water samples are obtained monthly at the SSFL and from Bell Creek. The water is drawn into 1-liter polyethylene bottles, and transferred to the laboratory.

Five-hundred-milliliter volumes of water are evaporated to dryness in crystallizing dishes at approximately 90 °C. The residual salts are redissolved into distilled water, transferred to copper planchets, dried under heat lamps, and counted for alpha and beta radiation.

4. Ambient Air

Air sampling is performed continuously at the Headquarters and SSFL sites with automatic air samplers, operating on 24-h sampling cycles. Airborne particulate radioactivity is collected on Type HV-70 filter media, which are

automatically changed daily at the end of each sampling period. The samples are counted for alpha and beta radiation following a minimum 120-h decay period to allow the decay of radon particulate daughters. The volume of a typical daily ambient air sample is approximately 25 m^3.

Figure 8 is a graph of the daily averaged long-lived alpha and beta ambient air radioactivity concentrations for the Headquarters and SSFL facilities during 1977. The average beta concentration for each month is also indicated by horizontal bars. The graph shows few prominent peaks occurring during the first 9 months, followed by a large increase in concentration during late September and early October with subsequent decreasing levels through the year's end.

C. COUNTING AND CALIBRATION

Environmental soil, vegetation, water, and ambient air samples are counted for alpha and beta radiation with a low-background gas flow proportional counting system, capable of the simultaneous counting of both alpha and net beta radiation. The sample-detector configuration provides a nearly 2π geometry. The thin-window detector is continually purged with methane counting gas. A preset time mode of operation is used for all samples. The minimum detection limits shown in Table 9 were determined by using typical values for counting time, system efficiencies for detecting alpha and beta radiation, background count rates (approximately 0.05 cpm α and 1.0 cpm β) and sample size. For the table, the minimum statistically significant amount of radioactivity, irrespective of sample configuration, is taken as that amount equal in count rate to three times the standard deviation of the system background count rate.

Counting system efficiencies are determined routinely with Ra-D+E+F (with alpha absorber), Cl^{36}, Th^{230}, U^{235}, and Pu^{239} standard sources, and with K^{40}, in the form of standard reagent grade KCl, which is used to simulate soil and vegetation samples. Self-absorption standards are made by dividing sieved KCl into samples, increasing in mass by 200-mg increments, from 100 to 3000 mg. The samples are placed in copper planchets, of the type used for environmental samples, and counted. The ratio of sample activity to the

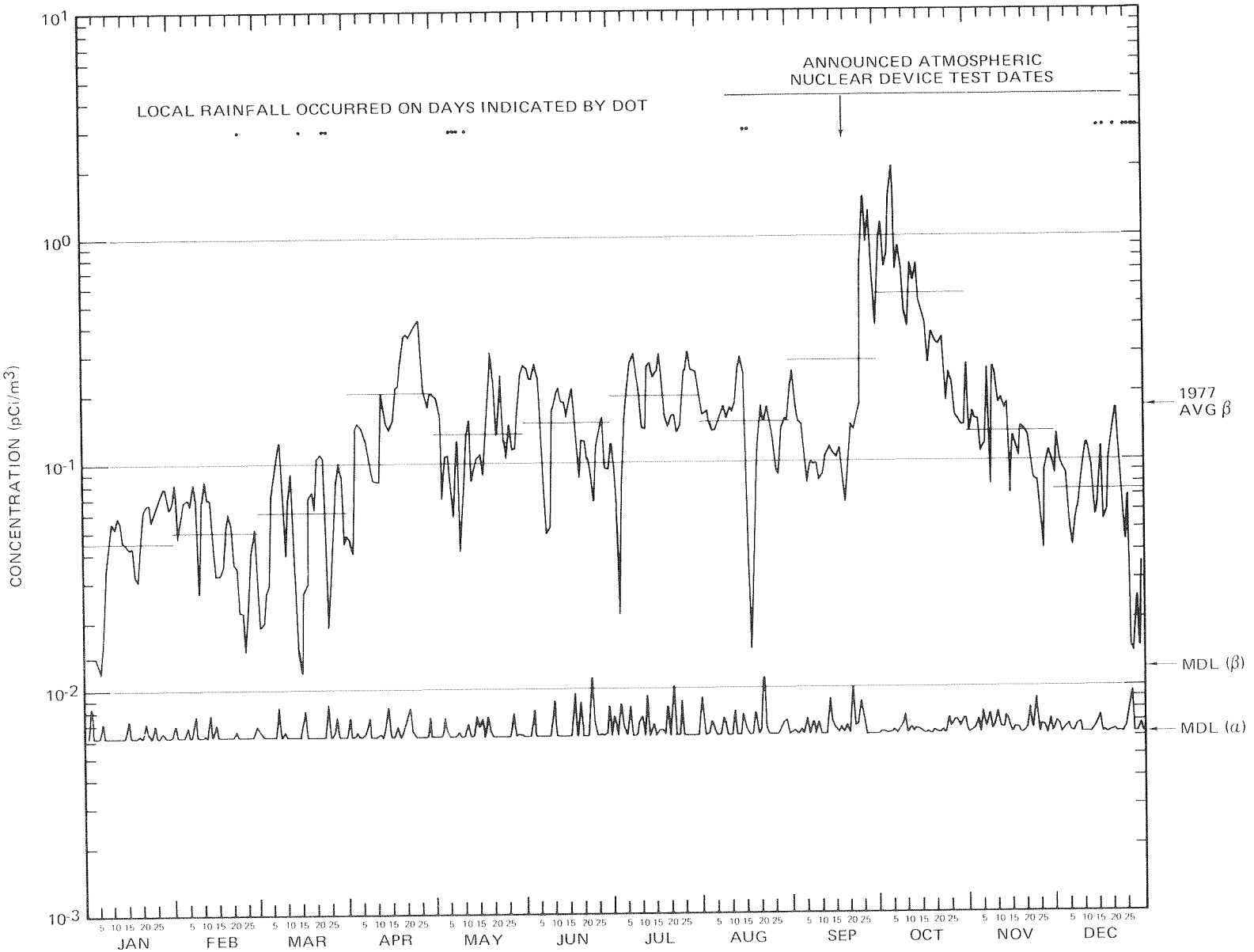

Figure 8. Daily Averaged Long-Lived Airborne Radioactivity at Headquarters and SSFL – 1977

TABLE 9

MINIMUM RADIOACTIVITY DETECTION LIMITS (MDL)

Sample	Activity	Minimum Detection Limits*
Soil	α	$(6.0 \pm 7.2)\ 10^{-8}$ μCi/g
	β	$(2.3 \pm 2.3)\ 10^{-7}$ μCi/g
Vegetation	α	$(1.2 \pm 1.4)\ 10^{-7}$ μCi/g ash
	β	$(3.7 \pm 3.6)\ 10^{-7}$ μCi/g ash
Water	α	$(2.4 \pm 2.9)\ 10^{-10}$ μCi/mℓ
	β	$(6.1 \pm 6.1)\ 10^{-10}$ μCi/mℓ
Air	α	$(6.2 \pm 7.4)\ 10^{-15}$ μCi/mℓ
	β	$(1.2 \pm 1.2)\ 10^{-14}$ μCi/mℓ

*95% Confidence Level

observed net count rate for each sample is plotted as a function of sample weight. The correction factor (ratio) corresponding to sample weight may be 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 proved usable by applying it to various-sized aliquots of uniformly mixed environmental samples and observing that the resultant specific activities fall within the expected statistical counting error.

Since the observed radioactivity in environmental samples results primarily from natural and weapons-testing sources, and is at such low concentrations, an effort is not made to identify individual radionuclides. The detection of significant levels of radioactivity would lead to an investigation of the radioactive material involved, the sources and possible causes.

D. NONRADIOACTIVE MATERIALS

Rockwell International Corporation, Rocketdyne Division, 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 wastewater, pursuant to Section 402 of the Federal Water Pollution Control Act. The permit, NPDES No. CA0001309, became effective on September 27, 1976, and supersedes all previously held permits for wastewater discharge from the Rocketdyne Division SSFL. Discharge of overflow and storm runoff only is permitted into Bell Creek from water reclamation retention ponds. Discharge generally occurs only during and immediately after periods of heavy rainfall or during extended periods of rocket engine testing.

Only one of the retention ponds receives influent directly from the AI SSFL. It is identified as Retention Pond R-2A, Sample Station W-12 in Table 8. The influent includes sewage treatment plant effluent and surface runoff water. Grab-type water samples, taken at the retention pond prior to a discharge, are analyzed for non-radioactive chemical constituents by a California State certified analytical testing laboratory and for tritium. The specific constituents analyzed for, and their respective limitations in discharged wastewater, are presented in Appendix B. Wastewater originating from facilities located throughout the Santa Susana Field Laboratories are composited in the retention pond. Therefore, the point or origin of nonradioactive constituents found in wastewater is impossible to determine.

IV. EFFLUENT MONITORING PROGRAM

Effluents which may contain radioactive material are generated at AI facilities as the result of operations performed under contract to DOE, under NRC Special Nuclear Materials License SNM-21, and under State of California Radioactive Material License 0015-59. The specific facilities are identified as Buildings 001 and 004 at the Headquarters site, and Buildings 020, 021, 022, and 055 at the Santa Susana Site, SSFL.

A. TREATMENT AND HANDLING

Waste streams released to unrestricted areas are limited, in all cases, to gaseous effluents. No contaminated liquids are discharged to unrestricted areas.

The level of radioactivity contained in all atmospherically discharged effluents is reduced to the lowest practicable values by passing the effluents through certified, high efficiency particulate air (HEPA) filters. These effluents are sampled for particulate radioactive materials by means of continuous stack exhaust samplers at the point of release. In addition, stack monitors installed at Buildings 020, 021, 022, and 055 provide automatic alarm capability in the event of the release of gaseous activity from Buildings 020 or 021, 022, or particulate activity from Building 055. The HEPA filters used for filtering gaseous effluents are 99.97% efficient for particles of 0.3-μm diameter. Particle filtration efficiency increases above and below this size.

The average concentration and total radioactivity in gaseous effluent released to unrestricted areas in shown in Table 10. The effectiveness of the air cleaning systems is evident from the fact that in most cases, the gaseous effluent released is less radioactive than the ambient air, which is indicative that there are not radioactivity releases during normal facility operations.

Liquid wastes released to sanitary sewage systems, a controlled areas as provided for by 10CFR20, are generated at the Headquarters Site only. Liquid wastes are discharged from Building 001 following analysis on a volume basis only. There is no continuous flow. Building 004 liquid chemical wastes are released to a proportional sampler installation which retains an aliquote each time a fixed volume is released to the sanitary sewage system. No liquid

TABLE 10

ATMOSPHERICALLY DISCHARGED EFFLUENT RELEASED
TO UNRESTRICTED AREAS – 1977

Building	Point of Release	Approximate Effluent Volume (ft^3)	Activity Monitored	Approximate Minimum Detection Limit ($\mu Ci/m\ell$)	Annual* Average Concentration ($\mu Ci/m\ell$)	Sampling Period Maximum Observed Concentration ($\mu Ci/m\ell$)	Total Radio-Activity Released (Ci)
001	Stack Exit	2.4×10^{10}	α	1.7×10^{-16}	$<1.1 \times 10^{-14}$	8.4×10^{-14}	$<1.0 \times 10^{-5}$
			β	5.3×10^{-16}	$<4.4 \times 10^{-15}$	2.4×10^{-14}	$<4.1 \times 10^{-6}$
004	Stack Exit	5.0×10^{10}	α	4.6×10^{-16}	$<6.1 \times 10^{-16}$	2.1×10^{-15}	$<8.8 \times 10^{-7}$
			β	1.6×10^{-15}	$<5.2 \times 10^{-15}$	4.7×10^{-14}	$<7.5 \times 10^{-6}$
020	Stack Exit	2.1×10^{10}	α	9.8×10^{-17}	$<1.7 \times 10^{-16}$	4.2×10^{-16}	$<1.0 \times 10^{-7}$
			β	3.1×10^{-16}	2.3×10^{-14}	1.6×10^{-13}	1.3×10^{-5}
021-022	Stack Exit	1.0×10^{10}	α	2.3×10^{-16}	$<4.0 \times 10^{-16}$	1.3×10^{-15}	$<1.1 \times 10^{-7}$
			β	7.4×10^{-16}	$<1.1 \times 10^{-14}$	6.6×10^{-14}	$<3.0 \times 10^{-6}$
055	Stack Exit	1.6×10^{10}	α	2.5×10^{-16}	$<3.3 \times 10^{-16}$	6.3×10^{-16}	$<1.5 \times 10^{-7}$
						Total	$<3.9 \times 10^{-5}$

Annual average ambient air radioactivity concentration – 1977

α	$<6.6 \times 10^{-15}$
β	$<1.7 \times 10^{-13}$

*Effluent radioactivity is generally less than ambient air radioactivity.

effluents are released from the Santa Susana Buildings 020, 021, 022, or 055, except as controlled liquid radioactive waste solidified for land burial. The average concentration and total radioactivity in liquid effluents discharged is shown in Table 11.

B. FACILITY DESCRIPTIONS

1. Headquarters Site

a. Building 001 – NRC and California State Licensed Activities

Operations at Building 001 which may generate radioactive effluents consist of production operations associated with the manufacture of enriched uranium fuel elements. Only atmospherically discharged effluents are released from the building to uncontrolled areas. Following analysis for radioactivity concentration, liquid wastes are released to the sanitary sewage system, which is considered a controlled area, as provided by 10 CFR 20. Nuclear fuel material handled in unencapsulated form in this facility contains the uranium isotopes U^{234}, U^{235}, U^{236}, and U^{238}. No significant quantities of these radionuclides were released.

b. Building 004 – NRC and California State Licensed Activities

Operations at Building 004 which may generate radioactive effluents consist of research studies in physics and chemistry, and the chemical analysis of small quantities of fuel materials, usually limited to a few grams. Only atmospherically discharged effluents are released from the building to uncontrolled areas. Liquid laboratory wastes are released to a proportional sampler installation which retains an aliquot of wastewater each time a fixed volume is released to the facility sanitary sewage system. The aliquots are composited and analyzed for radioactivity. Nuclear fuel material handled in unencapsulated form in this facility contains the uranium isotopes U^{234}, U^{235}, U^{236}, and U^{238}. Major quantities of other radionuclides in encapsulated form include Co^{60} and Pm^{147}. No significant quantities of these radionuclides were released. The monitoring of Headquarters Site sewage effluent for tritium commenced during December. The tritium in water concentration for the initial sampling period was 4.6×10^{-6} μCi/ml equivalent to 0.15% of the unrestricted area release guide value.

TABLE 11

LIQUID EFFLUENT DISCHARGED TO SANITARY SEWER – 1977

Building	Point of Release	Approximate Effluent Volume (gal)	Activity Monitored	Approximate MDL (μCi/mℓ)	Annual Average Concentration (μCi/mℓ)	Sample Maximum Observed Concentration (μCi/mℓ)	Total Radioactivity Released (Ci)
001	Retention Tank	1,500	α	1.2×10^{-9}	5.5×10^{-8}	5.5×10^{-8}	3.1×10^{-7}
			β	4.1×10^{-9}	6.5×10^{-8}	6.5×10^{-8}	3.7×10^{-7}
004	Proportional Sampler	1,408,200	α	1.2×10^{-9}	$<1.8 \times 10^{-8}$	1.9×10^{-7}	$<9.8 \times 10^{-5}$
			β	4.1×10^{-9}	$<1.0 \times 10^{-7}$	5.8×10^{-6}	$<5.4 \times 10^{-4}$
020*	–	0	–	–	–	–	0
021 - 022*	–	0	–	–	–	–	0
055*	–	0	–	–	–	–	0

*All liquid radioactive wastes are solidified and land buried as dry waste.

2. Atomics International - Santa Susana Field Laboratories

a. Building 020 — NRC and California State Licensed Activities

Operations at Building 020 which may generate radioactive effluents consist of hot cell examination of irradiated nuclear fuels and reactor components. Only atmospherically discharged effluents are released from the building to uncontrolled areas. The effluent may contain particulate material, as well as radioactive gases, depending on the operations being performed and the history of the irradiated fuel and other material. The chemical form of such materials may be U metal, UO_2, UC, mixed fission products, and various activation products. No radioactive liquid waste is released from the facility. Radioactive material handled in unencapsulated form in this facility includes the following radionuclides: Th^{232}, U^{233}, U^{234}, U^{235}, U^{236}, and U^{238} as constituents in the various fuel materials; and Cs^{137}, Sr^{90}, Kr^{85}, and Pm^{147} as mixed fission products. No significant quantities of these radionuclides were released.

b. Building 021 - 022 — DOE Contract Activities

Operations at Buildings 021 and 022 which may generate radioactive effluents consist of the processing, packaging, and temporary storage of liquid and dry radioactive waste material for disposal. Only atmospherically discharged effluents are released from the building to uncontrolled areas. No radioactive liquid waste is released from the facility. Nuclear fuel material handled in encapsulated or unencapsulated form contains the uranium isotopes U^{234}, U^{235}, U^{236}, U^{238}, plus Cs^{137}, Sr^{90}, and Pm^{147} as mixed fission products. No significant quantities of these radionuclides were released.

c. Building 055 — NRC and California State Licensed Activities

Operations at Building 055 which may generate radioactive effluents consist of fabrication of plutonium and plutonium-uranium fuel pins. Only atmospherically discharged effluents are released from the facility to uncontrolled areas. No radioactive liquid waste is released from the facility.

The various fuel materials (depleted and enriched uranium and plutonium) contain the following radionuclides: U^{234}, U^{235}, U^{236}, U^{238}, Pu^{238}, Pu^{239}, Pu^{240}, Pu^{241}, and Am^{241}. No significant quantities of these radionuclides were released.

APPENDIX A
COMPARISON OF ENVIRONMENTAL RADIOACTIVITY DATA FOR 1977 WITH PREVIOUS YEARS

This section compares environmental monitoring results for the calendar year 1977 with previous annual data.

The data presented in Tables A-1 through A-5 summarize all past annual average radioactivity concentrations. These data show the effects of both the short-lived and long-lived radioactive fallout from nuclear weapons tests superimposed on the natural radioactivity inherent in the various sample types.

Over the considerable period of time 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 is seen to occur in 1971. This increase is observed in both the on-site and the off-site samples and resulted from use of an improved counting system with a thinner sample configuration. The thinner sample increases the sensitivity of the detector to alpha-emitting radionuclides in the sample, thus producing a higher measured specific activity.

Similarly, prior to 1971, gross activity in ambient air was measured, including both alpha and beta activity. In 1971, measurements were begun which allowed separate identification of these two types of activity.

The types of random variations observed in the data indicate that there is no local source of unnatural radioactivity in the environment. Also, the similarity between on-site and off-site results further indicate that the contribution to general environmental radioactivity due to operations at Atomics International is essentially nonexistent.

TABLE A-1

SOIL RADIOACTIVITY DATA – 1957 THROUGH 1977

Year	On Site – Average (10^{-6} μCi/g)			Off Site – Average (10^{-6} μCi/g)		
	Number Samples	α	β	Number Samples	α	β
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
1969	144	0.42	27	48	0.42	25
1968	144	0.47	26	48	0.48	26
1967	144	0.42	28	48	0.39	24
1966	144	0.41	29	48	0.44	25
1965	144	0.46	36	142	0.47	29
1964	152	0.46	32	299	0.44	26
1963	156	0.43	45	455	0.42	42
1962	147	0.44	48	453	0.41	47
1961	120	0.37	34	458	0.33	23
1960	115	0.41	23	362	0.37	19
1959	107	0.43	15	377	0.32	14
1958	80	0.27	21	309	0.26	10
1957	64	0.32	11	318	0.35	10

TABLE A-2

VEGETATION RADIOACTIVITY DATA – 1957 THROUGH 1977

Year	On Site – Average (10^{-6} μCi/g ash)			Off-Site – Average (10^{-6} μCi/g ash)		
	Number Samples	α	β	Number Samples	α	β
1977	144	<0.22	162	48	<0.21	142
1976	144	<0.19	170	48	<0.22	147
1975	144	<0.21	155	48	<0.21	141
1974	144	<0.20	152	48	<0.27	141
1973	144	<0.24	155	48	<0.24	142
1972	144	0.23	145	48	0.36	125
1971	144	0.24	165	48	0.31	132
1970	144	0.33	159	48	0.30	142
1969	144	0.40	165	48	0.36	144
1968	144	0.51	158	48	0.51	205
1967	144	0.62	286	48	0.39	413
1966	144	0.37	169	48	0.37	123
1965	144	0.56	162	142	0.61	138
1964	154	0.50	211	293	0.51	181
1963	156	0.44	465	456	0.37	388
1962	147	0.45	500	453	0.44	406
1961	120	0.35	224	459	0.29	246
1960	115	0.35	137	362	0.25	136
1959	96	0.29	212	293	0.18	168
1958	65	0.57	683	250	0.39	356
1957	58	1.1	208	304	0.89	200

TABLE A-3

SSFL PROCESS WATER RADIOACTIVITY DATA–
1957 THROUGH 1977

Year	Number Samples	Average α (10^{-9} μCi/ml)	Average β (10^{-9} μCi/ml)
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
1969	24	0.11	5.0
1968	24	0.16	5.0
1967	24	0.13	6.1
1966	24	0.13	4.6
1965	24	0.22	6.0
1964	23	0.18	5.3
1963	24	0.18	7.0
1962	24	0.21	12.0
1961	24	0.08	2.9
1960	22	0.08	1.9
1959	18	0.08	1.6
1958	13	0.16	4.7
1957	17	–	13.0

TABLE A-4

BELL CREEK AND ROCKETDYNE RETENTION POND RADIOACTIVITY DATA – 1966 THROUGH 1977

Year	Samples														
	Bell Creek Mud 54			Bell Creek Vegetation 54			Bell Creek Water 16			Retention Pond No. 6 Water			Retention Pond No. 12 Water		
	No. Samples	Average (10^{-6} μCi/g)		No. Samples	Average (10^{-6} μCi/g ash)		No. Samples	Average (10^{-9} μCi/mℓ)		No. Samples	Average (10^{-9} μCi/mℓ)		No. Samples	Average (10^{-9} μCi/mℓ)	
		α	β		α	β		α	β		α	β		α	β
1977	12	0.29	22.	12	<0.19	155.	12	<0.24	1.8	12	<0.24	4.3	12	<0.25	5.2
1976	12	0.38	23.	12	<0.17	164.	12	<0.25	2.2	12	<0.24	4.3	12	<0.28	4.4
1975	12	0.29	22.	12	<0.19	123.	12	<0.22	2.4	12	<0.24	4.2	12	<0.31	4.5
1974	12	0.32	22.	12	<0.16	142.	12	<0.21	2.5	12	<0.22	4.2	12	<0.21	4.5
1973	12	0.34	24.	12	<0.17	147.	12	<0.21	2.7	12	<0.23	4.5	12	<0.37	5.6
1972	12	0.32	22.	12	0.12	139.	12	0.20	2.5	12	0.22	5.3	12	0.22	5.5
1971	12	0.36	23.	12	0.19	128.	12	0.15	3.8	12	0.18	6.2	12	0.16	6.4
1970	12	0.44	24.	12	0.23	165.	12	0.15	3.7	12	0.15	6.9	12	0.12	7.4
1969	12	0.35	27.	12	0.28	166.	12	0.04	4.0	12	0.07	5.9	11	0.10	5.7
1968	11	0.32	24.	11	0.39	170.	8	0.05	4.6	11	0.23	8.1	12	0.33	7.7
1967	12	0.40	24.	12	0.38	180.	12	0.07	5.8	12	0.19	6.6	10	0.17	7.0
1966	3	0.39	25.	3	1.1	108.	3	0.75	2.5	9	0.11	5.8	8	1.1	6.3

TABLE A-5

AMBIENT AIR RADIOACTIVITY DATA –
1957 THROUGH 1977

Year	Headquarters Average (10^{-12} μCi/mℓ)			SSFL Average (10^{-12} μCi/mℓ)		
	Number Samples	α	β	Number Samples	α	β
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
1969	687	–	0.27	2364	–	0.26
1968	650	–	0.32	2157	–	0.32
1967	712	–	0.39	2400	–	0.41
1966	706	–	0.18	2205	–	0.17
1965	483	–	0.83	1062	–	0.21
1964	355	–	2.7	–		†
1963	360	–	6.6	292	–	4.7
1962	343	–	7.3	314	–	5.6
1961	313	–	4.2	176	–	3.6
1960	182	–	0.24	44	–	0.44
1959	215	–	2.5	257	–	0.93
1958	366	–	4.9	164	–	2.7
1957	63	–	1.6	141	–	2.7

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

†Insufficient data

APPENDIX B

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD CRITERIA FOR DISCHARGING NONRADIOACTIVE CONSTITUENTS FROM ROCKETDYNE DIVISION, SSFL

The discharge of an effluent in excess of the following limits given in Table B-1 is prohibited.

TABLE B-1

NPDES NO. CA0001309, EFFECTIVE SEPTEMBER 27, 1976

Constituent	Discharge Rate (lb/day)	Concentration Limit (mg/ℓ)	
	30-day Average	30-day Average	Maximum
Total Dissolved Solids	1,267,680	—	950
Chloride	200,160	—	150
Sulfate	400,320	—	300
Suspended Solids*	66,720	50	150
Settleable Solids*	—	0.1	0.3
BOD 20 °C	26,690	20	60
Oil and Grease	13,350	10	15
Chromium	6.67	0.005	0.01
Fluoride	1,340	—	1.0
Boron	1,340	—	1.0
Residual Chlorine	—	—	0.1
Fecal Coliform (MPN/100 mℓ)	—	—	23
Surfactants (as MBAS)	667	—	0.5
pH			6.0-9.0

*Not applicable to discharges containing rainfall runoff during or immediately after periods of rainfall.

APPENDIX C
REFERENCES

1. DOE Manual Chapter 0513
2. DOE Manual Chapter 0524, Appendix
3. Code of Federal Regulations, Title 10, Part 20
4. California Radiation Control Regulations, California Administrative Code, Title 17, Public Health
5. California Regional Water Quality Control Board, Los Angeles Region, Order No. 74-379, NPDES No. CA0001309, Effective September 27, 1976

APPENDIX D
EXTERNAL DISTRIBUTION

1. Radiologic Health Section, State Department of Public Health, California
2. Radiological Health Division, Los Angeles County Health Department, California
3. Environmental Health Division, Environmental Resource Agency, Ventura County, California
4. U.S. Department of Energy, San Francisco Operations Office
5. U.S. Nuclear Regulatory Commission, Division of Reactor Licensing
6. Gordon Facer, Division of Military Applications, DOE
7. Andrew J. Pressesky, Reactor Research and Development, DOE
8. James Miller, Division of Biomedical and Environmental Research, DOE
9. DOE-Headquarters Library, Attention: Charles Sherman