ENERGY SYSTEMS GROUP ENVIRONMENTAL MONITORING AND FACILITY EFFLUENT ANNUAL REPORT 1980

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ABSTRACT

Environmental and facility effluent radioactivity monitoring at the Energy Systems Group (ESG) of Rockwell International (California operations) is performed by the Radiation and Nuclear Safety Group of the Health, Safety and Radiation Services Department. Soil, vegetation, and surface water are routinely sampled to a distance of 10 miles from ESG sites. Continuous ambient air sampling and radiation monitoring by thermoluminescent dosimetry are performed on-site for measuring airborne radioactivity concentrations and site ambient radiation levels. Radioactivity in emissions discharged to the atmosphere from ESG facilities is continuously sampled and monitored to ensure that levels released to unrestricted areas are within appropriate limits and to identify processes that may require additional engineering safeguards to minimize radioactivity levels in such discharges. In addition, selected nonradioactive constituent concentrations in surface water discharged to unrestricted areas are determined. This report summarizes and discusses monitoring results for 1980.

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 of ESG 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.

I. INTRODUCTION

The Energy Systems Group (ESG) of Rockwell International Corporation has been engaged in nuclear energy research and development since 1946. ESG 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 and research 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, production of gaseous and liquid fuels from coal, and solar and ocean thermal energy development.

The administrative, scientific research, and manufacturing facilities (Figure 1) are located in Canoga Park, California, approximately 23 miles northwest of downtown Los Angeles. The site is level, typical of the San Fernando Valley floor. Certain nuclear programs, under licenses issued by the Nuclear Regulatory Commission (NRC) and the State of California, are conducted here. These include (1) Building 001 uranium fuel production facilities and (2) Building 004 analytical chemistry laboratories and a gamma irradiation facility. The 290-acre Santa Susana Field Laboratories (SSFL) site (Figure 2) is located in the Simi Hills of Ventura County, approximately 23 miles northwest of downtown Los Angeles. The SSFL site, situated in rugged terrain typical of mountain areas of recent geological age, is underlain by the Chico formation, which is Upper Cretacious in age. The site may be described as an irregular plateau sprinkled with outcroppings above the more level patches and with peripheral eroded gullies. Elevations of the site vary from 1650 to 2250 ft above sea level. The surface mantle consists of sand and clay soil on sandstone. Both Department of Energy (DOE) and ESG owned facilities share this site, shown in Figure 3. The SSFL also contains facilities in which nuclear operations licensed by NRC and the State are conducted. The licensed facilities include: (1) the Rockwell International Hot Laboratory (RIHL), 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-ray and radioisotope radiography inspection facilities. The location of these sites in relation to nearby communities is shown in Figure 4.

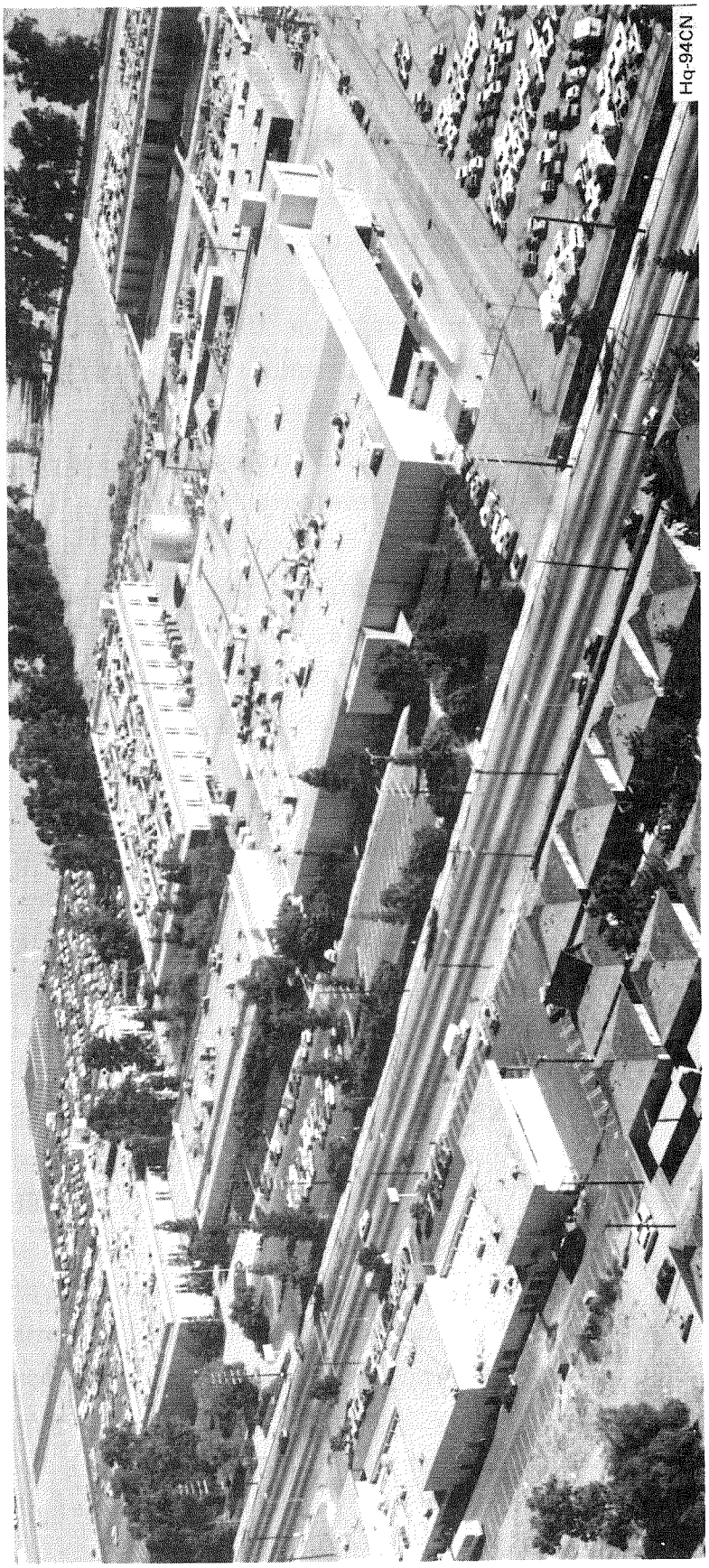

Figure 1. Energy Systems Group — De Soto Site

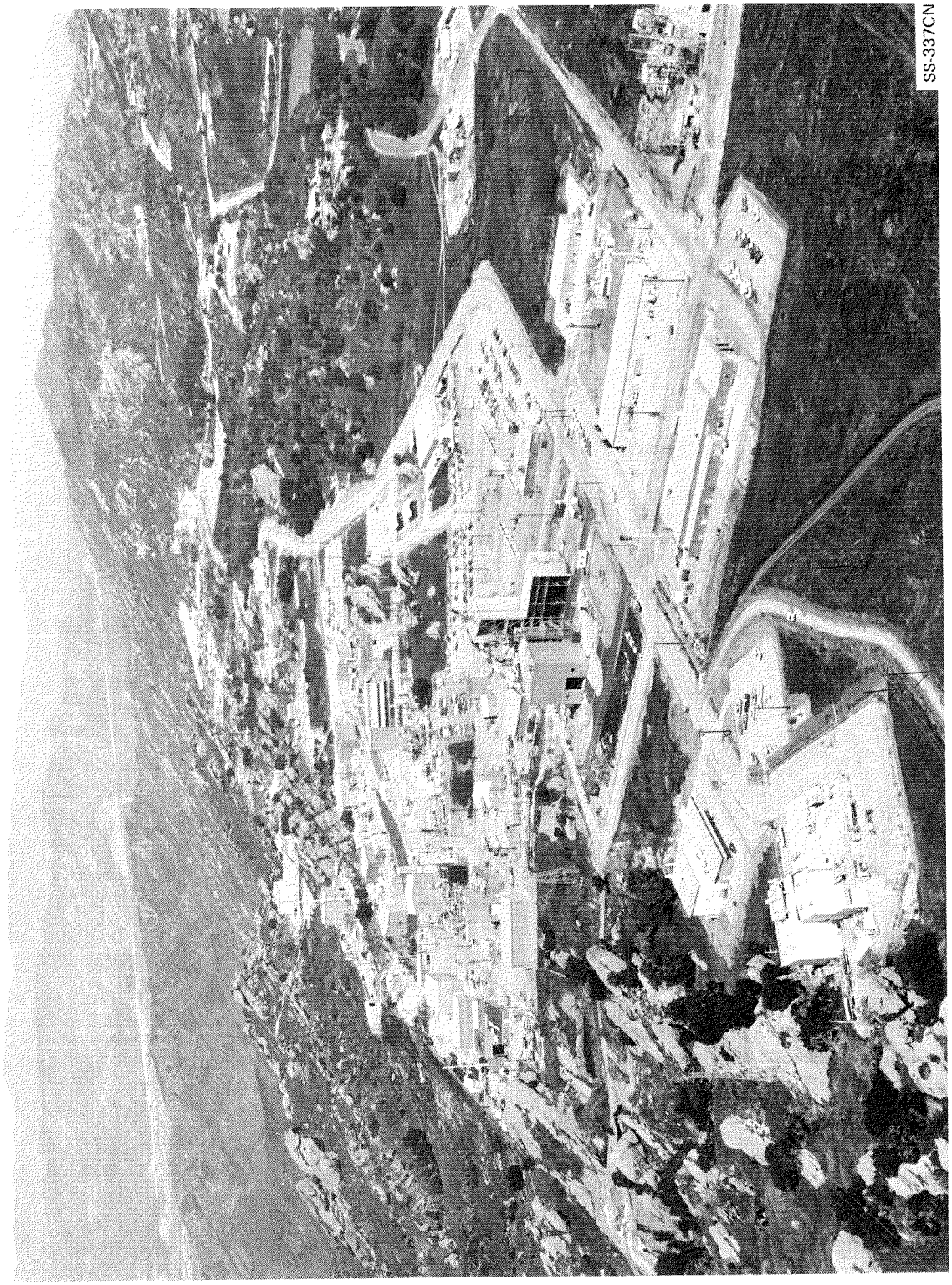

Figure 2. Energy Systems Group — Santa Susana Field Laboratories Site

ENERGY SYSTEMS GROUP
SANTA SUSANA FIELD LABORATORY

OCTOBER 1980

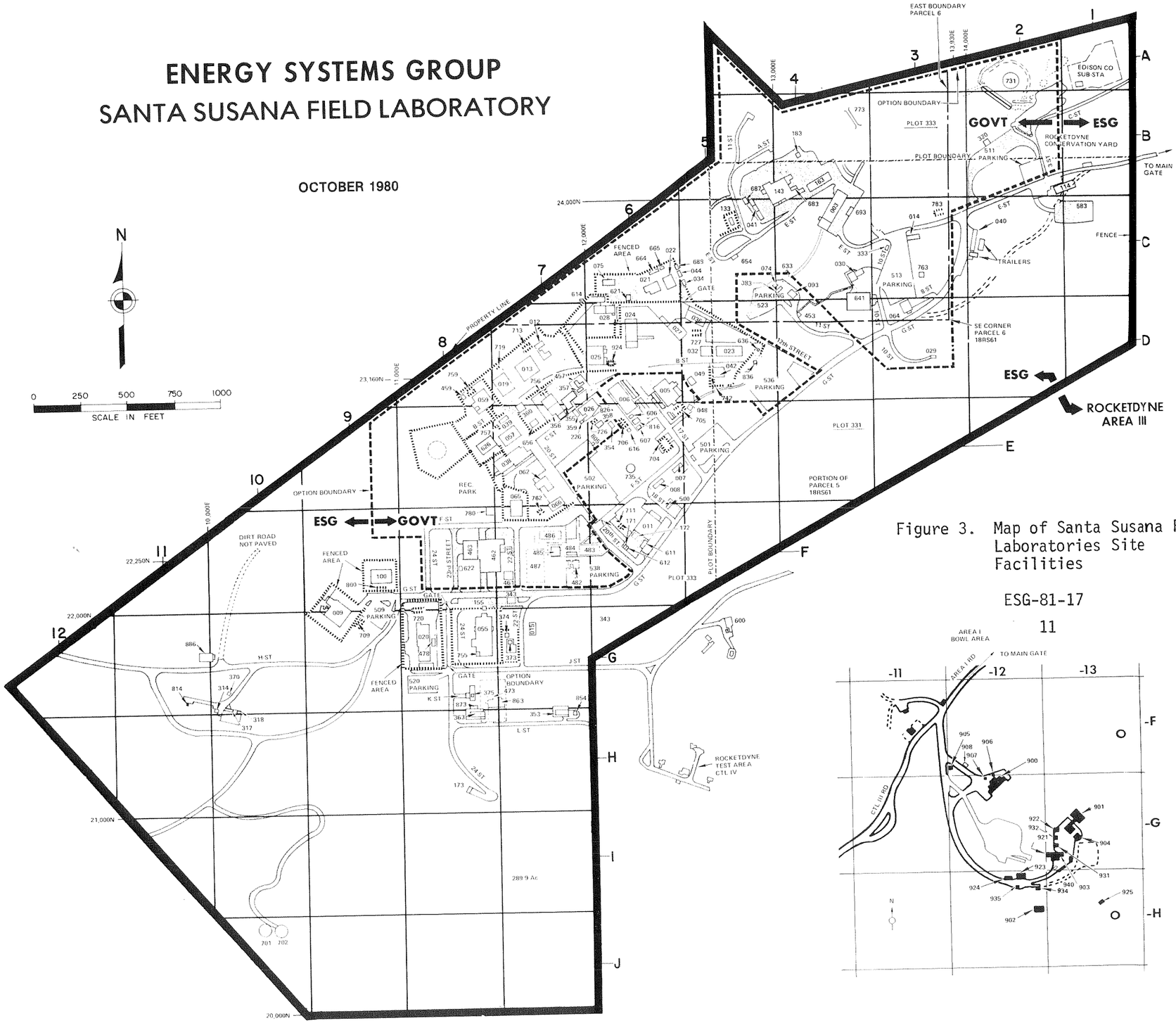

Figure 3. Map of Santa Susana Field Laboratories Site Facilities

ESG-81-17

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OWNED	ZONE	BUILDING NUMBER	DESCRIPTION
ROCKWELL/GOVT.	4C	003	EXCESS EQUIPMENT STORAGE
ROCKWELL	6D	005	ENVIRONMENTAL SYSTEMS
ROCKWELL	6D	006	SODIUM LABORATORY
ROCKWELL	6E	007	SODIUM STORAGE
ROCKWELL	6E	008	FLAMMABLE MATERIAL STORAGE
ROCKWELL	9G	009	ENGINEERING DEVELOPMENT FACILITY
ROCKWELL	6F	011	MANUFACTURING SUPPORT SHOP
GOVT	7D	012	TOOL CRIB – ETEC OPERATIONS
GOVT.	7D	013	THERMAL TRANSIENT FACILITY
GOVT.	3C	014	SODIUM STORAGE BUILDING
ROCKWELL	7G	015	SUPPLEMENTARY STORAGE BUILDING
GOVT.	7D	019	ETEC CONSTRUCTION STAGING
ROCKWELL	8G	020	ENERGY SYSTEMS GROUP HOT LABORATORY
GOVT.	6C	021	RADIOACTIVE WASTE, DECONTAMINATION AND PACKAGING BUILDING
GOVT.	6C	022	RADIOACTIVE WASTE STORAGE VAULT BUILDING
GOVT.	5D	023	LIQUID METALS CHEMISTRY LABORATORY
GOVT.	6D	024	DEVELOPMENT TEST BUILDING
GOVT.	6D	025	ETEC INSTRUMENTATION & INVENTORY STORAGE
GOVT.	6E	026	SMALL COMPONENT TEST LOOP CONTROL BUILDING
GOVT.	6D	027	ETEC QUALITY ASSURANCE
GOVT.	6D	028	LMFBR FUEL SAFETY
GOVT.	3D	029	SODIUM STORAGE
GOVT.	4C	030	SITE PURCHASING OFFICE
GOVT.	5D	032	ETEC GENERAL TEST
GOVT.	5C	034	R/A WASTE OFFICE BUILDING
GOVT.	5D	036	ETEC OPERATIONS
GOVT.	7E	038	ETEC ADMINISTRATION
GOVT.	7E	039	OFFICE BUILDING
ROCKWELL	2C	040	FACILITIES AND INDUSTRIAL ENGINEERING
GOVT.	5C	041	STORAGE BUILDING
GOVT.	5D	042	LMFBR TEST
GOVT.	6C	044	RMDF CLEAN SHOP
ROCKWELL	6E	048	PDU INSTRUMENTATION BUILDING
GOVT	6D	049	PDU CONTROL ROOM
ROCKWELL	8G	055	PLUTONIUM FACILITY
GOVT.	7E	057	ETEC LABORATORY
GOVT	8D	059	LARGE LEAK TEST RIG
GOVT.	7E	062	ETEC INSTRUMENTATION
GOVT.	3D	064	SOURCE AND SPECIAL NUCLEAR MATERIAL STORAGE
GOVT.	7E	065	ETEC CHEMISTRY LABORATORY
GOVT.	7E	066	INSTRUMENTATION REPAIR AND CALIBRATION BUILDING ETEC
ROCKWELL	4C	074	STORAGE BUILDING
GOVT	6C	075	CONTAMINATED EQUIPMENT STORAGE BUILDING
ROCKWELL	4C	083	CONTROL BUILDING – NEUTRON RADIOGRAPHY BUILDING
ROCKWELL	4C	093	NEUTRON RADIOGRAPHY BUILDING
ROCKWELL	9F	100	ADVANCED FUELS LABORATORY
ROCKWELL	2B	114	DECON TRAILER
GOVT.	5C	133	SODIUM BURN FACILITY
ROCKWELL	4B	143	SODIUM REACTOR EXPERIMENT – D&D
GOVT.	8G	155	CONTROL CENTER
ROCKWELL	4B	163	BOX SHOP
ROCKWELL	6F	171	STORAGE BUILDING
ROCKWELL	6F	172	X RAY BUILDING
ROCKWELL	8H	173	GAMMAGRAPH BUILDING
ROCKWELL	4B	183	FIRE PUMP BUILDING – D&D
GOVT.	7E	226	SCTL MG BUILDING
ROCKWELL	10G	314	LARGE LEAK INJECTOR DEVICE (LLID) TEST CONTROL BUILDING
GOVT.	10F	317 & 318	PISTOL RANGE
GOVT.	2B	320	FUEL OIL CONTROL BUILDING
ROCKWELL	3C	333	TIME CLOCK BUILDING
ROCKWELL	7G	343	TIME CLOCK BUILDING
ROCKWELL	7H	353	RESEARCH AND DEVELOPMENT LABORATORY BUILDING
GOVT.	6E	354	CONTROL ELEMENT TEST STRUCTURE
GOVT.	7D	355	SCTI SUPPORT BUILDING
GOVT.	7D	356	SODIUM COMPONENT TEST INSTALLATION
GOVT.	7D	357	ETEC PUMP BEARING TEST FACILITY CONTROL BUILDING
GOVT.	6E	358	SCTL SUPPORT BUILDING
GOVT.	7E	359	COMPRESSOR BUILDING
GOVT.	7E	360	CHEMICAL STORAGE BUILDING
ROCKWELL	8H	363	RESEARCH AND DEVELOPMENT LABORATORY BUILDING
ROCKWELL	7G	373	DEVELOPMENT TEST BUILDING
GOVT.	7G	374	TEST LOOP ENCLOSURE
ROCKWELL	8G	375	CONTROL SHELTER BUILDING
ROCKWELL	4D	453	NEUTRON RADIOGRAPHY STORAGE
GOVT.	7D	457	PUMP BEARING TEST STRUCTURE
GOVT.	8D	459	UNINTERRUPTIBLE POWER SUPPLY
GOVT.	7E	461	MOTOR GENERATOR BUILDING
GOVT.	8F	462	SODIUM PUMP TEST FACILITY
GOVT.	8F	463	CMCF
ROCKWELL	8G	473	HYDRAULIC TEST INSTRUMENTATION BUILDING
ROCKWELL	8G	478	RADIOACTIVE HOLDUP TANK
GOVT	7F	482	GOVERNMENT PROJECT OFFICES
GOVT.	7F	483	ETEC OFFICE COMPLEX
GOVT.	7F	484	REST ROOM – TRAILER
GOVT.	7F	485	ETEC OFFICE COMPLEX
GOVT.	7F	486	ETEC OFFICE COMPLEX
ROCKWELL	7F	487	ETEC OFFICE BUILDING
ROCKWELL	6F	500	COMPRESSED GAS BOTTLE STORAGE DOCK
ROCKWELL	5E	501	PARKING LOT
ROCKWELL	7E	502	PARKING LOT
ROCKWELL	9G	509	PARKING LOT
ROCKWELL	2B	511	PARKING LOT
GOVT	3C	513	PARKING LOT
ROCKWELL	8G	520	PARKING LOT
ROCKWELL	5C	523	PARKING LOT
ROCKWELL	5D	536	PARKING LOT
GOVT	6F	538	PARKING LOT
ROCKWELL	7G	573	PARKING LOT
ROCKWELL	2B	583	CONSERVATION STORAGE YARD
ROCKWELL	5F	600	SEWAGE TREATMENT PLANT
ROCKWELL	6E	606	HYDROGEN RECOMBINER TEST
ROCKWELL		607	STORAGE
ROCKWELL	6F	611	PAINT SPRAY BOOTH
ROCKWELL	6F	612	STORAGE BUILDING
GOVT	7G	614	DRAINAGE SUMP
ROCKWELL	6E	616	COOLING TOWER
GOVT	6C	621	RADIOACTIVE ACCOUNTABLE WASTE STORAGE BUILDING
GOVT.	8F	622	SMALL PARTS CLEANING PAD
ROCKWELL	2B	623	GUARD POST NO. 1
GOVT	8E	626	ETEC INVENTORY STORAGE
ROCKWELL	4C	633	REACTOR COOLING WATER PAD
GOVT	5D	636	GUARD POST
GOVT.	6C	641	RECEIVING & STORAGE BUILDING
GOVT.	5C	654	INTERIM RADIOACTIVE WASTE – D&D
GOVT.	7E	656	SCTI COOLING TOWER
GOVT.	6C	664	LOW LEVEL RADIOACTIVE WASTE PROCESSING
GOVT.	6C	665	RMDF OXIDATION FACILITY
GOVT.	4C	683	ELECTRICAL SUBSTATION
GOVT.	C5	687	LOADING DOCK
GOVT.	6C	688	AUXILIARY SKID BUILDING
GOVT	4C	693	ELECTRICAL SUBSTATION NO. 1
ROCKWELL	10J	701	WATER TANK (DEER FLATS)
ROCKWELL	10J	702	WATER TANK (DEER FLATS)
GOVT	6E	704	ELECTRICAL SUBSTATION
ROCKWELL	6E	705	ELECTRICAL SUBSTATION
ROCKWELL	6E	706	ELECTRICAL SUBSTATION
ROCKWELL	9G	709	ELECTRICAL SUBSTATION
ROCKWELL	6F	711	ELECTRICAL SUBSTATION
GOVT.	7D	713	ELECTRICAL SUBSTATION
GOVT.	7D	719	ELECTRICAL SUBSTATION
ROCKWELL	8G	720	ELECTRICAL SUBSTATION
GOVT.	6D	725	ELECTRICAL SUBSTATION
GOVT	7D	726	ELECTRICAL SUBSTATION
GOVT	6D	727	ELECTRICAL SUBSTATION
ROCKWELL	10G	730	STORAGE SHED
GOVT.	2A	731	1.5M FUEL OIL STORAGE TANK
GOVT.	6E	735	86K FUEL OIL STORAGE DAY TANK
GOVT.	5D	742	ELECTRICAL SUBSTATION
ROCKWELL	8G	755	ELECTRICAL SUBSTATION
GOVT	7D	756	ELECTRICAL SUBSTATION
GOVT.	8E	757	ELECTRICAL SUBSTATION
GOVT.	8D	759	ELECTRICAL SUBSTATION
GOVT.	7F	762	ELECTRICAL SUBSTATION
GOVT.	3C	763	ELECTRICAL SUBSTATION
GOVT.	4B	773	DRAINAGE CONTROL DAM
GOVT.	8F	780	ELECTRICAL SUBSTATION
SCE	3C	783	ELECTRICAL SUBSTATION
ROCKWELL	9F	800	ELECTRICAL SUBSTATION
ROCKWELL	7E	805	TIME CLOCK BUILDING
ROCKWELL	11G	814	LARGE LEAK INJECTOR DEVICE
ROCKWELL	6E	816	RECOMBINER CANOPY
GOVT.	6E	826	SCTL TEST BAY
ROCKWELL	5D	836	TIME CLOCK BUILDING
GOVT	7H	854	TEST STRUCTURE
ROCKWELL	7H	863	HYDRAULIC TEST FACILITY
ROCKWELL	8G	873	HYDRAULIC TEST LABORATORY
ROCKWELL	11G	886	SODIUM DISPOSAL FACILITY
			BOWL AREA – LOCATED ROCKETDYNE AREA
ROCKWELL	G-12	900	CONTROL CENTER
ROCKWELL	G-13	901	PRE TEST – BOWL
ROCKWELL	H-12	902	PLUME STUDY BUILDING
ROCKWELL	G-13	903	INSTRUMENT AND WORKSHOP
ROCKWELL	G-13	904	POWER CONTROL
ROCKWELL	F-12	905	OFFICE TRAILER CONV. B 046
ROCKWELL	F-12	906	CHANGE ROOM
ROCKWELL	G-12	907	SUBSTATION
ROCKWELL	F-12	908	WORKSHOP
ROCKWELL	G-13	921	VTS I TEST STAND
ROCKWELL	G-13	922	VTS II TEST STAND
ROCKWELL	H-12	923	VTS III TEST STAND
ROCKWELL	H-12	924	STEAM PLANT BUILDING
ROCKWELL	H-13	925	FIREX PUMP HOUSE
ROCKWELL	G-13	931	ELECTRICAL BUILDING
ROCKWELL	G-13	932	ELECTRICAL BUILDING
ROCKWELL	H-12	934	VTS III CONTROL ROOM
ROCKWELL	H-12	935	VTS III SUBSTATION
ROCKWELL	G-13	940	CONSTRUCTION TRAILER (TEMP.)

Figure 4. Map of General Los Angeles Area
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Also included within the SSFL site is an 82-acre government-optioned area where DOE contract activities are conducted, primarily by the nonnuclear Energy Technology Engineering Center (ETEC). 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 packaging 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 that had been used for SNAP (Systems for Nuclear Auxiliary Power) reactor test operations, Buildings 024 and 059, and the Sodium Reactor Experiment (SRE), Building 143. No fissile material is located at any of these facilities.

Licensed programs conducted during 1980 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 RIHL 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 enriched uranium, and the development of processes for the fabrication of advanced fuels.

The basic policy for control of radiological and chemical hazards at ESG requires that, through engineering controls, adequate containment of such materials be provided and that, through rigid operational controls, facility effluent releases and external radiation levels be reduced to a minimum. The environmental monitoring program provides a measure of the effectiveness of the Group safety procedures and of the engineering safeguards incorporated into facility designs. Specific radionuclides in facility effluent or environmental samples are not routinely identified due to the extremely low radioactivity levels normally detected, but would 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 emissions are continuously monitored or sampled, as appropriate. This provides a direct measure of 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 boundaries of ESG sites are referred to as "on-site" stations; those located within a 10-mile radius of a site are referred to as "off-site" stations. The on-site environs of the De Soto and SSFL sites are sampled monthly to determine the concentration of radioactivity in typical surface soil, vegetation, and water. Soil is sampled on-site semiannually for plutonium analysis. Similar off-site environmental samples, except for plutonium analysis, are obtained quarterly. Continuous on-site and off-site ambient air sampling provides information concerning long-lived airborne particulate radioactivity. On-site ambient radiation monitoring utilizing thermoluminescent dosimetry (TLD), begun in 1971, measures radiation levels in the environs of both the De Soto and SSFL sites and at several off-site locations.

Nonradioactive wastes discharged to unrestricted 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 unrestricted areas. Liquid wastes generated at the De Soto site are discharged into the city sewage system. This effluent is sampled to determine radioactivity. Sanitary sewage from all DOE and ESG facilities at the SSFL site is treated at an on-site sewage plant. The plant outfall drains into retention pond R-2A, located on the adjoining Rocketdyne Division site. The surface water drainage system of the SSFL is composed of catch ponds and open drainage ditches leading to retention pond R-2A. 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 monitored at discharge for radioactive and 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 1980. A comparison of 1980 radioactivity results with results from previous years appears in Appendix A.

II. ENVIRONMENTAL MONITORING SUMMARY RESULTS

A. RADIOACTIVE MATERIALS — 1980

The sampling and analytical 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 1980 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. None of the maximum observed values, which occurred randomly during the year as shown in the tables, shows a great increase over the average values beyond natural variability. The ambient air sampling data show no greatly increasing or decreasing trends for most of the year and can be described as generally constant with some increase in local airborne radioactivity levels occurring during the fourth quarter.

The results reported in Tables 1-A and 2 show no significant difference between on-site and off-site samples. Table 1-B shows no significant variation in soil plutonium concentrations for the 1980 sample sets. 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. One atmospheric test in the northern hemisphere

TABLE 1-A

SOIL RADIOACTIVITY DATA — 1980

Area	Activity	No. Samples	Gross Radioactivity (μCi/g)	
			Annual Average Value (95% Confidence Level)	Maximum Observed Value* and Month Observed
On Site	α	144	$(6.0 \pm 1.5)\ 10^{-7}$	11.4×10^{-7} (January)
	β	144	$(2.4 \pm 0.1)\ 10^{-5}$	11.0×10^{-5} (January)
Off Site	α	48	$(5.8 \pm 1.5)\ 10^{-7}$	10.3×10^{-7} (April)
	β	48	$(2.3 \pm 0.1)\ 10^{-5}$	3.0×10^{-5} (October)

*Maximum value observed for single sample.

TABLE 1-B

SOIL PLUTONIUM RADIOACTIVITY DATA — 1980

Sample Location	9 July 1980 Survey Results		22 December 1980 Survey Results	
	Pu^{238} (μCi/g)	$Pu^{239} + Pu^{240}$ (μCi/g)	Pu^{238} (μCi/g)	$Pu^{239} + Pu^{240}$ (μCi/g)
S-56	$(0.7 \pm 2.4)\ 10^{-9}$	$(0.5 \pm 1.3)\ 10^{-9}$	$(-0.8 \pm 1.4)\ 10^{-9}$	$(13.0 \pm 3.0)\ 10^{-9}$
S-57	$(1.4 \pm 3.4)\ 10^{-9}$	$(9.5 \pm 4.8)\ 10^{-9}$	$(-0.3 \pm 2.3)\ 10^{-9}$	$(5.6 \pm 3.2)\ 10^{-9}$
S-58	$(-0.2 \pm 2.4)\ 10^{-9}$	$(1.6 \pm 2.0)\ 10^{-9}$	$(0.4 \pm 3.1)\ 10^{-9}$	$(9.9 \pm 4.6)\ 10^{-9}$
S-59	$(-1.2 \pm 2.3)\ 10^{-9}$	$(8.2 \pm 3.8)\ 10^{-9}$	$(-0.8 \pm 2.1)\ 10^{-9}$	$(4.2 \pm 2.7)\ 10^{-9}$
S-60	$(-1.1 \pm 1.9)\ 10^{-9}$	$(1.7 \pm 1.8)\ 10^{-9}$	$(-1.6 \pm 1.7)\ 10^{-9}$	$(29.5 \pm 6.5)\ 10^{-9}$

Note: Minus (-) indicates sample value less than reagent blank.

was announced during 1980. 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}.

TABLE 2

VEGETATION RADIOACTIVITY DATA — 1980

Area	Activity	No. Samples	Gross Radioactivity (μCi/g)			% of Samples with Activity <MDL
			Dry Weight Annual Average Value	Ash		
				Annual Average Value (95% Confidence Level)	Maximum Value* and Month Observed	
On Site	α	144	$(<3.1 \pm 2.1)\ 10^{-8}$	$(<2.5 \pm 1.7)\ 10^{-7}$	1.3×10^{-6} (January)	46
	β	144	$(2.1 \pm 0.04)\ 10^{-5}$	$(1.60 \pm 0.03)\ 10^{-4}$	2.71×10^{-4} (November)	0
Off Site	α	48	$(<4.2 \pm 3.3)\ 10^{-8}$	$(<1.9 \pm 1.5)\ 10^{-7}$	5.2×10^{-7} (October)	44
	β	48	$(3.1 \pm 0.06)\ 10^{-5}$	$(1.42 \pm 0.03)\ 10^{-4}$	2.21×10^{-4} (January)	0

*Maximum value observed for single sample.

TABLE 3

SSFL SITE — DOMESTIC WATER RADIOACTIVITY DATA — 1980

Area	Activity	No. Samples	Gross Radioactivity (μCi/ml)	
			Average Value (95% Confidence Level)	Maximum* Value and Month Observed
ESG-SSFL	α	24	$(<2.2 \pm 2.7)\ 10^{-10}$	$<2.2 \times 10^{-10}$ (100% <MDL)
	β	24	$(2.4 \pm 0.7)\ 10^{-9}$	3.4×10^{-9} (February)

*Maximum value observed for single sample.

TABLE 4

BELL CREEK AND ROCKETDYNE SITE RETENTION POND
RADIOACTIVITY DATA — 1980

Area	Activity	No. Samples	Gross Radioactivity Concentration			
			Average Value (95% Confidence Level)	Maximum* Value and Month Observed	% of Guide†	% of Samples with Activity <MDL
Bell Creek Mud No. 54 (μCi/g)	α	12	$(5.1 \pm 1.4)\ 10^{-7}$	9.3×10^{-7} (February)	NA	0
	β	12	$(2.3 \pm 0.1)\ 10^{-5}$	3.0×10^{-5} (February)	NA	0
Pond R-2A Mud No. 55 (μCi/g)	α	12	$(5.1 \pm 1.4)\ 10^{-7}$	7.4×10^{-7} (December)	NA	0
	β	12	$(2.2 \pm 0.1)\ 10^{-5}$	2.4×10^{-5} (Jan & Nov)	NA	0
Bell Creek Vegetation No. 54 (μCi/g-ash)	α	12	$(<1.8 \pm 1.5)\ 10^{-7}$	3.6×10^{-7} (February)	NA	42
	β	12	$(1.50 \pm 0.03)\ 10^{-4}$	2.22×10^{-4} (January)	NA	0
Bell Creek Vegetation No. 54 (μCi/g dry weight)	α	12	$(<3.1 \pm 2.6)\ 10^{-8}$	1.1×10^{-7} (February)	NA	42
	β	12	$(2.4 \pm 0.1)\ 10^{-5}$	4.4×10^{-5} (February)	NA	0
Bell Creek Water No. 16 (μCi/ml)	α	12	$(<2.3 \pm 2.7)10^{-10}$	$<2.3 \times 10^{-10}$ (§)	<0.005	100
	β	12	$(2.9 \pm 0.8)\ 10^{-9}$	5.2×10^{-9} (October)	1.0	0
Pond Water No. 6 (μCi/ml)	α	12	$(<2.3 \pm 2.7)10^{-10}$	$<2.3 \times 10^{-10}$ (§)	<0.005	100
	β	12	$(2.9 \pm 0.7)\ 10^{-9}$	4.7×10^{-9} (November)	1.0	8
SSFL Pond R-2A Water No. 12 (μCi/ml)	α	12	$(<2.3 \pm 2.7)10^{-10}$	$<2.3 \times 10^{-10}$ (§)	<0.005	100
	β	12	$(3.9 \pm 0.8)\ 10^{-9}$	5.7×10^{-9} (November)	1.3	0

*Maximum value observed for single sample.
†Guide: 5×10^{-6} μCi/mlα, 3×10^{-7} μCi/mlβ; 20 CFR 20 Appendix B, CAC 17, DOE Manual Chapter 0524.
NA — not applicable, no Guide value having been established.
§All samples were <MDL for 1980.

TABLE 5

AMBIENT AIR RADIOACTIVITY DATA — 1980

Site Location	Activity	No. Samples	Average Value (95% Confidence Level)	Maximum* Value and Date Observed	% of Guide†	% of Samples with Activity <MDL
De Soto On Site (μCi/ml)	α§	685	$(<6.5 \pm 7.7)\ 10^{-15}$	4.5×10^{-14} (12/28)	<0.22	92
	β**	685	$(<3.9 \pm 1.4)\ 10^{-14}$	3.8×10^{-13} (12/25)	<0.013	47
SSFL On Site (μCi/ml)	α§	1611	$(<6.4 \pm 7.8)\ 10^{-15}$	2.5×10^{-14} (07/11)	<10.7	94
	β**	1611	$(<3.6 \pm 1.4)\ 10^{-14}$	4.5×10^{-13} (12/25)	<0.12	52
SSFL Sewage Treatment Plant Off Site (μCi/ml)	α§	366	$(<6.3 \pm 7.6)\ 10^{-15}$	1.8×10^{-14} (07/09)	<10.5	95
	β**		$(<3.2 \pm 1.6)\ 10^{-14}$	3.1×10^{-13} (12/25)	<0.11	63
SSFL Control Center Off Site (μCi/ml)	α§	365	$(<6.3 \pm 7.9)\ 10^{-15}$	2.0×10^{-14} (07/11)	<10.5	97
	β**		$(<3.7 \pm 1.4)\ 10^{-14}$	3.6×10^{-13} (12/25)	<0.12	62

*Maximum value observed for single sample.

†Guide: De Soto site, 3×10^{-12} μCi/mlα, 3×10^{-10} μCi/mlβ; 10 CFR 20 Appendix B, SSFL site, 6×10^{-14} μCi/mlα, 3×10^{-11} μCi/mlβ; 10 CFR 20 Appendix B, CAC 17, and DOE Manual Chapter 0524

§MDL = 6.1×10^{-15} μCi/ml — Individual daily samples with activity levels of 0 to 6.1×10^{-15} μCi/ml are recorded and averaged as 6.1×10^{-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 most data were below the minimum detection levels.

Domestic water used at the SSFL site is obtained from Ventura County Water District No. 17, which also supplies nearby communities, and is distributed on site by the same piping system previously used when all facility process water was obtained from on-site wells. Two on-site water wells were operated during 1980 to reduce comsumption of Ventura County domestic water. The well water proportion in the blend averaged about 40% for the year for a total well water consumption of approximately 7.8×10^{7} gal. Pressure for the water system is provided by elevated storage tanks.

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

As discussed earlier, surface waters discharged from SSFL facilities and the sewage plant effluent drain southward into retention pond R-2A 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 21 September 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 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 domestic water supply shows no significant variation in either alpha or beta activity.

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 ESG facilities. Radioactivity concentration guide values are those concentration limits adopted by DOE, NRC, and the State of California as maximum permissible concentrations (MPC). The MPC 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 lowest MPC value for the various radionuclides present is selected. Accordingly, for SSFL site surface water, the Guide values of 5×10^{6} µCi/ml alpha activity corresponding to Pu^{239} and 3×10^{-7} µCi/ml beta activity corresponding to Sr^{90} are appropriate. The corresponding most restrictive Guide value for De Soto site wastewater radioactivity discharged to the sanitary sewage system,

a controlled area, is 8×10^{-4} μCi/ml alpha activity corresponding to U^{235} and 1×10^{-3} μCi/ml beta activity corresponding to Co^{60}. 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/ml for SSFL site ambient air alpha activity is due to work with unencapsulated plutonium. The value of 3×10^{-11} μCi/ml for beta activity is due to the presence of Sr^{90} in fission products in irradiated nuclear fuel at the SSFL site. The Guide value of 3×10^{-12} μCi/ml for De Soto ambient air alpha activity is due to work with unencapsulated uranium (including depleted uranium). The Guide value of 3×10^{-10} μCi/ml is for Co^{60} for which the ambient air beta activity Guide is appropriate since it is the most restrictive limit for beta-emitting radionuclides present at the De Soto site. 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 De Soto and SSFL sites. Air is drawn through Type HV-70 filter media, which are analyzed for long-lived radioactivity after a minimum 120-h decay period that eliminates naturally occurring short-lived particulate radioactivity. The average concentrations of ambient air alpha and beta radioactivity for 1980 are presented separately in Table 5.

Radioactivity levels observed in environmental samples for 1980, 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 which 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 foreign atmospheric nuclear tests continue to be occasionally observed in daily ambient airborne radioactivity levels. This effect was readily discernible during late 1980. The long-term effects of airborne radioactivity on surface sample radioactivity levels are not discernible for recent years. The continuing relative

constancy in environmental radioactivity levels is due primarily to the dominance of naturally occurring radionuclides in the environment and to the longer-life fission product radioactivity from aged fallout.

Site ambient radiation monitoring is performed with thermoluminescent dosimeters. Each dosimeter contains 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 and SSFL sites. Each dosimeter, sealed in a light-proof energy compensation shield, is installed in a polyethylene container which is mounted ~1 m above ground at each location. The dosimeters are exchanged and evaluated quarterly. There were 13 on-site TLD monitoring locations used during the year. Three additional dosimeter sets, located at locations up to 10 miles from the ESG sites, are similarly evaluated to determine the local area off-site ambient radiation level, which averaged 0.019 mrem/h for 1980. The averaged radiation dose rate and equivalent annual dose monitored at each dosimeter location are presented in Table 6.

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 natural background radiation from cosmic radiation, radionuclides in the soil, radon and thoron in the atmosphere, and radioactive fallout from nuclear weapons tests. Locally, the natural background radiation level is approximately 160 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 ESG operations.

B. NONRADIOACTIVE MATERIALS — 1980

Processed wastewater and most collected surface runoff discharged from the SSFL site flows to retention pond R-2A, operated by Rocketdyne. Water samples from the pond are analyzed for various constituents, as required by the Regional Water Quality Control Board for each discharge to Bell Canyon. Such discharges

TABLE 6

DE SOTO AND SSFL SITES — AMBIENT RADIATION
DOSIMETRY DATA — 1980

TCD	Average Dose Rate (mrem/h)	Equivalent Annual Dose (mrem)
1 De Soto	0.019	166
2 De Soto	0.017	149
3 De Soto	0.016	140
4 De Soto	0.018	158
5 De Soto	0.019	166
6 De Soto	0.022	193
7 De Soto	0.020	175
1 SSFL	0.018	158
2 SSFL	0.019	166
3 SSFL	0.021	184
4 SSFL	0.020*	175
5 SSFL	0.018*†	158
6 SSFL	0.018	158
1 Off-Site Control	0.018	158
2 Off-Site Control	0.019	166
3 Off-Site Control	0.019	166

*Excludes second quarter data due to missing dosimeter.
†Excludes third quarter data due to damage to the dosimeter from a brush fire.

are normally required only as a result of excessive rainfall run-off. During such releases, the NPDES permit concentration limits for turbidity and for suspended and settleable solids do not apply. The results of analyses for each discharge for 1980, most of which were rainfall-related discharges, are presented in Table 7.

TABLE 7

NONRADIOACTIVE CONSTITUENTS IN WASTEWATER DISCHARGED TO UNRESTRICTED AREAS – 1980
(Analysis Results for Wastewater Discharged from Pond R-2A to Bell Creek on Date Indicated – Sample Station W-12)

Constituents	January 9*		January 16*		February 11*		February 11	
	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide
Total Dissolved Solids (mg/l)	300	31.6	356	37.5	190	20.0	56	5.9
Chloride (mg/l)	32	21.3	37	24.7	21	14.0	51	34.0
Sulfate (mg/l)	83	27.7	85	28.3	44	14.7	106	35.3
Suspended Solids† (mg/l)	58	38.7	18	12.0	75	50	10	6.7
Settleable Solids† (ml/l)	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3
BOD_5 (mg/l)	6	10.0	11	18.3	5	8.3	NA	-
Oil and Grease (mg/l)	4	26.7	<1	<6.7	3	20	<1	<6.7
Turbidity (TU)	38	-	21	-	72	-	6	-
Chromium (mg/l)	0.004	40.0	0.005	50.0	0.007	70.0	0.004	40.0
Fluoride (mg/l)	0.7	70.0	0.9	90.0	0.6	60.0	1.0	100.0
Boron (mg/l)	<0.2	<20.0	0.3	30.0	<0.2	<20.0	0.2	20.0
Residual Chlorine (mg/l)	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0
Fecal Coliform (MPN/100 ml)	<2.2	<9.5	<2.2	<9.5	5.1	22.2	5.1	22.2
Surfactants (MBAS)	0.02	4.0	0.04	4.0	0.01	20.0	0.02	4.0
pH	8.2		7.8		7.9		8.4	
Rainfall (in.)	4.5		3.0		Included in February 13			
Estimated Rainfall Runoff (gal)	9×10^7		6×10^7		Same			
Release Volume (gal)	1.7×10^6		1.2×10^6		Same			

Constituents	February 13*		February 20*		March 1		March 3*	
	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide
Total Dissolved Solids (mg/l)	247	26.0	142	14.9	359	37.8	208	21.9
Chloride (mg/l)	24	16.0	8	5.3	38	25.3	20.	13.3
Sulfate (mg/l)	60	20.0	36	12.0	98	32.7	47	15.7
Suspended Solids† (mg/l)	85	56.7	24	16.0	6	4.0	80	53.3
Settleable Solids† (ml/l)	0.4	133.0	0.2	66.6	<0.1	<33.3	<0.1	<33.3
BOD_5 (mg/l)	9	15.0	1	1.7	NA	-	3	5.0
Oil and Grease (mg/l)	2	13.3	<1	<6.7	<1	<6.7	<1	<6.7
Turbidity (TU)	128	-	52	-	8	-	45	-
Chromium (mg/l)	0.022	220.0	0.020	200.0	0.010	100.0	0.010	100.0
Fluoride (mg/l)	0.6	60.0	0.5	50.0	0.9	90.0	0.7	70.0
Boron (mg/l)	<0.2	<20.0	<0.2	<20.0	0.2	20.0	0.2	20.0
Residual Chlorine (mg/l)	<0.04	<40.0	<0.01	<10.0	<0.04	<40.0	<0.04	<40.0
Fecal Coliform (MPN/100 ml)	9.2	40.0	>16	>69.5	NA	-	2.2	9.6
Surfactants (MBAS)	0.02	10.0	<0.01	<20.0	0.1	20.0	0.2	4.0
pH	8.2		7.7		7.9		7.8	
Rainfall (in.)	4.2		9.6				2.81	
Estimated Rainfall Runoff (gal)	8.4×10^7		1.92×10^8				5.6×10^7	
Release Volume (gal)	1.5×10^6		1×10^6		1.5×10^5		1.35×10^6	

Constituents	March 18*		May 2*		November 10		December 4*	
	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide
Total Dissolved Solids (mg/l)	449	47.3	395	41.6	664	69.9	421	44.3
Chloride (mg/l)	42	28.0	57	38.0	90	60.0	50	33.3
Sulfate (mg/l)	98	32.7	110	36.7	142	47.3	111	37.0
Suspended Solids† (mg/l)	15	10.0	16	10.7	11	7.3	85	56.7
Settleable Solids† (ml/l)	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3	0.2	66.6
BOD_5 (mg/l)	6	10.0	3	5.0	3.	5.0	30	50.0
Oil and Grease (mg/l)	<1	<6.7	<1	<6.7	<1	<6.7	7	46.7
Turbidity (TU)	52	-	13	-	3	-	33	-
Chromium (mg/l)	0.004	40.0	0.003	30.0	0.002	20.0	0.001	10.0
Fluoride (mg/l)	0.7	70.0	0.7	70.0	0.8	80.0	0.6	60.0
Boron (mg/l)	0.3	30.0	0.2	20.0	0.2	20.0	0.2	20.0
Residual Chlorine (mg/l)	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	0.04	40.0
Fecal Coliform (MPN/100 ml)	<2.2	9.6	<2.2	<9.6	>16	>69.5	9.2	40.0
Surfactants (MBAS)	0.03	6.0	0.03		0.05		0.01	2.0
pH	8.3		8.1		8.1		8.0	
Rainfall (in.)	0.56		0.15				1.07	
Estimated Rainfall Runoff (gal)	1.1×10^7		3×10^6				2.1×10^7	
Release Volume (gal)	1.2×10^6		1.8×10^6		2.3×10^6		1.3×10^6	

NA = Not Available: analysis not requested or not performed.
* = Rainfall related discharge.
† = Not applicable to discharges containing rainfall runoff during or immediately after periods of rainfall.
Note: Pond R-2A capacity - 2.5×10^6 gal.

III. ENVIRONMENTAL MONITORING PROGRAM

A. GENERAL DESCRIPTION

Soil and vegetation sample collection and analysis for radioactivity were initiated in 1952, in the Downey, California area, where the Energy Systems Group was initially located. Environmental sampling was subsequently extended to the then 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 nuclear activities were relocated to Canoga Park in 1955. The primary purpose of the environmental monitoring program is to survey environmental radioactivity adequately to ensure that ESG 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 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.

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

Sample preparation for gross radioactivity determination consists of transferring the soils to Pyrex beakers and drying in a muffle furnace at $\sim 500^{\circ}C$ for

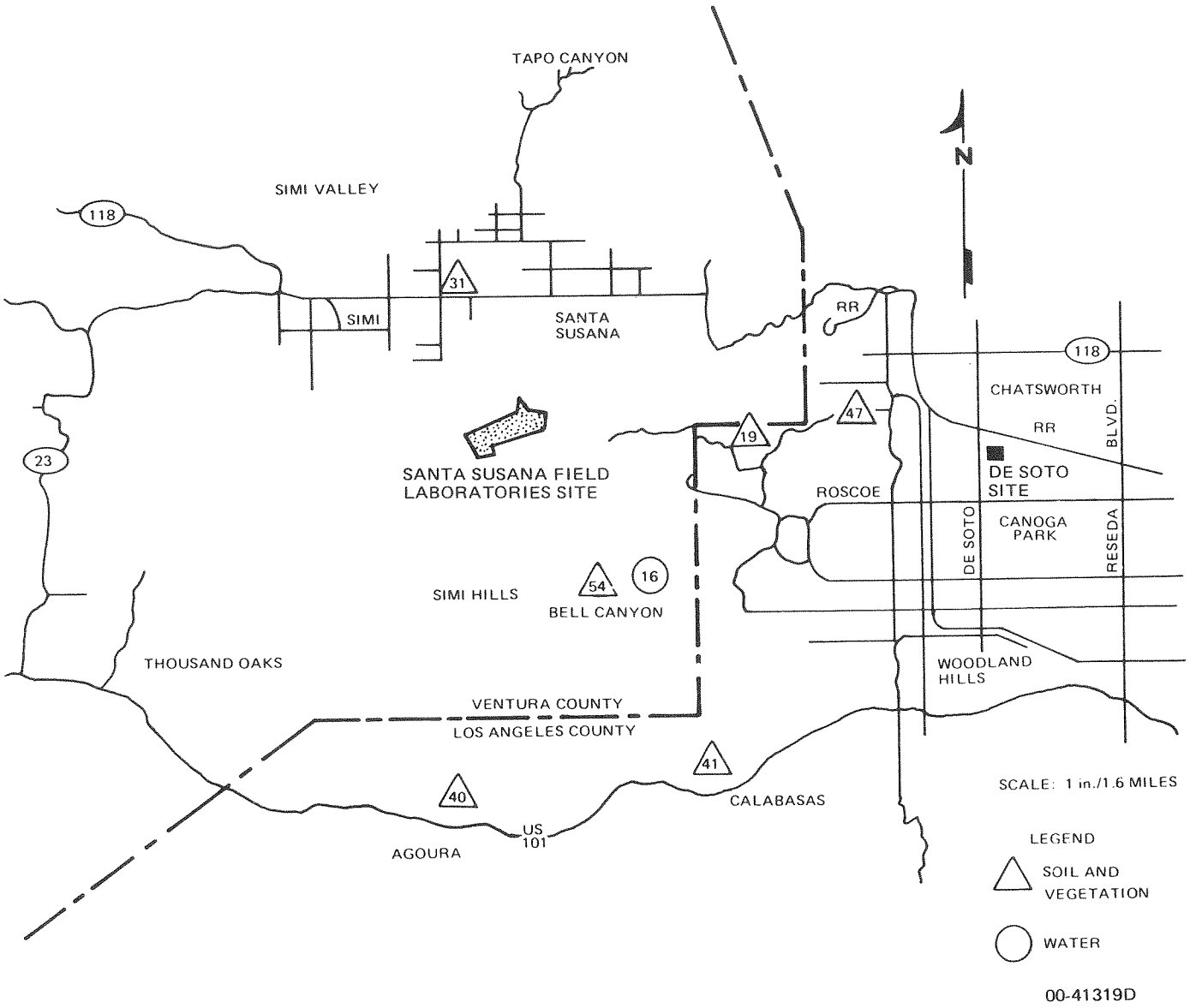

Figure 5. Map of Canoga Park, Simi Valley, Agoura, and Calabasas Sampling Stations

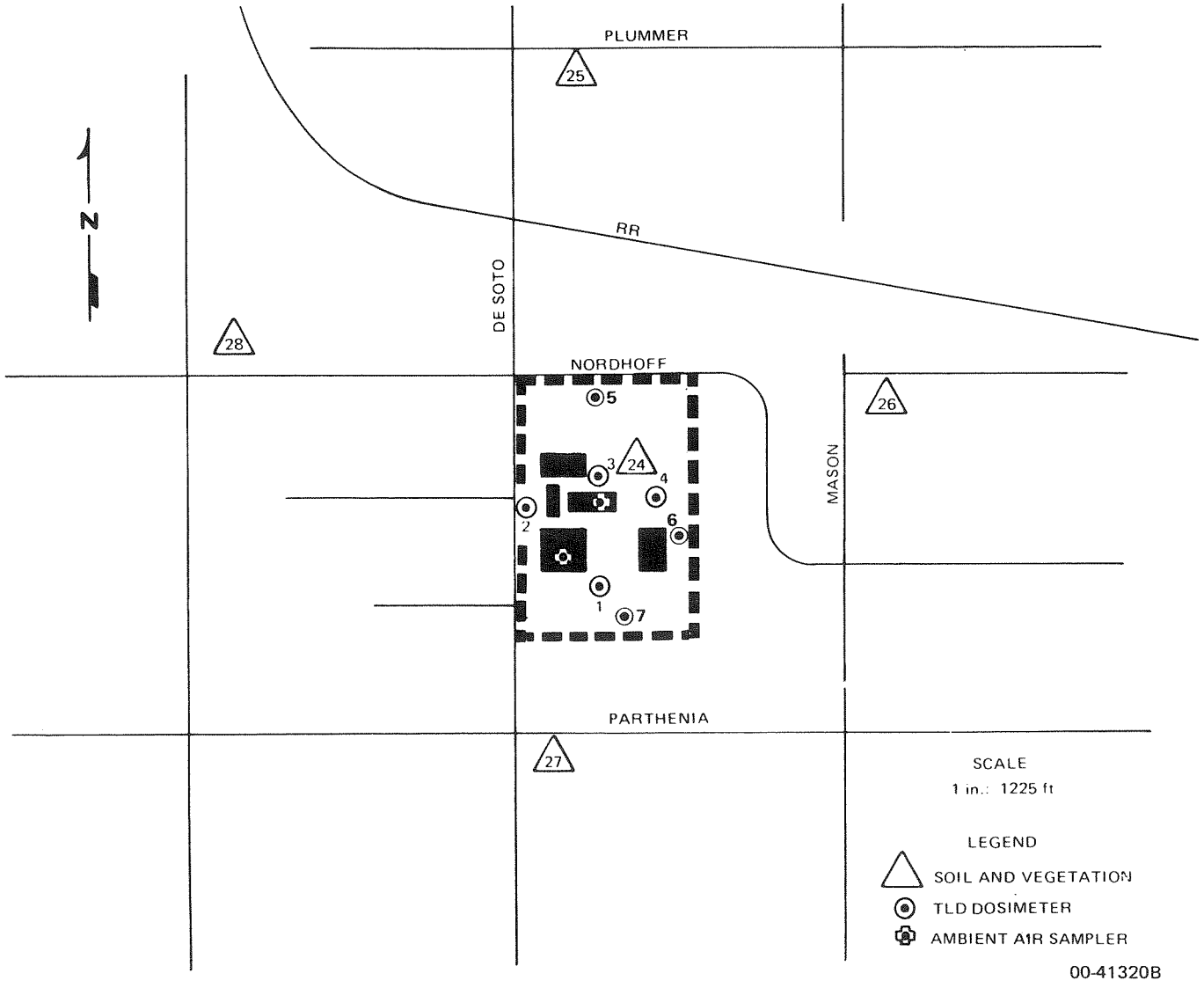

Figure 6. Map of De Soto Site and Vicinity Sampling Stations

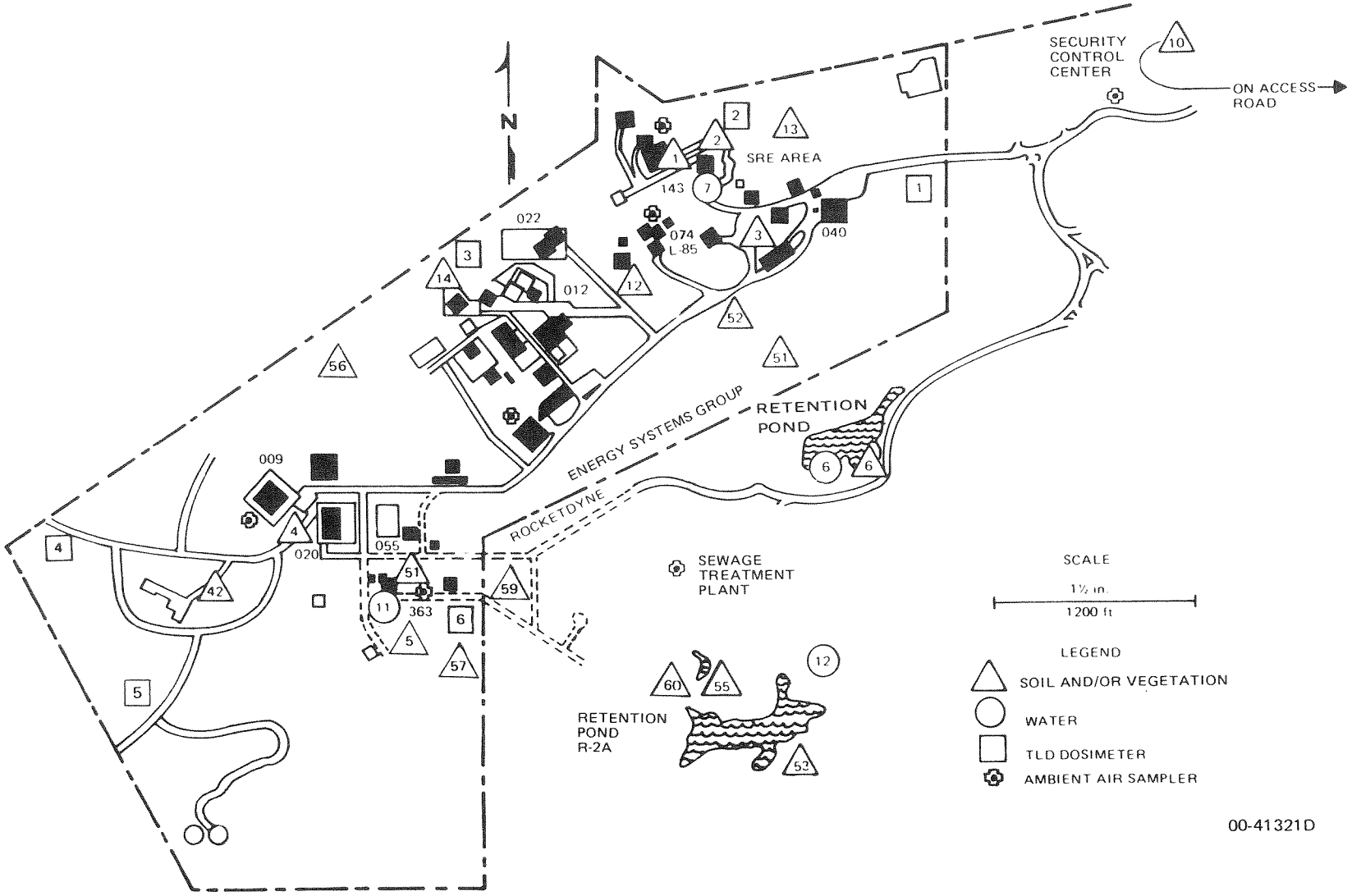

Figure 7. Map of Santa Susana Field Laboratories Site Sampling Stations

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 1 of 3)

Station	Location
SV-1	SSFL Site, Bldg. 143
SV-2	SSFL Site, Bldg. 143 Perimeter Drainage System
SV-3	SSFL Site, Bldg. 064
SV-4	SSFL Site, Bldg. 020
SV-5	SSFL Site, Bldg. 363
SV-6	Rocketdyne Site Interim Retention Pond
SV-10	SSFL Site Access Road
SV-12	SSFL Site, Bldg. 093 (L-85 Reactor)
SV-13	SSFL Site, at SRE Water Retention Pond
SV-14	SSFL Site, Bldg. 028
SV-19	SSFL Site Entrance, Woolsey Canyon
SV-24	De Soto Site, Bldg. 004
SV-25	De Soto Avenue and Plummer Street
SV-26	Mason Avenue and Nordhoff Street
SV-27	De Soto 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	SSFL Site, Bldg. 886
SV-47	Chatsworth Reservoir North Boundary
SV-51	SSFL Site, Bldg. 029
SV-52	SSFL Site, Burro Flats Drainage Control Pond, G Street and 17th Street
SV-53	Rocketdyne Site Pond R-2A Spillway, Head of Bell Canyon
SV-54	Bell Creek
S-55	Rocketdyne Site Retention Pond R-2A (Pond Bottom Mud)
S-56	SSFL Site, F Street and 24th Street

SV — Soil and Vegetation Sample Station
S — Soil Sample Station

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 2 of 3)

Station	Location
S-57	SSFL Site, J Street at Bldg. 055
S-58	SSFL Site, Bldg. 353
S-59	Rocketdyne Site Test Area CTL 4
S-60	Rocketdyne Site Retention Pond R-2A
W-6	Rocketdyne Site Interim Retention Pond (drains to Pond R-2A)
W-7	SSFL Site Domestic Water, Bldg. 003
W-11	SSFL Site Domestic Water, Bldg. 363
W-12	Rocketdyne Site Area II Final Retention Pond R-2A
W-16	Bell Creek
A-1	De Soto Site, Bldg. 001 Roof
A-2	De Soto Site, Bldg. 004 Roof
A-3	SSFL Site, Bldg. 009, West Side
A-4	SSFL Site, Bldg. 011, West Side
A-5	Rocketdyne Site, Bldg. 600, North Side
A-6	Rocketdyne Site, Bldg. 207, North Side
A-7	SSFL Site, Bldg. 074, South Side
A-8	SSFL Site, Bldg. 143, West Side
A-9	SSFL Site, Bldg. 363, West Side
TLD-1	De Soto Site, South of Bldg. 102
TLD-2	De Soto Site, West Boundary
TLD-3	De Soto Site, Guard Post No. 1, Bldg. 201
TLD-4	De Soto Site, East Fence
TLD-5	De Soto Site, North Boundary
TLD-6	De Soto Site, East Boundary
TLD-7	De Soto Site, South Boundary
TLD-1	SSFL Site, Bldg. 114

S — Soil Sample Station
W — Water Sample Station
A — Air Sampler Station
TLD — Thermoluminescent Dosimeter Location

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 3 of 3)

Station	Location
TLD-2	SSFL Site, SRE Water Retention Pond
TLD-3	SSFL Site, Electric Substation No. 719
TLD-4	SSFL Site, West Boundary on H Street
TLD-5	SSFL Site, at Southwest Boundary
TLD-6	SSFL Site, Bldg. 854
TLD-1	Off Site, Northridge
TLD-2	Off Site, Simi Valley
TLD-3	Off Site, Northridge

TLD — Thermoluminescent Dosimeter Location

8 h. After cooling, the soil is sieved to obtain uniform particle size. Two-gram aliquots of the sieved soil are weighed into 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. Soil plutonium analysis is performed according to the guidelines specified in U.S. NRC Regulatory Guide 4.5 titled "Measurements of Radionuclides in the Environment-Sampling and Analysis of Plutonium in Soil" by a certified independent testing laboratory.

2. Vegetation

The analysis of vegetation, performed as an adjunct to the soil analysis, is done to determine the uptake of radioactivity by plants. These plants do not contribute to the human food chain, and there is no 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. 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 is 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 ~500°C for 8 h, producing a completely burned ash. One-gram aliquots of pulverized ash from each beaker are weighed into 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 determining the equivalent dry weight gross radioactivity concentration value.

3. Water

Surface and domestic supply water samples are obtained monthly at the SSFL site 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 ~90°C. The residual salts are redissolved into distilled water, transferred to planchets, dried under heat lamps, and counted for alpha and beta radiation.

4. Ambient Air

Air sampling is performed continuously at the De Soto 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. 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 De Soto and SSFL sites during 1980. The average beta concentration for each month is also indicated by horizontal bars. The graph shows a generally increasing trend in airborne radioactivity during the final quarter of the year. Several transient peak concentration levels were observed within the general trend. This activity is attributed to a foreign atmospheric test of a nuclear device during October.

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. The system is capable of simultaneously counting 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 countrates (approximately 0.05 cpm α and 1.0 cpm β), and sample size. For the table, the

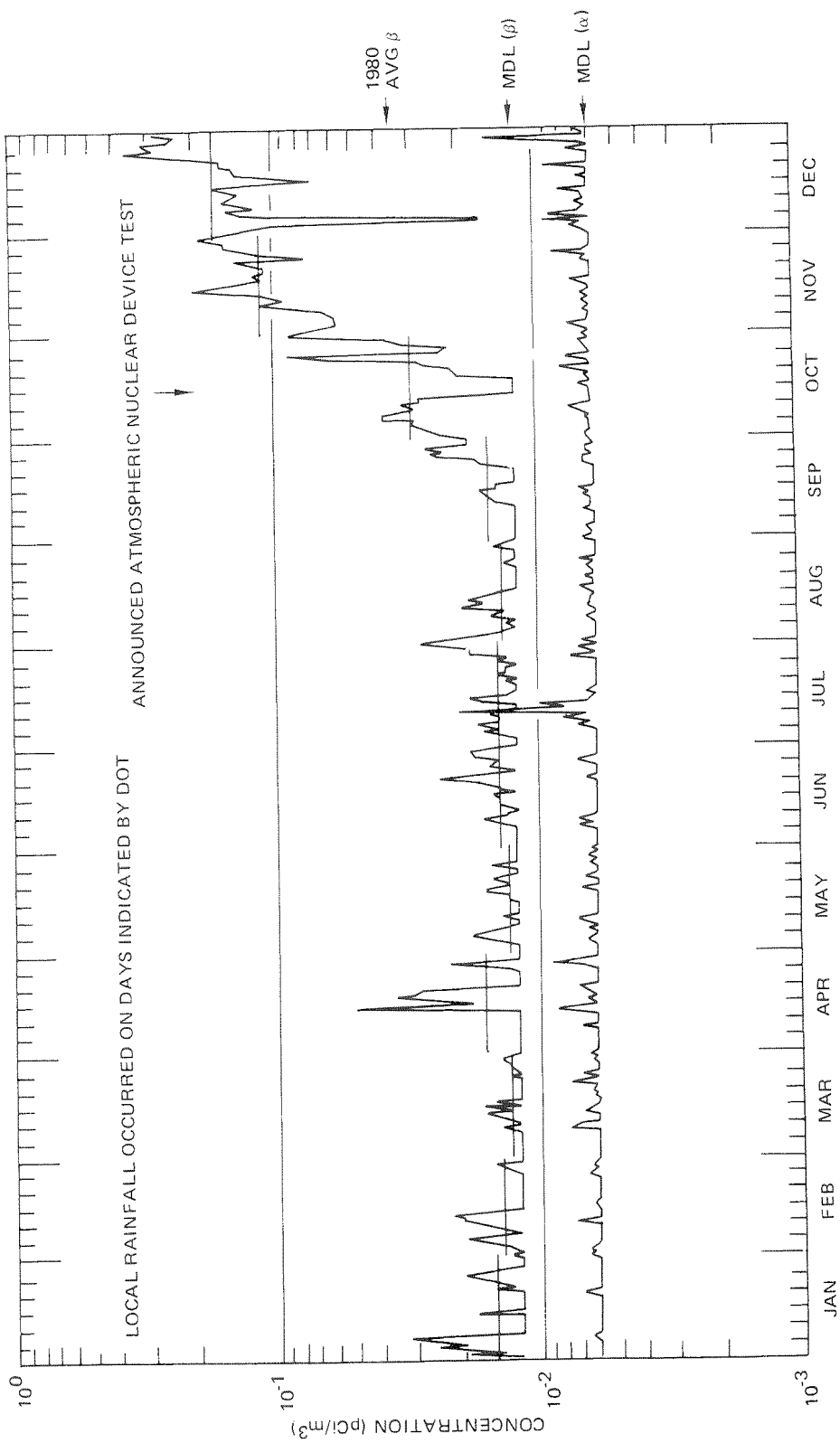

Figure 8. Daily Averaged Long-Lived Airborne Radioactivity at the De Soto and Santa Susana Field Laboratories Sites — 1980

minimum statistically significant amount of radioactivity, irrespective of sample configuration, is taken as that amount equal in countrate to three times the standard deviation of the system background countrate.

TABLE 9

MINIMUM RADIOACTIVITY DETECTION LIMITS (MDLs)

Sample	Activity	Minimum Detection Limits
Soil	α	$(5.7 \pm 6.8)\ 10^{-8}$ μCi/g
	β	$(2.3 \pm 2.3)\ 10^{-7}$ μCi/g
Vegetation	α	$(1.1 \pm 1.4)\ 10^{-7}$ μCi/g ash
	β	$(3.7 \pm 3.7)\ 10^{-7}$ μCi/g ash
Water	α	$(2.2 \pm 2.7)\ 10^{-10}$ μCi/ml
	β	$(6.2 \pm 6.2)\ 10^{-10}$ μCi/ml
Air	α	$(6.1 \pm 8.0)\ 10^{-15}$ μCi/ml
	β	$(1.2 \pm 1.3)\ 10^{-14}$ μCi/ml)

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 observed net countrate 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 countrate 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 statistial counting error.

Since the observed radioactivity in environmental samples results primarily from natural and weapons-testing sources, and is at such low concentrations, no effort is 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 the 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 27 September 1976 and supersedes all previously held permits for wastewater discharge from the Rocketdyne Division, SSFL. Discharge of overflow and storm runoff is only 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 ESG SSFL site. It is identified as retention pond R-2A, Water 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 nonradioactive chemical constituents and for radioactivity by a California State certified analytical testing laboratory. The specific constituents analyzed for, and their respective limitations in discharged wastewater, are presented in Appendix B. Wastewater originating from facilities located throughout the SSFL site is collected at the retention pond. The point of origin of nonradioactive constituents normally found in wastewater is impossible to determine; however, in the event of excessive amounts of any of these materials in wastewater, the origin may be determined from the knowledge of facility operations involving their use. Twelve off-site discharges of wastewater from Pond R-2A occurred during 1980.

IV. EFFLUENT MONITORING PROGRAM

Effluents that may contain radioactive material are generated at ESG 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 0015-71. The specific facilities are identified as Buildings 001 and 004 at the De Soto 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 emissions. No contaminated liquids are discharged to unrestricted areas.

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

The average concentration and total radioactivity in gaseous releases to unrestricted areas are shown in Table 10. The effectiveness of the air cleaning systems is evident from the fact that, in most cases, the gaseous emissions are less radioactive than is ambient air. The total shows that no significant quantities of radioactivity were released in 1980.

Liquid wastes released to sanitary sewage systems, a controlled area as provided for by CAC 17 and 10 CFR 20, are generated at the De Soto site only.

TABLE 10

ATMOSPHERIC DISCHARGES TO UNRESTRICTED AREAS — 1980

Building	Approximate Emissions Volume (ft^3)	Activity Monitored	Approximate Minimum Detection Limit ($\mu Ci/ml$)	Annual Average Concentration ($\mu Ci/ml$)	Sampling Period Maximum Observed Concentration ($\mu Ci/ml$)	Total Radio-activity Released (Ci)	% of Guide†	% of Samples with Activity <MDL
001 De Soto	1.9×10^{10}	α	1.9×10^{-16}	$<1.0 \times 10^{-14}$	1.8×10^{-13}	$<5.3 \times 10^{-6}$	<0.33	46
		β	6.1×10^{-16}	$<8.2 \times 10^{-15}$	9.4×10^{-14}	$<4.3 \times 10^{-6}$	<0.003	37
004 De Soto	2.4×10^{10}	α	2.5×10^{-16}	$<1.2 \times 10^{-15}$	1.4×10^{-14}	$<1.0 \times 10^{-6}$	<0.04	38
		β	8.7×10^{-16}	$<7.3 \times 10^{-15}$	1.1×10^{-13}	$<4.9 \times 10^{-6}$	<0.002	34
020 SSFL	1.3×10^{10}	α	0.9×10^{-16}	$<4.6 \times 10^{-16}$	1.4×10^{-15}	$<1.7 \times 10^{-7}$	<0.77	15
		β	3.0×10^{-16}	4.6×10^{-14}	2.4×10^{-13}	1.7×10^{-5}	0.15	0
021-022 SSFL	1.3×10^{10}	α	1.0×10^{-16}	$<1.6 \times 10^{-16}$	5.7×10^{-16}	$<6.1 \times 10^{-8}$	<0.27	65
		β	3.1×10^{-16}	$<4.7 \times 10^{-15}$	3.5×10^{-14}	$<1.7 \times 10^{-6}$	<0.02	10
055 SSFL	7.9×10^{9}	α	2.7×10^{-16}	$<3.7 \times 10^{-16}$	4.8×10^{-15}	$<8.2 \times 10^{-8}$	<0.62	94
		β	8.9×10^{-16}	$<4.9 \times 10^{-15}$	3.5×10^{-14}	$<1.1 \times 10^{-6}$	<0.002	12

Total $<3.5 \times 10^{-5}$

Annual average ambient air radioactivity concentration — 1980

α	$< 6.4 \times 10^{-15}$
β	$< 3.6 \times 10^{-14}$

†Guide: De Soto site, 3×10^{-12} $\mu Ci/ml$ alpha, 3×10^{-10} $\mu Ci/ml$ beta, 10 CFR 20 Appendix B. SSFL site, 6×10^{-14} $\mu Ci/ml$ alpha, 3×10^{-11} $\mu Ci/ml$ beta, 3×10^{-12} $\mu Ci/ml$ beta (055 only); 10 CFR 20 Appendix B, CAC-17, and DOE Manual Chapter 0524.

Note: All release points are at the Stack Exit

Liquid wastes are discharged from Building 001 following analysis for radioactivity concentration. There is no continuous flow. Building 004 chemical wastes are released to an automatic discharge cycle retention tank system which periodically samples and composites aliquots of the tank contents prior to each discharge of a fixed volume of wastewater to the facility sanitary sewerage. No radioactive liquid effluents are released from Santa Susana Buildings 020, 021, 022, or 055. Liquid radioactive waste generated at SSFL is solidified for land burial. The average concentration and total radioactivity in effluents discharged are shown in Table 11.

B. ENERGY SYSTEMS GROUP FACILITY DESCRIPTIONS

1. De Soto 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 emissions 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 CAC 17 and 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}.

b. Building 004 – NRC and California State Licensed Activities

Operations at Building 004 that 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 emissions are released from the building to uncontrolled areas. Liquid laboratory wastes are released to an interim retention tank installation which samples and retains an aliquot of wastewater each time a fixed volume is released to the facility sanitary sewage system. The aliquots are composited and

TABLE 11

LIQUID EFFLUENT DISCHARGED TO SANITARY SEWER – 1980

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)	% of Guide†
001	Retention Tank	48,000	α	1.2×10^{-9}	$<7.3 \times 10^{-8}$	4.1×10^{-7}	1.3×10^{-5}	<0.009
			β	3.7×10^{-9}	$<6.2 \times 10^{-8}$	2.8×10^{-7}	1.1×10^{-5}	<0.006
004	Flow Sampler	1,717,000	α	1.2×10^{-9}	$<2.4 \times 10^{-8}$§	1.5×10^{-7}	$<1.6 \times 10^{-4}$	<0.003
			β	3.7×10^{-9}	$<6.3 \times 10^{-8}$§	6.5×10^{-7}	$<4.1 \times 10^{-4}$	<0.006
020*	–	0	–	–	–	–	–	
021 - 022*	–	0	–	–	–	–	–	
055*	–	0	–	–	–	–	–	

*All liquid radioactive wastes are solidified and land buried as dry waste.
†Guide: 8×10^{-4} μCi/ml alpha, 1×10^{-3} μCi/ml beta; 10 CFR 20 Appendix B, CAC-17
§% of samples <MDL: 52.3% alpha activity, 47.6% beta activity

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.

2. Santa Susana Field Laboratories Site

a. Building 020 – NRC and California State Licensed Activities

Operations at Building 020 that may generate radioactive effluents consist of hot cell examination of irradiated nuclear fuels and reactor components. Only atmospherically discharged emissions are released from the building to uncontrolled areas. The discharge may contain particulate material, as well as radioactive gases, depending on the operations being performed and the history of the irradiated fuel or 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.

b. Buildings 021 and 022 – 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 atmospherically discharged emissions 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.

c. Building 055 – NRC and California State Licensed Activities

Operations at Building 055 that may generate radioactive effluents consist of fabricating depleted uranium carbide fuel pellets and converting UC waste to the oxide state. Only atmospherically discharged emissions 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}.

C. ESTIMATION OF GENERAL POPULATION DOSE ATTRIBUTABLE TO ESG OPERATIONS

The release of airborne material at the De Soto site 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 in extent. 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 under this condition from the SSFL site would result in Pasquill Type D lofting diffusion conditions above the inversion and considerable atmospheric dispersion prior to diffusion, if any, 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 air flow is then dominated by frontal activity moving through the area or to the east, resulting in high-pressure systems in the great basin region. Frontal passages through the area during winter are generally accompanied by precipitation. 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 flow of marine air, and lapse rates which are slightly neutral. 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. Surface wind directions and average windspeed for the local area are summarized in Table 12.

TABLE 12

SURFACE WIND CONDITIONS: FREQUENCIES OF WIND DIRECTIONS AND TRUE-AVERAGE WIND SPEEDS

Wind Toward	Frequency	Wind Speeds for Each Stability Class						
		A	B	C	D	E	F	G
N	0.188	1.84	2.92	4.33	3.78	3.70	1.79	0.0
NNW	0.118	1.89	2.87	4.13	3.84	3.73	1.85	0.0
NW	0.085	1.86	2.65	3.62	4.01	3.98	1.92	0.0
WNW	0.131	1.85	2.58	3.75	4.02	4.03	1.95	0.0
W	0.053	1.31	1.74	2.70	2.82	3.58	1.75	0.0
WSW	0.024	1.16	1.34	2.37	3.25	3.35	1.49	0.0
SW	0.017	1.55	1.05	2.30	5.79	3.47	1.27	0.0
SSW	0.021	1.29	1.22	2.65	5.67	3.37	1.50	0.0
S	0.043	1.16	0.97	2.04	4.80	3.44	1.63	0.0
SSE	0.059	1.36	1.23	2.75	5.51	3.65	1.59	0.0
SE	0.052	1.46	1.13	2.89	5.32	3.72	1.52	0.0
ESE	0.046	1.24	1.24	2.58	4.63	3.74	1.63	0.0
E	0.030	1.46	1.39	2.08	3.73	3.60	1.46	0.0
ENE	0.022	1.24	1.39	2.52	3.00	3.05	1.30	0.0
NE	0.034	1.47	1.79	2.70	2.94	2.92	1.24	0.0
NNE	0.077	1.66	2.36	3.85	3.46	3.42	1.28	0.0
	Average	1.72	1.74	2.95	4.16	3.55	1.57	-

The downwind concentration of radioactive material discharged to the atmosphere during 1980 from each of the four major ESG nuclear facilities has been calculated with the AIRDOS-EPA computer code methodology.

To determine the nearest site boundary and nearest residence radioactivity concentrations, a mean wind speed for each stability class of 2.2 m/s was selected to evaluate the plume centerline (maximum) concentrations toward the sector in which those locations lie. The 80-km concentration is not direction specific, but is given for comparison with the nearby concentration values. These are shown in Table 13.

TABLE 13

MAXIMUM DOWNWIND PLUME CENTERLINE CONCENTRATIONS
OF GASEOUS EMISSIONS – 1980

Facility	Release Rate (Ci/yr)	Distance (m) to		Downwind Concentration ($\mu Ci/cm^3$)*		
		Boundary	Residence	Boundary	Residence	80-km
B/001	9.6×10^{-6}	110 W	171 SW	6.7×10^{-17}	7.6×10^{-17}	1.8×10^{-19}
B/020	1.7×10^{-5}	305 NW	1900 SE	1.9×10^{-17}	1.5×10^{-17}	2.4×10^{-19}
B/022	1.8×10^{-6}	350 NW	2300 SE	7.2×10^{-19}	7.3×10^{-19}	2.2×10^{-20}
B/055	1.2×10^{-6}	400 NW	1830 SE	3.7×10^{-19}	1.8×10^{-18}	1.8×10^{-20}

*Assume $\bar{\mu}$ = 2.2 m/s average wind speed, constant direction, full year.

The demographic information used to estimate the general population dose distribution around the De Soto and SSFL sites was based on the 1970 general census data projected to 1980. The projection was based on an average growth rate of 5.17%/year. The population distribution surrounding the De Soto facility and to a radius of 8 km is centered on the De Soto site. Beyond 8 km and out to 80 km, the De Soto distribution is centered on coordinates 34^{o} 14' 25" north and 118^{o} 39' 00" west. This is between the De Soto and SSFL sites, which are approximately 10 km apart. The population distribution surrounding the SSFL site out to a radius of 80 km is site centered for all distance segments.

The general population man-rem dose estimates are calculated from the demographic distribution and the sector-averaged downwind radioactivity concentrations generated by AIRDOS-EPA, which uses release rate, wind speed, wind direction and frequency, inversion, lapse, and effective stack height parameters as input data. Population dose estimates are presented in Tables 14 and 15 for the De Soto and SSFL sites. The exposure mode is by inhalation with lung, the critical organ for U^{235} and Pu^{239}, and bone for Sr^{90}. The doses for the SSFL site are summed for all release points and nuclides.

TABLE 14

POPULATION DOSE ESTIMATES FOR ATMOSPHERICALLY DISCHARGED EMISSIONS FROM THE DE SOTO FACILITY – 1980

22.5° Sector	Dose to Receptor Population Segment (man-rem)						
	0-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	6.3E-4	2.1E-6	5.4E-5	4.3E-6	2.8E-6	2.3E-7	6.9E-4
NNW	3.4E-4	2.7E-6	6.4E-6	6.4E-7	3.0E-7	7.1E-6	3.6E-4
NW	1.3E-4	1.1E-4	1.1E-4	1.3E-6	9.4E-7	4.5E-7	3.5E-4
WNW	2.6E-4	2.4E-3	1.9E-4	3.8E-4	2.6E-4	1.1E-5	3.5E-3
W	6.2E-4	8.3E-5	4.2E-4	7.2E-4	8.9E-4	2.3E-6	2.7E-3
WSW	1.5E-3	2.4E-5	3.3E-4	4.2E-5	2.8E-5	0	1.9E-3
SW	1.5E-3	5.0E-5	4.9E-5	0	0	0	1.6E-3
SSW	1.3E-3	3.8E-5	2.0E-5	0	0	0	1.4E-3
S	1.9E-3	1.1E-4	9.9E-5	0	1.4E-6	0	2.1E-3
SSE	4.1E-3	1.1E-3	2.0E-3	1.4E-3	2.1E-3	2.8E-4	1.1E-2
SE	2.6E-3	2.0E-3	5.2E-3	1.2E-2	7.7E-3	4.3E-3	3.4E-2
ESE	2.2E-5	3.0E-3	5.4E-3	7.2E-3	4.9E-3	3.0E-3	2.4E-2
E	1.2E-3	1.9E-3	2.4E-3	9.8E-4	4.9E-4	2.9E-4	7.3E-3
ENE	1.0E-3	7.0E-4	8.4E-4	9.3E-6	2.6E-6	1.2E-5	2.5E-3
NE	6.4E-4	4.4E-6	1.8E-4	1.4E-5	8.5E-5	1.3E-4	1.1E-3
NNE	3.4E-4	5.7E-6	3.5E-4	1.7E-5	1.8E-5	1.5E-5	7.4E-4
Total	1.8E-2	1.2E-2	1.8E-2	2.3E-2	1.6E-2	8.0E-3	9.5E-2

1. Average individual dose = 7.3E-9 rem for the total population of 80-km radius area.

2. Total 80-km radius man-rem dose estimate from naturally occurring airborne radioactivity dose to the lung of ∿0.1 rem/year = 1,300,000 (1.3E+6) man-rem.

TABLE 15

POPULATION DOSE ESTIMATES FOR ATMOSPHERICALLY DISCHARGED EMISSIONS FROM THE SSFL FACILITIES – 1980

22.5^{o} Sector	Dose to Receptor Population Segment (man-rem)						
	0-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	3.5E-4	1.8E-6	4.3E-6	1.1E-6	1.1E-6	3.3E-7	3.6E-4
NNW	6.2E-4	1.3E-7	3.1E-5	1.4E-7	1.2E-7	1.3E-6	6.5E-4
NW	7.5E-4	1.8E-5	2.8E-5	1.6E-5	1.5E-6	1.7E-7	8.1E-4
WNW	2.1E-4	1.7E-5	1.1E-4	5.9E-5	9.3E-5	1.8E-5	5.1E-4
W	0	3.5E-5	9.4E-5	2.6E-4	2.9E-5	0	4.2E-4
WSW	0	1.5E-4	3.9E-5	3.0E-5	0	0	2.2E-4
SW	1.4E-5	3.8E-5	8.2E-6	0	0	0	6.0E-5
SSW	6.6E-5	2.8E-5	1.0E-5	0	0	0	1.0E-4
S	4.3E-6	1.4E-5	8.5E-6	0	0	0	2.7E-5
SSE	1.0E-5	2.2E-5	4.3E-5	0	6.6E-5	1.6E-5	1.6E-4
SE	1.7E-4	2.4E-4	1.7E-4	1.2E-3	1.4E-3	8.5E-4	4.0E-3
ESE	1.5E-4	3.5E-4	6.8E-4	1.2E-3	1.1E-3	6.3E-4	4.1E-3
E	8.3E-5	9.9E-5	6.9E-4	2.2E-4	1.2E-4	5.5E-5	1.3E-3
ENE	2.1E-5	2.1E-5	1.1E-4	5.6E-6	3.5E-6	1.3E-5	1.7E-4
NE	1.8E-4	5.3E-5	3.9E-5	4.1E-5	6.8E-6	4.0E-5	3.6E-4
NNE	1.4E-4	1.1E-6	8.2E-6	1.8E-6	1.1E-6	8.6E-7	1.5E-4
Total	2.8E-3	1.1E-3	2.1E-3	3.0E-3	2.8E-3	1.6E-3	1.3E-2

Average individual dose = 1.9E-9 rem for the 80-km radius area total population.

The off-site doses are extremely low compared to the maximum permissible exposures recommended for the general population. These values are 3 rem/year for bone and 1.5 rem/year for the lung for an individual, and they are one-third of these values for the general population. The highest average individual dose for 1980 is for the De Soto 0-8 km segment, which is equivalent to an average dose/man-year of 0.00005 mrem, or 0.00003% of the maximum permissible exposure for an individual and 0.00001% of the general population exposure limit. Estimated radiation doses due to atmospheric discharges of radioactivity from all ESG facilities are a small fraction of the recommended limits and are far below doses due to internal deposition of natural radioactivity in air, which is ∿50 to 100 mrem/year.

APPENDIX A

COMPARISON OF ENVIRONMENTAL RADIOACTIVITY DATA FOR 1980 WITH PREVIOUS YEARS

This section compares environmental monitoring results for the calendar year 1980 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 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 increases the sensitivity of the detector to alpha-emitting radionuclides in the sample, thus producing a higher measured specific radiation.

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 radiation.

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 ESG is essentially nonexistent.

TABLE A-1

SOIL RADIOACTIVITY DATA — 1957 THROUGH 1980

Year	On Site-Average (10^{-6} µCi/g)			Off Site - Average (10^{-6} µCi/g)		
	Number Samples	α	β	Number Samples	α	β
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
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 1980

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
1980	144	<0.25	160	48	<0.19	142
1979	144	<0.24	139	48	<0.23	134
1978	144	<0.24	166	48	<0.24	143
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 SITE DOMESTIC WATER RADIOACTIVITY DATA — 1957 THROUGH 1980

Year	Number Samples	Average α (10^{-9} μCi/ml)	Average β (10^{-9} μCi/ml)
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
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 DIVISION RETENTION POND RADIOACTIVITY DATA – 1966 THROUGH 1980

Year	Samples														
	Bell Creek Mud 54			Bell Creek Vegetation 54			Bell Creek Water 16			Interim Retention Pond Water 6			Final Retention Pond R-2A Water 12		
	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
1980	12	0.51	23.	12	<0.18	150.	12	<0.22	2.9	12	<0.22	2.9	12	<0.22	3.9
1979	12	0.46	23.	12	<0.26	136.	12	<0.23	3.2	12	<0.25	3.1	12	<0.23	4.5
1978	12	0.42	23.	12	<0.26	156.	12	<0.24	2.5	12	<0.25	4.3	12	<0.25	4.6
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 CONCENTRATION DATA –
1957 THROUGH 1980

Year	DeSoto Site Average (10^{-12} µCi/ml)			SSFL Site Average[§] (10^{-12} µCi/ml)		
	Number Samples	α	β	Number Samples	α	β
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
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
§Includes Rocketdyne Site Air Sampler 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 limits given in Table B-1 is prohibited.

TABLE B-1

NPDES NO. CA00-01309, 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_5	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)	-	-	23.0
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
6. Meteorology and Atomic Energy — 1968, TID 24190
7. Report of Committee II on Permissible Dose for Internal Radiation (1959), ICRP Publication 2
8. Deposition and Retention Models for Internal Dosimetry of the Human Respiratory Tract, ICRP Committee II Task Group on Lung Dynamics
9. Document TI #N001TI000-046 titled "Method of Estimating General Population Radiation Dose Attributable to Atmospheric Discharge of Radioactivity from ESG Nuclear Facilities," J. D. Moore
10. AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Doses to Man from Airborne Releases of Radionuclides, ORNL-5532
11. Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21, AI-76-21

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. Resources Management Agency, County of Ventura, 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