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ROCKETDYNE DIVISION ENVIRONMENTAL MONITORING AND FACILITY EFFLUENT ANNUAL REPORT DE SOTO AND SANTA SUSANA FIELD LABORATORIES SITES 1988

Rockwell International

Rocketdyne Division
6633 Canoga Avenue
Canoga Park, California 91303

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I. INTRODUCTION

Environmental and facility effluent radioactivity monitoring at the Rocketdyne Division of Rockwell International is performed by the Radiation and Nuclear Safety Group of the Health, Safety, and Environment Department. Soil and surface water are routinely sampled to a distance of 16 km from division sites. Groundwater from Santa Susana Field Laboratories (SSFL) supply water wells and other test wells is periodically sampled to measure radioactivity. Continuous ambient air sampling and direct radiation monitoring by thermoluminescent dosimetry are performed at several on-site and off-site locations for measuring airborne radioactivity concentrations and site ambient radiation levels. Radioactivity in effluents discharged to the atmosphere from nuclear facilities is continually sampled and monitored to assure that amounts released to uncontrolled areas are below appropriate limits. These procedures also help identify processes that may require additional engineering safeguards to minimize radioactivity in such discharges. In addition, selected nonradioactive chemical constituent concentrations in surface water discharged to uncontrolled areas are measured.

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

Work in nuclear energy research and development in what has become the Rocketdyne Division of Rockwell International Corporation began in 1946. In addition to a broad spectrum of conventional programs in rocket propulsion, space utilization, and national defense, Rocketdyne is working on the design, development, and testing of components and systems for central station nuclear power plants, the decladding of irradiated nuclear fuel, and the decontamination and decommissioning of facilities.

Nuclear research programs licensed by the State of California are conducted at the De Soto site (Figure 1) in the Building 104 Applied Nuclear Technology laboratories and in the Gamma Irradiation Facility. The De Soto

location is typical of the San Fernando Valley floor at an altitude of 875 ft above sea level. Nuclear research programs licensed by the State of California are conducted there in the Building 104 Applied Nuclear Research laboratories and in the Gamma Irradiation Facility (containing approximately 35 kCi of ^{60}Co and 570 kCi of ^{137}Cs).

The Santa Susana Field Laboratories (SSFL) site (Figure 2) occupies 2,668 acres located in the Simi Hills of Ventura County, approximately 30 miles northwest of downtown Los Angeles. The SSFL site is situated on rugged terrain which typifies mountain areas of recent geological age. A sandstone bedrock unit called the upper cretaceous Chatsworth formation underlies this area. The site may be described as an irregular plateau sprinkled with outcroppings above the more level patches and with peripheral eroded ravines. Elevations of the site vary from 1650 to 2250 ft above sea level. The surface mantle consists of unconsolidated gravel, sand, silt, and clay. Both Department of Energy (DOE) and Rockwell International owned facilities, shown in Figure 3, share the Area IV portion of this site. The SSFL site also contains facilities in which nuclear operations licensed by the U.S. Nuclear Regulatory Commission and the State are conducted. The licensed facilities include (1) the Rockwell International Hot Laboratory (RIHL) (Building 020), (2) several X-ray and radioisotope industrial radiography inspection facilities, and (3) a radiation instrument calibration laboratory. The DOE facility is the Radioactive Material Disposal Facility which receives, processes, and packages radioactive wastes for disposal at authorized DOE disposal sites.

At the Canoga site, the predominate use of radiation is in industrial radiography for quality control inspection of rocket engine components. Other uses involve research and development.

The location of these sites in relation to nearby communities is shown in Figure 4. Surrounding the De Soto complex is light industry, other commercial establishments, apartment buildings, and single-family houses. Bare land surrounds most of the SSFL site, with occasional cattle grazing on the southern portion and some orchard farming at the eastern boundary. No significant

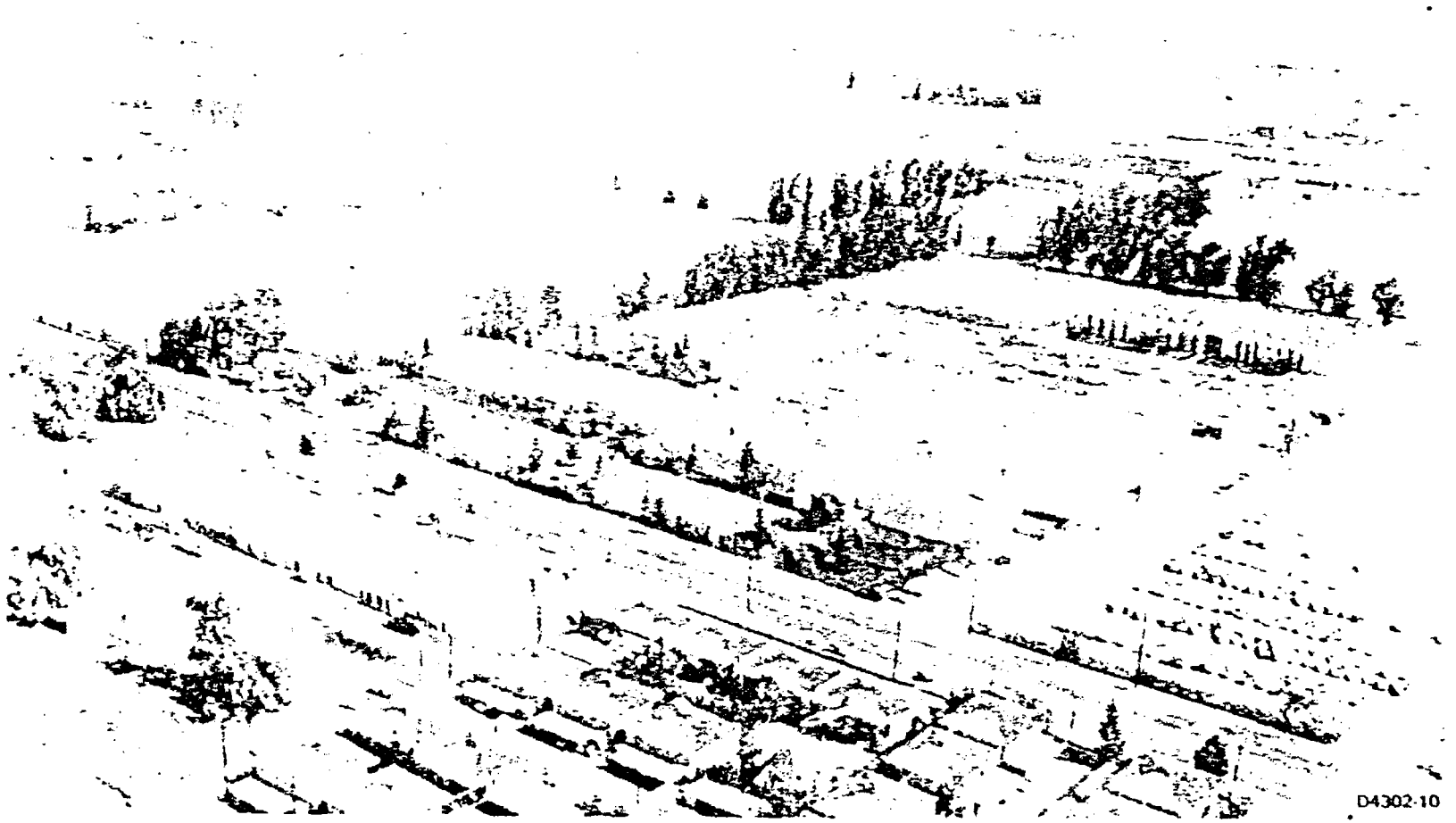

Figure 1. Rocketdyne Division--De Soto Site

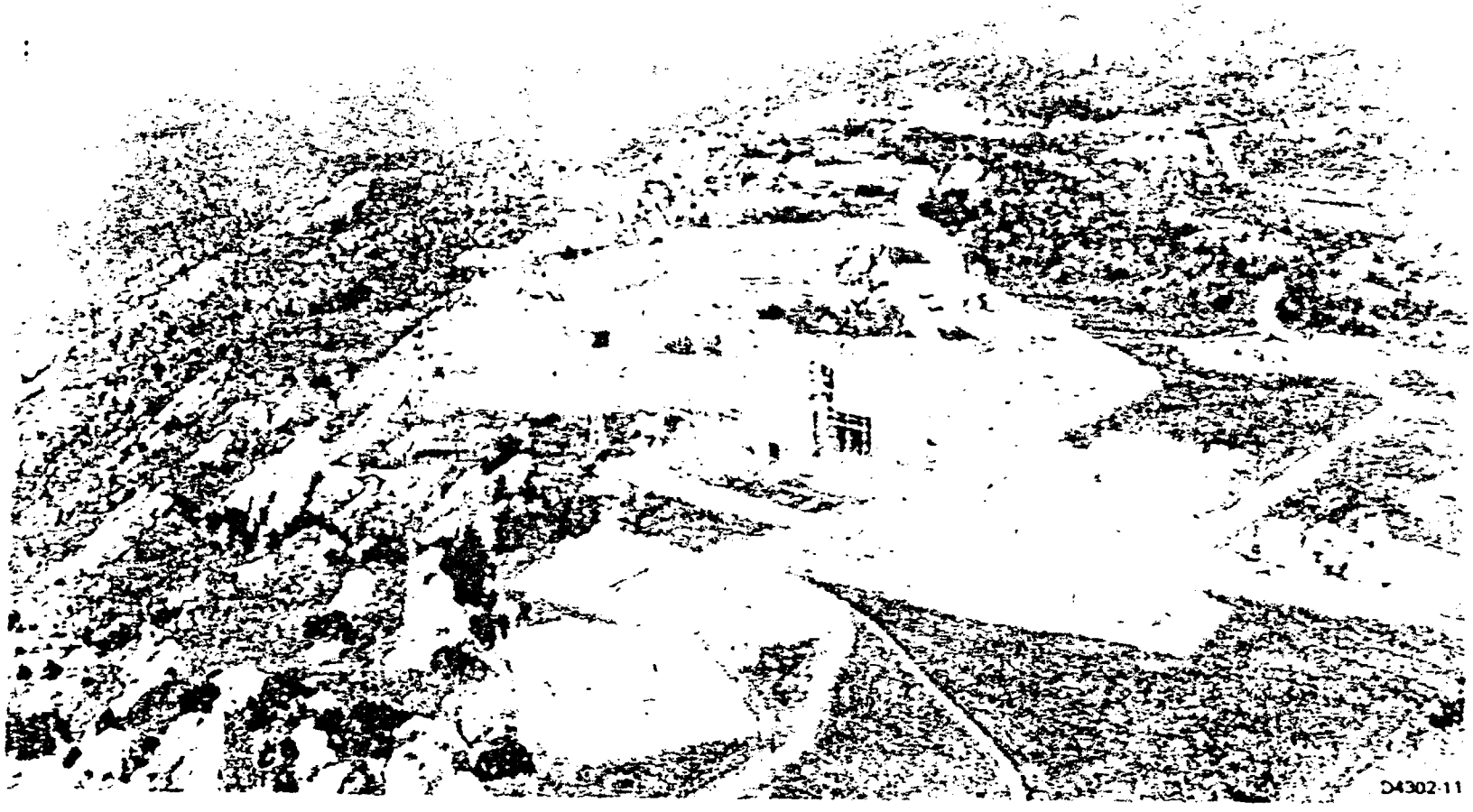

Figure 2. Rocketdyne Division— Santa Susana Field Laboratories Site

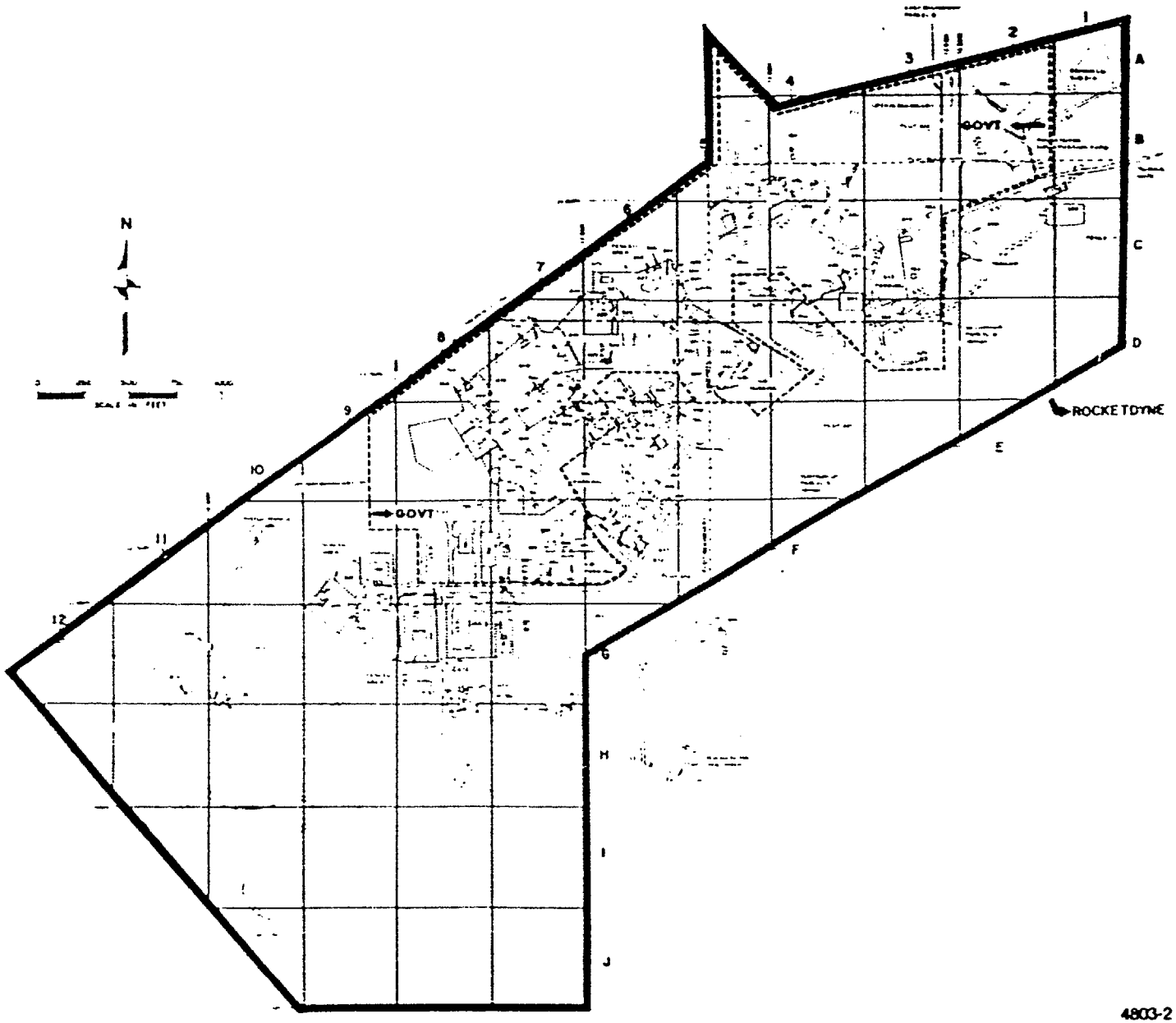

Figure 3. Map of Santa Susana Field Laboratories Site Facilities

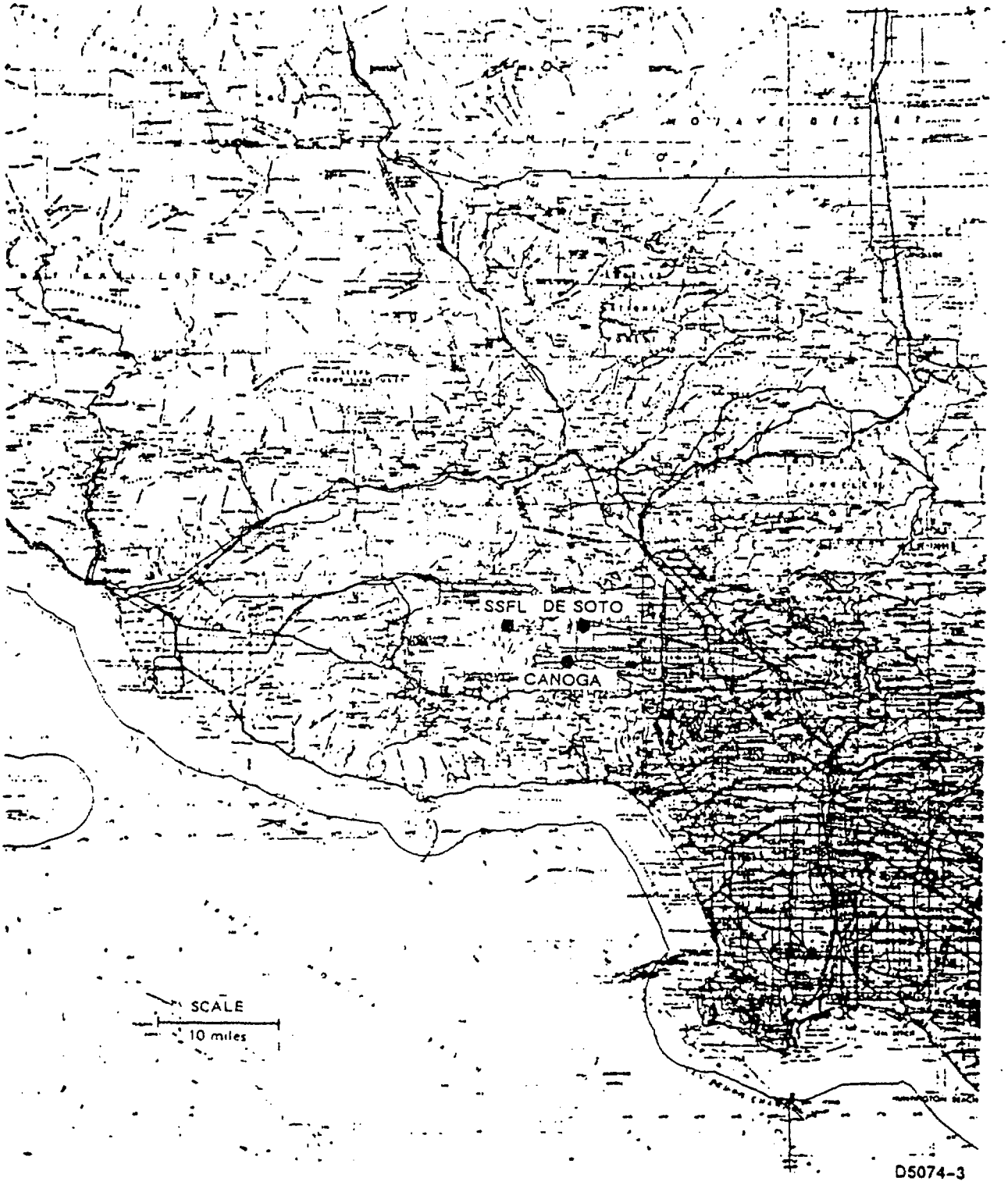

Figure 4. Map of General Los Angeles Area

agricultural land use exists within 30 km of the SSFL site. With the exception of the Pacific Ocean about 20 km south, no recreational body of water of noteworthy size is located in the surrounding area. Four major reservoirs providing domestic water to the Los Angeles area are located within 50 km of SSFL. However, the closest is more than 16 km away.

Within the SSFL site is an 82-acre government-optioned area where Department of Energy (DOE) contract activities are conducted. Most of the work is performed by the nonnuclear Energy Technology Engineering Center (ETEC). The major operational nuclear installation within the DOE-optioned area is the Radioactive Material Disposal Facility (RMDF). This facility is used for storage of irradiated fuel and for packaging radioactive wastes resulting from decommissioning and fuel decladding operations. Radioactive water is evaporated and the sludge is dried and disposed as packaged dry waste together with other dry wastes at a DOE disposal site.

Licensed programs conducted during 1988 were limited to maintenance and decontamination of the RIHL which was used for nuclear reactor fuel decladding and reactor system component examination.

The basic policy for the control of radiological and chemical hazards requires that adequate containment of such materials be provided through engineering controls and that facility effluent releases and external radiation levels be reduced to a minimum through rigid operational controls. The environmental monitoring program implements some safety procedural effectiveness and monitors the engineering safeguards incorporated into facility designs. Except for plutonium, specific radionuclides in environmental samples are not routinely identified because of the extremely low radioactivity levels normally detected. Gross alpha and beta radiation analyses are performed on all other environmental samples. Based upon comparison with current analytical results and the historical data, any significant increase in radioactivity levels would be easily detected. This is assured by attention to the maximum value measured for each sample type throughout the year. Identification of noticeably elevated radioactivity would lead to further analyses and

investigation. Relatively few different radionuclides are involved in operations conducted on site. Facility effluent sample filters for 1988 were composited for specific radiochemistry analysis.

Occasional gamma-spectral analyses of bulk samples such as soil, water, and ambient air sample collection filters confirm that the major radionuclides present are normally those of the naturally occurring thorium and uranium decay chains, plus other natural radionuclides such as the primordial ^{40}K, and ^{7}Be produced by cosmic ray interactions in the atmosphere.

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

Environmental sampling stations located within the De Soto and SSFL Area IV boundaries are referred to as "on-site" stations; those located outside these boundaries, or relatively distant from any nuclear facilities, are referred to as "off-site" stations. The De Soto and SSFL locations are sampled quarterly to determine the concentration of radioactivity in typical surface soil. Soil is also sampled on-site (SSFL) and off-site semiannually for plutonium analysis. Similar off-site environmental samples, except for plutonium analysis, are also obtained quarterly. Water samples are obtained monthly at both De Soto and SSFL from supply water sources, retention ponds, and also from deep and shallow wells on a seasonal frequency. Continuous ambient air sampling provides information concerning long-lived airborne particulate radioactivity. On-site ambient radiation monitoring using thermoluminescent dosimetry (TLD) measures environmental radiation levels at the Canoga, De Soto, and SSFL sites and also at several off-site locations.

Nonradioactive wastes discharged to uncontrolled areas are limited to liquids released to sanitary sewage systems and to surface water drainage systems. No intentional releases of any liquid pollutants are made to uncontrolled areas. Sanitary sewage from all facilities at the SSFL site is

treated at on-site sewage plants. The outfall from the plant for Area IV flows into retention pond R-2A, located toward the southern boundary of the SSFL site. The surface water drainage system of SSFL, which is composed of catch ponds and open drainage ditches, also drains to retention pond R-2A. Water from the pond may be reclaimed as industrial process water or released, as necessary, off-site into Bell Creek, a tributary of the Los Angeles River. The pond water is sampled monthly for radioactivity. It is also sampled at discharge for both radioactive and nonradioactive pollutants as required by the discharge permit (NPDES CA0001309) issued to Rocketdyne Division by the California Regional Water Quality Control Board. In addition, an automatic water sampler takes samples from the discharge stream channel (Bell Creek) whenever water is present.

Section II of this report summarizes and discusses monitoring and sampling methods and describes possible sources of radioactivity. Results of environmental monitoring for 1988 are presented and evaluated in Section III. Part A deals with radioactive materials and reports gross alpha and beta radioactivity and also plutonium isotopes in soil. The maximum value determined for each type of analysis is reported in the tables and shows no significant elevation over the averaged values. Measurements of radionuclide components in atmospheric emissions provide the basis for dose commitment calculations. Part B discusses results of monitoring nonradioactive materials. The sampling and analytical methods used in the environmental monitoring program for radioactive materials are described in Section IV. Treatment and handling of effluents is described in Section V. This section also provides facility descriptions and estimates the general population dose attributable to Rocketdyne operations. A comparison of 1988 radioactivity results with the results from previous years appears in Appendix A. Appendix B provides a summary of the Environmental Monitoring Program Quality Control. Appendix C shows regulatory limits on nonradioactive pollutants in water released from the site. References are listed in Appendix D. The external distribution of this report comprises Appendix E, and a table of alternative units for radiological data is shown in Appendix F. Additional environmetal information of concern to DOE is presented in Appendix G.

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II. SUMMARY AND EVALUATION OF ENVIRONMENTAL MONITORING RESULTS

Except as noted below, all radioactivity levels observed in environmental samples for 1988 are close to radioactivity levels measured during recent years and listed in the previous issues of this report. Local environmental radioactivity levels have decreased and been generally constant during the past several years. These levels are produced by natural and man-made radionuclides. They have revealed the presence of fallout from past atmospheric testing of nuclear devices and from the Chernobyl reactor accident. Present levels are due mainly to primordial natural radionuclides.

The results of this environmental monitoring indicate that there are no significant sources of unnatural radioactive material in the vicinity of the Rocketdyne sites. Additionally, identical results obtained from on-site and off-site samples provide supporting evidence that nuclear operations at Rocketdyne have not contributed to general environmental radioactivity. The atmospheric discharge of radioactive materials provides the only potentially significant exposure pathways to the general public resulting from Rocketdyne nuclear operations. The only exposure pathways to people are via whole body external exposure, inhalation exposure to released materials, and direct radiation exposure. All liquid radioactive wastes are processed for disposal at DOE disposal sites. Liquid radioactive wastes are not released into the environment and do not constitute an exposure pathway.

The maximum individual annual exposures estimated for persons at the site boundary and also at the residence nearest the SSFL site are small when compared with natural radiation and with all applicable guidelines. Inhalation exposure estimates were derived from AIRDOS-EPA calculated concentrations at the boundary and the nearest residence and the dose conversion factors appropriate for radionuclides identified in the effluent from each nuclear facility. Dose conversion factors for all atmospheric effluents were taken from DOE/EH-0071, "Internal Dose Conversion Factors for Calculation of Dose to the Public." This inhalation exposure estimate is the sum of contributions calculated for the measured releases from each facility. Exposures by other modes of the airborne pathway are considered to be negligibly small compared to the

inhalation mode. The external radiation exposure estimates at the maximum exposed boundary location and at the nearest residence are based on results for site ambient radiation dosimeters and also for several facility workplace radiation dosimeters. The unshielded external annual exposure resulting from operations conducted at the RMDF is estimated to be about 40 mR at the nearest boundary-line location and less than 0.1 mR for the nearest residence. The boundary-line exposure is conservative in that the rugged terrain at the site boundary nearest the RMDF precludes anything more than the rare and temporary presence of any person at that location. These values were determined by calculating the unattenuated exposure expected at the boundary and nearest residence on the basis of the highest annual result for area dosimeters in place around the facility. For the nearest residence, radiation attenuation by the air lowers direct radiation to practically nonexistent levels. In most cases, intervening irregular rock formations and hills completely shield off-site locations from the radiation sources. Only natural background radiation inherent to the residence location would be present. Boundary-line direct radiation exposures for the State of California and U.S. NRC-licensed operations at other Rocketdyne nuclear facilities were well below 10 mR for the year.

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

Supply water at the SSFL site is sampled monthly at two locations. This supply consists of water from deep wells site-blended with potable water from the Ventura County Water District 17. In addition, shallow groundwater is periodically sampled at a standpipe adjacent to the basement level of a de-activated reactor test facility (Building 059). These samples are evaluated

for any transfer of activation product radioactivity from the underground reactor test vault containment into the surrounding soil. None has been detected. Therefore, these analyses serve as a measure of radioactivity naturally present in the groundwater. Deep well water samples are also evaluated to determine any impact of Rocketdyne Division nuclear operations on the deep groundwater system underlying SSFL.

Quality assurance measures incorporated into the environmental monitoring program include participation in DOE-sponsored programs such as the Environmental Dosimeter Intercomparison Program and the DOE Environmental Measurements Laboratory Quality Assessment Program (EML-QAP). In 1988, Environmental Monitoring participated in two EML-QAP sample analysis sets (QAP XXVIII and XXIX). Analysis of the QAP results indicates that accuracy in measuring radioactivity in the sample media provided for the intercomparison has improved. In addition to participation in these programs, laboratory analyses of split and replicate samples are routinely evaluated for the reproducibility of sample radioactivity measurements of water and soil gross radioactivity. Control charts of counting system radiation response are maintained. These data are periodically evaluated to determine the correlation between sample sets and trends in background.

III. ENVIRONMENTAL MONITORING RESULTS

A. RADIOACTIVE MATERIALS--1988

The average radioactivity concentrations in local soil, surface and groundwater, and in ambient air for 1988 are presented in Tables 1 through 6.

The presentation of data in the tables includes the annually averaged data for each sample type and the maximum radioactivity level detected for a single sample from the annual set. The single sample is reported because of its significance in indicating the occurrence of a major episode or an area-wide incident of radioactive material deposition. Except for soil, supply water, and air samples, none of the maximum observed values, which generally occurred randomly during the year, show a great increase over the annually averaged values beyond inherent variability. (Refer to Tables 1 through 6.) The ambient air sampling data show no greatly increasing or decreasing trends for the year and can be described as generally constant, with some increase in airborne radioactivity occurring through the third and fourth quarters.

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

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

TABLE 1
SOIL RADIOACTIVITY DATA—1988

Area	Activity	Number of Samples	Gross Radioactivity (pCi/g) Annual Average Value and Dispersion	Gross Radioactivity (pCi/g) Maximum Observed Value* and Month Observed
On-site (quarterly)	Alpha	48	29.1 ± 6.2	53.6 (October)
	Beta	48	26.0 ± 2.8	31.4 (October)
Off-site (quarterly)	Alpha	48	25.6 ± 6.2	39.6 (October)
	Beta	48	24.4 ± 2.7	29.6 (April)
Pond R-2A mud No. 55	Alpha	4	28.7 ± 3.6	33.6 (January)
	Beta	4	24.7 ± 0.8	25.4 (January)
Bell Creek upper stream bed soil No. 62	Alpha	4	22.0 ± 7.5	33.2 (October)
	Beta	4	23.9 ± 1.5	25.1 (December)

*Maximum value observed for single sample.

TABLE 2
SOIL PLUTONIUM RADIOACTIVITY DATA--1988

Sample Location	29 June 1988 Survey Results ^{238}Pu (pCi/g)	29 June 1988 Survey Results $^{239}Pu + ^{240}Pu$ (pCi/g)	1 December 1988 Survey Results ^{238}Pu (pCi/g)	1 December 1988 Survey Results $^{239}Pu + ^{240}Pu$ (pCi/g)
S-56	0.0004 ± 0.0002	0.0008 ± 0.0002	0 ± 0.0001	0.0012 ± 0.0002
S-57	0 ± 0.0001	0.0039 ± 0.0005	0 ± 0.0001	0.0032 ± 0.0005
S-58	0.0004 ± 0.0001	0.0022 ± 0.0003	0 ± 0.0001	0.0033 ± 0.0004
S-59	0.0001 ± 0.0001	0.0031 ± 0.0004	0.0002 ± 0.0001	0.0069 ± 0.0008
S-60	0.0001 ± 0.0001	0.0029 ± 0.0004	0 ± 0.0001	0.0032 ± 0.0004
S-61*	0.0004 ± 0.0002	0.0003 ± 0.0002	0 ± 0.0001	0.0001 ± 0.0001

*Off-site location

For comparison with these results, published data from soil tests in nearby Burbank, California in 1970-71 show a plutonium concentration of approximately 0.002 pCi/g for ^{239}Pu + ^{240}Pu and approximately 0.00006 pCi/g for ^{238}Pu. The data in Table 2 show no significant increases in on-site soil plutonium relative to the Burbank values and no significant variation in soil plutonium concentrations for the 1988 sample sets.

The detected gross radioactivity in soil is due to various naturally occurring radionuclides present in the environment, to radioactive fallout of dispersed nuclear weapons materials, and fission product radioactivity produced by past atmospheric tests of nuclear weapons. No atmospheric nuclear weapons tests were announced during 1988. Naturally occurring radionuclides include ^{7}Be, ^{40}K, ^{87}Rb, ^{147}Sm, and the uranium and thorium series (including radon and daughters). The radionuclide composition of local area surface soil has been determined to be predominantly ^{40}K, natural thorium, and natural uranium, both in secular equilibrium with daughter nuclides, with less than 1% fission-produced radionuclides, principally ^{137}Cs and ^{90}Sr. Radioactivity in aged fallout consists primarily of the fission produced ^{90}Sr-^{90}Y, ^{137}Cs, and ^{147}Pm, and also ^{234}U and ^{239}Pu. Gamma spectrometric analysis of composited ambient air samples collected during 1988 detected the cosmogenic radionuclide ^{7}Be, plus additional natural radionuclides of terrestrial origin, the natural uranium and thorium series, and ^{40}K. Relative amounts of these radionuclides were approximately 73% ^{40}K, 25% ^{7}Be, and the remainder due to the natural uranium series and natural thorium series. The value for ^{7}Be is representative for the mixture only at the time of measurement since the physical half-life is extremely short compared with those of the other radionuclides detected.

Supply water is sampled monthly at De Soto and at two widely separated SSFL site locations. The average supply water radioactivity concentration for each site is presented in Table 3. Supply water used at De Soto is supplied by the Los Angeles Department of Water and Power. Supply water used at the SSFL site is obtained partly from the Ventura County Water District No. 17, which also supplies nearby communities, and from local well water. Two

TABLE 3

SUPPLY WATER RADIOACTIVITY DATA--1988

Area	Activity	Number of Samples	Gross Radioactivity (10^{-9} µCi/ml) Average Value and Dispersion	Gross Radioactivity (10^{-9} µCi/ml) Maximum Value* and Month Observed
De Soto (monthly)	Alpha	12	3.80 ± 1.42	6.57 (April)
	Beta	12	4.10 ± 0.43	5.16 (March)
SSFL (monthly)	Alpha	24	5.40 ± 3.34	13.81 (June)
	Beta	24	3.93 ± 0.84	5.80 (June)

*Maximum value observed for single sample.

on-site water wells (wells 5 and 13) were operated during FY 1988 to reduce the consumption of the Ventura County water. The well water proportion in the blend averaged about 67% for the year, for a total well water consumption of about 2.7×10^5 m^3 (7.1×10^7 gal).

A shallow standpipe, connected to a French drain at foundation level, is being used for sampling of groundwater adjacent to the underground reactor test vault. (This standpipe was installed during a construction modification to a currently deactivated Space Nuclear Auxiliary Power, SNAP, reactor test facility.) Water in the standpipe is periodically sampled for the purpose of detecting any transfer of activation product radioactivity from the containment to the outside environment. Radioactivity in seven samples taken during 1988 averaged 1.2×10^{-8} µCi/ml beta with no alpha activity detected. Gamma spectrometric analysis, with a minimum detection limit for ^{60}Co of about 5×10^{-7} µCi/ml, has not identified any specific unnatural radionuclides in the water; thus, the observed activity is attributed to dissolved radioelements of natural origin in the soil bed.

A recent hydrogeologic study at SSFL describes two groundwater systems at the site: a shallow, unconfined system in the alluvial surface mantle of the Burro Flats area and along the major drainage channels, and a deeper groundwater system in the fractured Chatsworth sandstone. Alluvium along the major surface drainage systems may store and transmit groundwater to the underlying Chatsworth formation through fractures. Water levels in the alluvium respond to recharge resulting from surface flows and may vary considerably between wet and dry periods. The alluvium, composed of a heterogeneous mixture of gravel, sand, silt, and clay, has estimated hydraulic conductivities ranging from 0.1 to 1000 gal/day/ft^2.

The Chatsworth formation is composed of well-consolidated, massively bedded sandstones with interbedded layers of siltstone and claystone. The layer may be as thick as 6,000 ft at the SSFL site. The direction of groundwater flow in the formation is probably radially off-site toward the surrounding lowlands and is probably controlled by fracture zones.

The hydrogeologic environment at the SSFL site is a dynamic system. Groundwater is recharged at the site, moves through the aquifers, and discharges to the surface or to other aquifers down-gradient of the site. The groundwater system is recharged by precipitation and by unlined ponds and drainage channels. Because of the meager rainfall in the area and the relatively large variability in annual precipitation, groundwater recharge may vary greatly from year to year. Specific pathways of possible contaminant transport are difficult to predict on the basis of on-site well data. The most likely pathways are along fracture zones that trend off-site.

As discussed earlier, surface waters discharged from SSFL facilities and the sewage plant outfall drain southward into Rocketdyne retention pond R-2A. When the pond is full, the water may be discharged into Bell Creek, a tributary of the Los Angeles River in the San Fernando Valley, Los Angeles County. Average radioactivity concentrations in retention pond R-2A, upper Bell Creek, and test well samples are presented in Table 4.

TABLE 4

SSFL SITE RETENTION POND, SITE RUNOFF, AND WELL WATER RADIOACTIVITY DATA 1988
(Sheet 1 of 4)

Area	Activity	Number of Samples	Gross Radioactivity Concentration ($\times 10^{-9}$ µCi/ml) Annual Average Value and Dispersion	Maximum Value[a] and Month Observed	Percent of Samples With Activity <LLD[b]
Pond No. 6 (Monthly)	Alpha	12	2.04 ± 1.63	4.48 (September)	100
	Beta	12	4.18 ± 0.70	5.56 (October)	0
Pond No. 12 (R-2A) (Monthly)	Alpha	12	4.47 ± 2.11	8.47 (September)	92
	Beta	12	4.51 ± 0.91	6.49 (September)	0
Upper Bell Creek No. 17 (Seasonal)	Alpha	8	3.67 ± 2.36	8.92 (December)	75
	Beta	8	4.31 ± 0.85	5.59 (December)	0
Well WS-4A (Seasonal)	Alpha	3	5.54 ± 2.33	6.89 (March)	100
	Beta	3	4.35 ± 0.12	4.48 (June)	0
Well WS-5 (Seasonal)	Alpha	12	3.47 ± 3.07	8.95 (August)	83
	Beta	12	4.27 ± 0.93	6.21 (August)	0
Well WS-6 (Seasonal)	Alpha	3	6.78 ± 1.48	7.83 (March)	50
	Beta	3	5.02 ± 0.56	5.63 (December)	0
Well WS-7 (Seasonal)	Alpha	2	9.16 ± 6.84	14.00 (June)	50
	Beta	2	5.75 ± 1.15	6.56 (June)	0

TABLE 4

SSFL SITE RETENTION POND, SITE RUNOFF, AND WELL WATER RADIOACTIVITY DATA 1988
(Sheet 2 of 4)

Area	Activity	Number of Samples	Gross Radioactivity Concentration ($\times 10^{-9}$ µCi/ml) Annual Average Value and Dispersion	Gross Radioactivity Concentration ($\times 10^{-9}$ µCi/ml) Maximum Value[a] and Month Observed	Percent of Samples With Activity <LLD[b]
Well WS-8 (Seasonal)	Alpha	4	7.95 ± 2.66	10.60 (March)	25
	Beta	4	3.68 ± 1.65	6.10 (December)	0
Well WS-9 (Seasonal)	Alpha	3	9.67 ± 1.56	10.82 (June)	0
	Beta	3	4.60 ± 0.22	4.76 (December)	0
Well WS-9A (Seasonal)	Alpha	1	4.40	4.40 (December)	100
	Beta	1	3.37	3.37 (December)	0
Well WS-11 (Seasonal)	Alpha	Well out of service			
	Beta				
Well WS-12 (Seasonal)	Alpha	2	6.38 ± 5.62	10.35 (June)	50
	Beta	2	5.42 ± 0.19	5.53 (June)	0
Well WS-13 (Seasonal)	Alpha	12	4.62 ± 3.21	8.54 (October)	83
	Beta	12	4.09 ± 0.75	5.78 (June)	0

TABLE 4

SSFL SITE RETENTION POND, SITE RUNOFF, AND WELL WATER RADIOACTIVITY DATA 1988
(Sheet 3 of 4)

Area	Activity	Number of Samples	Gross Radioactivity Concentration ($\times 10^{-9}$ µCi/ml) Annual Average Value and Dispersion	Gross Radioactivity Concentration ($\times 10^{-9}$ µCi/ml) Maximum Value[a] and Month Observed	Percent of Samples With Activity <LLD[b]
Well WS-14 (Seasonal)	Alpha	2	10.44 ± 0.01	10.45 (December)	0
	Beta	2	4.61 ± 0.30	4.82 (December)	0
Well OS-1 (Seasonal)	Alpha	3	5.50 ± 3.23	7.77 (March)	33
	Beta	3	4.20 ± 0.95	5.19 (September)	0
Well OS-2 (Seasonal)	Alpha	3	6.40 ± 2.29	9.01 (December)	66
	Beta	3	2.96 ± 1.23	4.23 (September)	0
Well OS-5 (Seasonal)	Alpha	3	7.53 ± 7.39	15.11 (September)	66
	Beta	3	4.20 ± 0.41	4.46 (September)	0
Well OS-8 (Seasonal)	Alpha	2	3.52 ± 3.31	5.86 (December)	100
	Beta	2	3.60 ± 1.39	4.59 (December)	0
Well OS-10 (Seasonal)	Alpha	1	4.87	4.87 (December)	100
	Beta	1	1.55	1.55 (December)	0

TABLE 4

SSFL SITE RETENTION POND, SITE RUNOFF, AND WELL WATER RADIOACTIVITY DATA 1988
(Sheet 4 of 4)

Area	Activity	Number of Samples	Gross Radioactivity Concentration ($\times 10^{-9}$ µCi/ml) Annual Average Value and Dispersion	Maximum Value[a] and Month Observed	Percent of Samples With Activity <LLD[b]
Well OS-13 (Seasonal)	Alpha	Dry well--no sample			
	Beta				
Well OS-15 (Seasonal)	Alpha	1	11.87	11.87 (December)	100
	Beta	1	6.63	6.63 (December)	0
Well OS-16 (Seasonal)	Alpha	2	11.06 ± 7.18	16.13 (June)	50
	Beta	2	4.90 ± 0.88	5.52 (March)	0
Well RS-20 (Seasonal)	Alpha	1	2.29	2.29 (December)	100
	Beta	1	0.50	0.50 (December)	100
Well RS-21 (Seasonal)	Alpha	1	14.60	14.60 (March)	0
	Beta	1	1.75	1.75 (March)	0
Well RS-22 (Seasonal)	Alpha	2	11.56 ± 8.32	17.45 (March)	50
	Beta	2	2.01 ± 0.53	2.38 (September)	0

[a]Maximum value observed for single sample.
[b]Lower limit of detection: Approximately 0.4 x 10^{-9} µCi/ml alpha; 1.10 x 10^{-9} µCi/ml beta for water.

Comparison of the radioactivity concentrations in water from the ponds with that of the supply water shows no significant differences in either alpha or beta activity. Similarly, comparisons between on-site and off-site soil samples and those of upper Bell Creek stream bed show no significant differences.

The SSFL site surface water and the ambient air radioactivity concentration guide values selected for each site are the most restrictive limits for those radionuclides currently in use at Rocketdyne facilities and should not be taken to indicate the identification of these radionuclides in the samples. Radioactivity concentration guide values are those concentration limits adopted by the Nuclear Regulatory Commission (NRC) and the State of California as maximum permissible concentration (MPC) values for uncontrolled areas. These values are established in 10 CFR 20 and California Administrative Code Title 17. These MPCs are consistent with the derived air concentration (DAC) and drinking water guidelines presented in draft DOE Order 5400.XX (03/31/87). 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 single lowest MPC value for the various radionuclides present is selected rather than a derived MPC for the mixture. Accordingly, for SSFL site surface water, the guide values of 5×10^{-6} µCi/ml alpha activity corresponding to ^{239}Pu and 3×10^{-7} µCi/ml beta activity corresponding to ^{90}Sr are used.

Ambient air sampling for long-lived particulate alpha and beta radioactivity is performed continuously by automatic sequential samplers located at De Soto and SSFL. Air is drawn through glass fiber filters, which are analyzed for retained long-lived radioactivity after a minimum 120-h decay period that eliminates naturally occurring short-lived particulate radioactivity (most radon daughters). The average concentrations of ambient air alpha and beta radioactivity for 1988 are presented for the various sampler locations in Table 5.

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 x

TABLE 5

AMBIENT AIR RADIOACTIVITY DATA--1988

Area	Activity	Number of Samples	Gross Radioactivity Concentrations--Femtocuries per m^3 (10^{-15} µCi/ml) Annual Average Value and Dispersion	Maximum Value[a] and Date Observed	Percent of Guide[b]	Percent Less Than LLD
De Soto (2 locations)	Alpha	680	2.4 ± 2.6	15.0 (04/03)	0.08	96
	Beta		34.1 ± 21.8	108.6 (10/24)	0.01	48
SSFL Area IV (5 locations)	Alpha	1696	1.9 ± 2.7	17.3 (08/10)	3.2	98
	Beta		31.0 ± 20.4	134.4 (01/04)	0.10	55
SSFL sewage treatment plant	Alpha	355	2.2 ± 2.7	11.2 (09/07)	3.7	99
	Beta		31.5 ± 19.0	94.6 (12/14)	0.11	50
SSFL control center	Alpha	346	1.9 ± 2.7	10.9 (09/07)	3.2	98
	Beta		31.1 ± 19.3	99.8 (10/16)	0.10	56
All locations	Alpha	3077	2.1 ± 2.7	-	-	-
	Beta		31.7 ± 20.4			

[a]Maximum value observed for single sample.

[b]Guide De Soto site: 3×10^{-12} µCi/ml alpha, 3×10^{-10} µCi/ml beta; 10 CFR 20 Appendix B, CAC 17. SSFL site: 6×10^{-14} µCi/ml alpha, 3×10^{-11} µCi/ml beta; 10 CFR 20 Appendix B, CAC 17, DOE Order 5480.1A.

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

10^{-11} µCi/ml for beta activity is due to the presence of ^{90}Sr 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 prior work with unencapsulated depleted uranium. The guide value of 3×10^{-10} µCi/ml is for ^{60}Co, for which the ambient air beta activity guide is appropriate since it is the most restrictive limit for any beta-emitting radionuclide in use at De Soto. Guide value percentages are not presented for soil data, since none have been established.

Figure 5 is a graph of the weekly averaged long-lived alpha and beta ambient air radioactivity concentrations for De Soto and SSFL during 1988. The daily data were mathematically smoothed in a moving weekly average of daily data for the year. The average alpha and beta radioactivity concentrations for each month are indicated by horizontal bars. The graph shows an abrupt decrease in airborne radioactivity during March and April which is a

result of the movement of a series of intense rain storms into the Southern California area. By the end of June, activity returned to previous levels and continued to be generally constant or slightly increasing during the remainder of 1988. The activity detected in ambient air is attributed to naturally occurring radioactive materials and possibly to aged fission products from past atmospheric tests of nuclear devices. Radionuclides detected in air samples collected during 1988 include ^{7}Be and ^{40}K plus several naturally occurring radionuclides from the uranium and thorium series. While the data for air- borne alpha activity are nearly all below the minimum detection level for a single sample, averaging values from nine daily air samples over seven con- secutive days and over calendar months reveal the long-term behavior of this activity.

Monitoring of ambient radiation is performed with TLDs. Each dosimeter set uses two calcium fluoride (CaF_2:Mn) low background, bulb-type chip dosimeters. The dosimeter sets are placed at locations on or near the perimeters of the De Soto, SSFL, and Canoga sites. Each dosimeter, sealed in a light-proof energy compensation shield, is installed in a sealed plastic container mounted about 1 m above ground at each location. The dosimeters are exchanged and evaluated quarterly. During the year, 27 on-site TLD monitoring locations were used. Five additional dosimeter sets, placed at locations up to 10 miles from the sites, are similarly evaluated to determine the local area off-site ambient radiation level, which averaged 9 μR/h for 1988. Table 6 presents the quarterly and annual radiation exposures, the equivalent absolute and altitude-adjusted annual exposures, and exposure rates determined for each dosimeter location.

During the third quarter of 1988, TLD exposure data was somewhat higher than expected for the on-site and off-site dosimeters. The higher results were noted for both off-site and on-site dosimeters. It was concluded that the values were affected by an intermittently malfunctioning shutter in the

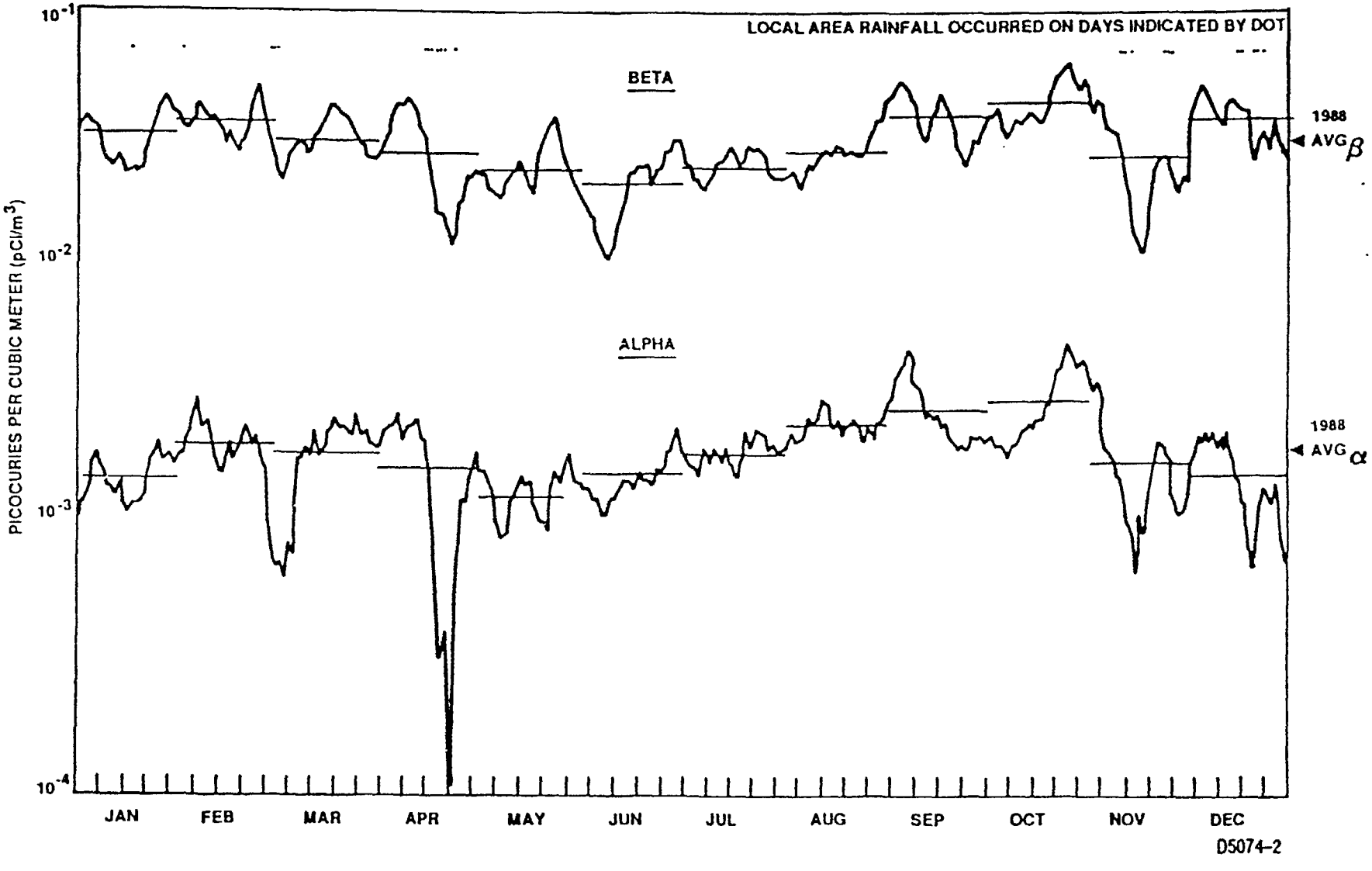

Figure 5. Weekly, Monthly, and Annual Averaged Long-Lived Airborne Radioactivity at the De Soto and Santa Susana Field Laboratories Sites--1988

TABLE 6

DE SOTO, SSFL, AND CANOGA SITES--AMBIENT RADIATION DOSIMETRY DATA--1988

TLD Location		Quarterly Exposure (mR)				Annual Exposure (mR)	Equivalent Exposure at 1000-ft ASL	
		Q-1	Q-2	Q-3	Q-4		(mR)	(μR/h)
De Soto	DS-1	20	23	27	20	90	91	10
	DS-2	21	21	22	16	80	82	9
	DS-3	20	23	27	17	87	90	10
	DS-4	19	18	27	20	84	85	10
	DS-5	20	15	20	15	70	71	8
	DS-6	23	16	33	15	87	88	10
	DS-7	23	16	37	19	95	96	11
	DS-8	19	10	31	15	75	78	9
Mean value		21	18	28	17	84	85	10
SSFL	SS-1	21	22	31	20	94	82	9
	SS-2	26	22	30	23	101	89	10
	SS-3	21	20	27	18	86	74	8
	SS-4	18	29	29	22	98	85	10
	SS-5	21	21	29	27	98	84	10
	SS-6	25	19	29	21	94	82	9
	SS-7	27	14	31	14	86	73	8
	SS-8	26	12	41	18	97	84	10
	SS-9	29	20	32	21	102	90	10
	SS-10	24	18	31	20	93	81	9
	SS-11	33	26	39	39	137	126	14
	SS-12	32	25	41	31	129	118	13
	SS-13	25	19	32	29	105	94	11
Mean value		25	21	32	23	102	89	10
Canoga	CA-1	22	11	24	12	69	72	8
	CA-2	19	13	31	13	76	78	9
	CA-3	23	14	24	13	74	75	9
	CA-4	24	13	25	15	77	79	9
	CA-5	19	7	43	8	77	79	9
	CA-6	17	14	34	13	78	79	9
Mean value		21	12	30	12	75	77	9
Off-site	OS-1	29	18	25	13	85	88	10
	OS-2	18	12	21	13	64	62	7
	OS-3	18	21	25	18	82	84	10
	OS-4	21	16	25	13	75	73	8
	OS-5	22	16	27	16	81	81	9
Mean value		22	17	25	15	77	78	9

dosimeter reader, which artificially increase the results. The data reported for 1988 include a correction for self-irradiation as recommended by the U.S. DOE Environmental Measurements Laboratory. This correction tends to reduce the exposure estimates. Improvements in dosimeter calibration methods, field deployment, and storage conditions continue to be implemented.

Table 6 shows that radiation exposures and equivalent annual exposure rates monitored on-site are nearly identical to levels monitored at the five widely separated off-site locations. These data reflect natural background radiation from cosmic radiation, radionuclides in the soil, radon and thoron in the atmosphere, and local radioactive fallout. Locally, the natural background radiation level as measured by these dosimeters is about 100 mR/yr. The small variability observed in the data is attributed to differences in elevation and geologic conditions at the various dosimeter locations. The altitude range for the dosimeter locations is from about 850-ft ASL (above sea level) at the Canoga facility to a maximum of about 1900-ft ASL at SSFL. When normalized to a specific altitude by adjusting the measured value (using an altitude adjustment factor equal to 15 mR/1000-ft elevation difference), derived radiation exposures for all locations are essentially identical. The 1988 averaged total exposure values adjusted to 1000-ft ASL are 85 $\pm$ 8 mR for De Soto, 89 $\pm$ 16 mR for the SSFL site, 77 $\pm$ 3 mR for the Canoga site, and 78 $\pm$ 10 mR for the off-site control dosimeters.

Supplementary measurements of ambient radiation levels with high-pressure ion chamber (HPIC) monitors are made at two locations at the SSFL site. The HPIC values for 1988 were equivalent to annual exposures of 109 mR for the Building 207 monitor and 97 mR for the Building 363 monitor. These values are in good agreement with results for nearby TLD locations for the year.

The Radiologic Health Section of the State of California Department of Health Services provides packages containing calcium sulfate ($CaSO_4$) dosimeters for independent monitoring of radiation levels in this area. These dosimeters are placed in field deployment containers used for the bulb dosimeters. The State dosimeters are returned to the Radiologic Health Section

for evaluation by their vendor laboratory. Data for these TLDs, placed at eight Rocketdyne dosimeter locations, both on-site and off-site, were not available from the State for inclusion in this report.

B. NONRADIOACTIVE MATERIALS--1988

Processed wastewater and most of the collected surface runoff discharged from the SSFL site flows to Rocketdyne retention pond R-2A. 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 are normally done only as a result of excessive rainfall runoff. During a relatively dry 1988, only 11 off-site discharges from pond R-2A occurred. Water is discharged to Bell Canyon under NPDES Permit No. CA0001309. The allowable limits of this permit are listed in Appendix C. (In addition, five discharges were made from Perimeter Pond, which does not receive any water from Area IV.) The results of the pond R-2A water analyses for each discharge during 1988 are presented in Table 7 and are compared with the discharge limits established by the NPDES Permit. During the discharge of September 22, the analytical results showed an excess of sulfate, above the allowable limit. This was presumed to have resulted from cooling water discharged from the Sodium Component Test Installation (SCTI).

TABLE 7

NONRADIOACTIVE CONSTITUENTS IN WASTEWATER DISCHARGED TO UNCONTROLLED AREAS -1988
(Analysis Results for Wastewater Discharged from Pond R-2A to
Bell Creek on Date Indicated -Sample Station W-12)
(Sheet 1 of 2)

Constituent	January 17*		February 29*		April 20*		September 22		November 14*		November 18	
	Result	Limit (%)	Result	Limit (%)	Result	Limit (%)	Result	Limit (%)	Result	Limit (%)	Result	Limit (%)
Total dissolved solids (mg/ℓ)	300	31.6	320	33.7	322	33.9	859	90.4	610	64.2	585	61.6
Chloride (mg/ℓ)	22	14.7	30	20.0	28	18.7	103	68.7	74	49.3	120	80.0
Sulfate (mg/ℓ)	82	27.3	78	26.0	88	29.3	332	110.7	170	56.7	140	46.7
Suspended solids (mg/ℓ)	40	-	25	-	63	-	29	-	27	-	9	-
Settleable solids (mg/ℓ)	0.3	100.0	<0.1	<33.3	0	0	0.1	<33.3	<0.01	<3.3	<0.01	<3.3
BOD_5 (mg/ℓ)	4	13.3	3	10.0	5	16.7	10	33.3	8	26.7	2	6.7
Oil and grease (mg/ℓ)	<5	<33.3	3	20.0	3	20.0	1	6.7	<1	<6.7	1.2	8.0
Turbidity (TU)	18	-	32	-	33	-	10	-	13	-	5	-
Fluoride (mg/ℓ)	0.2	20.0	0.4	40.0	0.2	20.0	0.7	70.0	0.6	60.0	0.5	50.0
Boron (mg/ℓ)	<0.1	<10.0	0.2	20.0	0.2	20.0	0.2	20.0	0.6	60.0	0.3	30.0
Residual chlorine (mg/ℓ)	<0.04	<40.0	<0.04	<40.0	0	0	0.04	40.0	<0.04	<40.0	<0.04	<40.0
Surfactants (MBAS)	<0.025	<5.0	0.03	6.0	0	0	0.04	8.0	0.03	6.0	0.03	6.0
pH	8.1		8.0		8.2		8.4		9.0		8.2	
Rainfall (cm)	6.1		5.7		3.6		-		0.64		-	
Estimated rainfall runoff (m^3)	41,416		32,172		-		-		22,680		-	
Release volume (m^3)	21,749		21,749		9,329		37,826		7,815		7,955	

*Rainfall-related discharge.

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TABLE 7

NONRADIOACTIVE CONSTITUENTS IN WASTEWATER DISCHARGED TO UNCONTROLLED AREAS -1988
(Analysis Results for Wastewater Discharged from Pond R-2A to
Bell Creek on Date Indicated -Sample Station W-12)
(Sheet 2 of 2)

	November 22		December 1		December 15*		December 21*		December 27*	
Constituent	Result	Limit (%)	Result	Limit (%)	Result	Limit (%)	Result	Limit (%)	Result	Limit (%)
Total dissolved solids (mg/ℓ)	510	53.7	520	54.7	576	60.6	210	22.1	220	23.2
Chloride (mg/ℓ)	119	79.3	125	83.3	66	44.0	24	16.0	27	18.0
Sulfate (mg/ℓ)	115	38.3	116	38.7	133	44.3	53	17.7	58	19.3
Suspended solids (mg/ℓ)	4.5	-	8	-	3.2	-	41	-	23.5	-
Settleable solids (mg/ℓ)	<0.01	<3.3	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3
BOD_5 (mg/ℓ)	3	10.0	9.6	32.0	1.6	5.3	2.6	8.7	2.5	8.3
Oil and grease (mg/ℓ)	<1.0	<6.7	<1.0	<6.7	<0.1	<0.7	2.2	14.7	<1.0	<6.7
Turbidity (TU)	5	-	6	-	2.5	-	56	-	29	-
Fluoride (mg/ℓ)	0.5	50.0	0.5	50.0	0.7	70	<0.1	<10.0	0.1	10.0
Boron (mg/ℓ)	0.3	30.0	0.3	30.0	0.6	60	0.1	10.0	0.2	20.0
Residual chlorine (mg/ℓ)	<0.1	<100	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	0	0
Surfactants (MBAS)	0.024	4.8	0.034	6.8	0.023	4.6	<0.01	<2.0	0.004	0.8
pH	8.2		7.8		8.0		7.1		7.7	
Rainfall (cm)	-		-		4.1		3		3.4	
Estimated rainfall runoff (m^3)	-		-		113,400		90,720		98,280	
Release volume (m^3)	19,005		4,062		4,813		8,712		20,160	

*Rainfall-related discharge.

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IV. ENVIRONMENTAL MONITORING PROGRAM

A. DESCRIPTION

The environmental monitoring program was initiated in 1952 at Rocketdyne's predecessor company, which was then located in Downey, California. At that time, a program of soil and vegetation sample collection and analysis was begun to study environmental effects from the nuclear research and development conducted there. This program was designed with the primary purpose of adequately surveying environmental radioactivity to ensure that company nuclear operations would not contribute significantly to local radioactivity. Any program changes have reflected this primary objective. Environmental sampling was subsequently extended to the then proposed Sodium Reactor Experiment (SRE) site in the Simi Hills in May 1954. Sampling was also begun in the Burro Flats area, southwest of SRE, where other nuclear installations were planned and are currently in operation. The Downey area survey was terminated when nuclear activities were relocated to Canoga Park in 1955. After review of the needs and results of the environmental monitoring program in 1986, sampling of vegetation for radioactivity analysis was terminated and soil sampling frequency was reduced to quarterly. This was based upon reviews of the sampling program and the nuclear operations being conducted at the site. The reduced nuclear operations and the historical data led to the conclusion that quarterly sampling was adequate to confirm releases of radioactivity identified by other monitoring methods. Although the reduction in the number of on-site soil samples taken annually is significant, the number of off-site soil samples taken annually remains the same. Table A-1 shows that the 1988 averaged values for soil activity compares well with values for prior years. Locations of sampling stations are shown in Figures 6 through 9 and listed in Table 8.

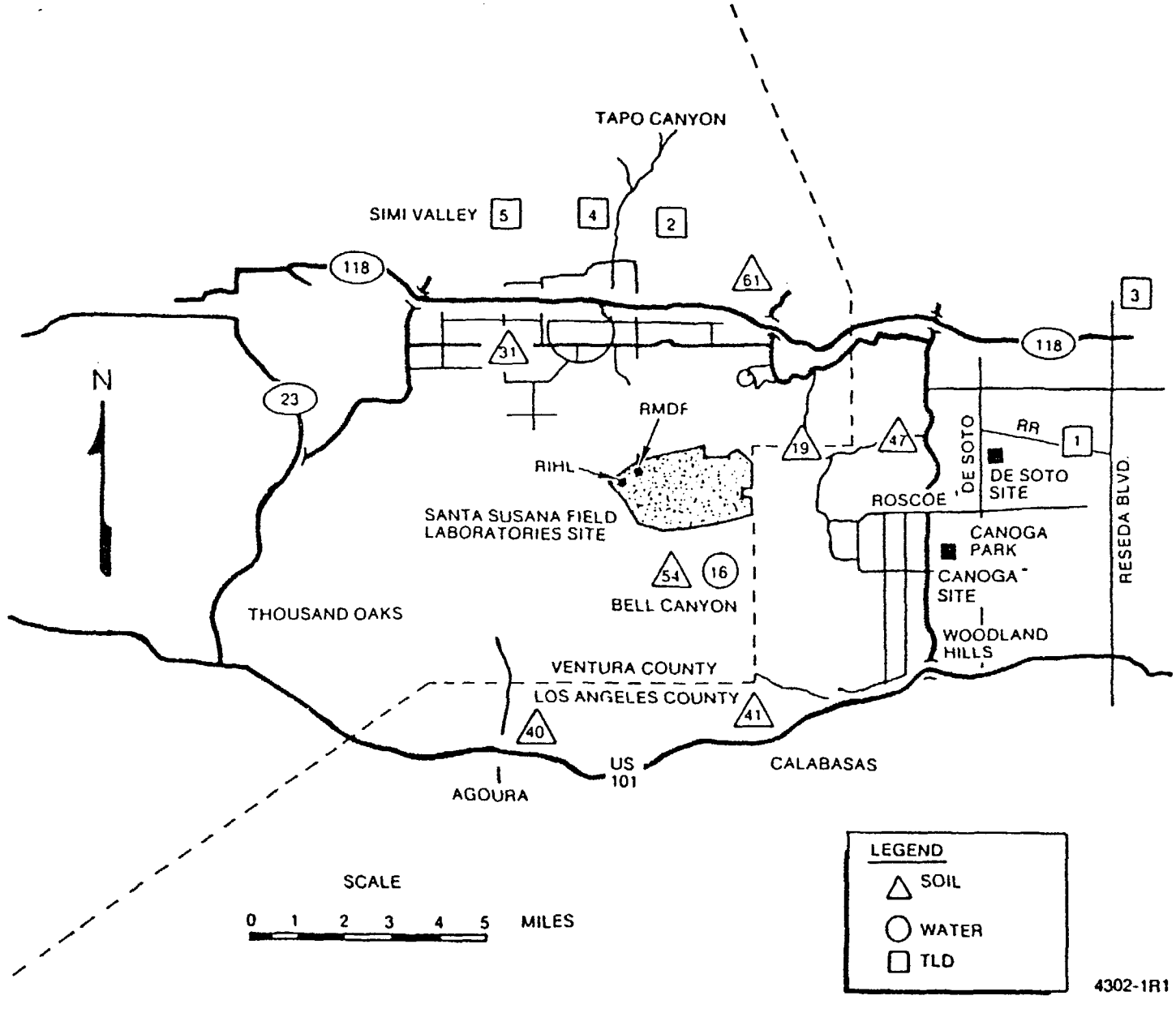

Figure 6. Map of Canoga Park, Simi Valley, Agoura, and Calabasas Sampling Stations

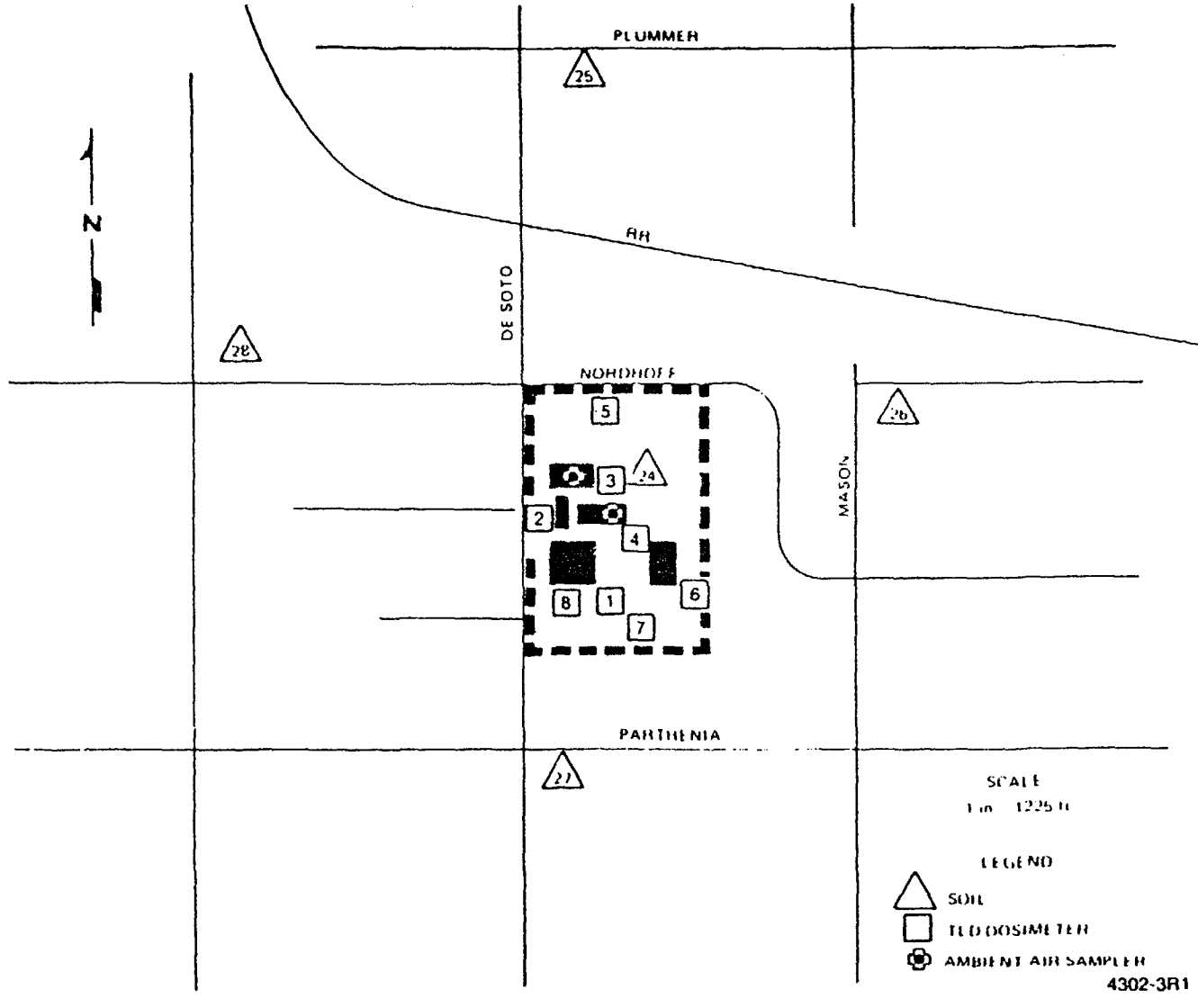

Figure 7. Map of De Soto Site and Vicinity Sampling Stations

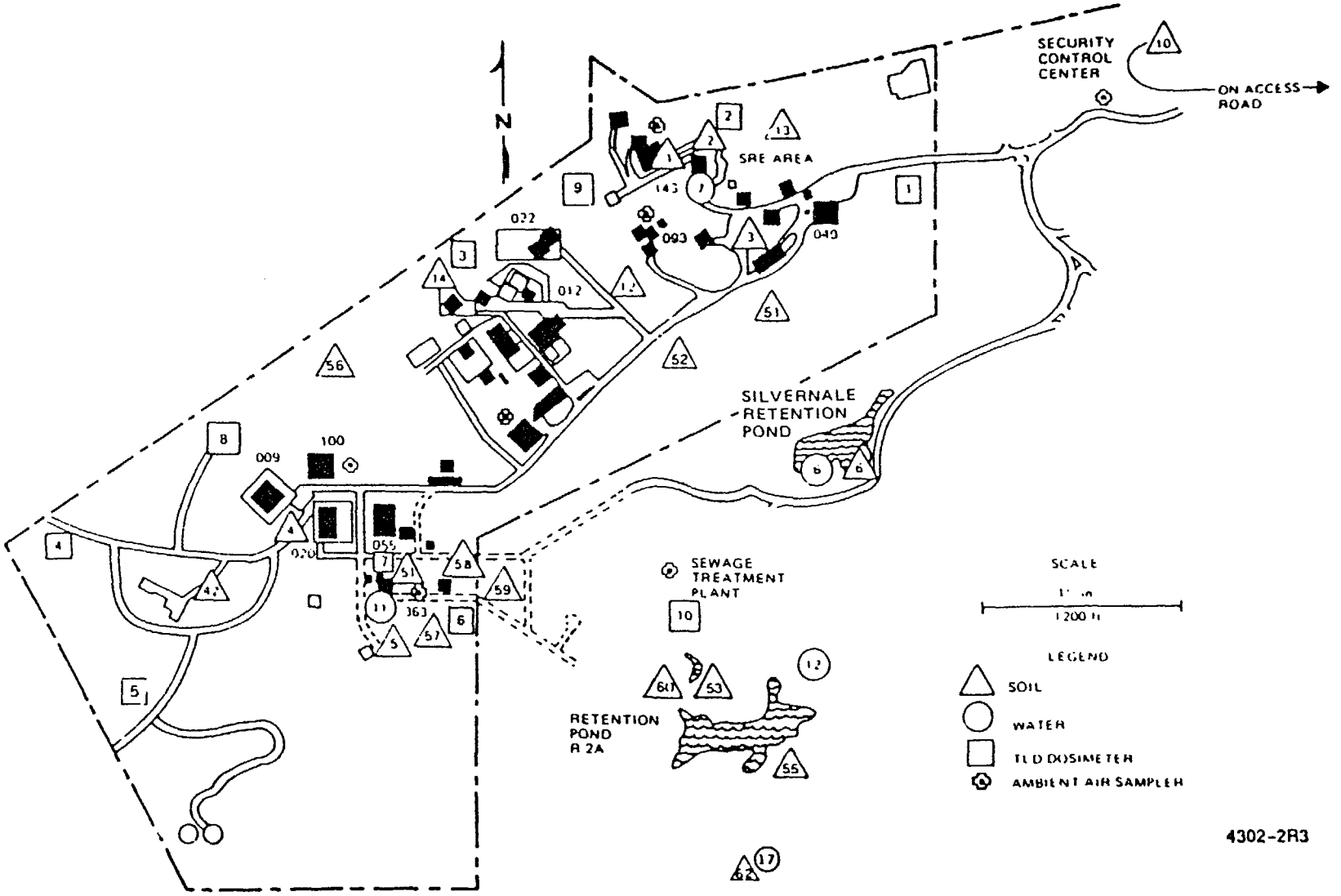

Figure 8. Map of Santa Susana Field Laboratories Site Sampling Stations

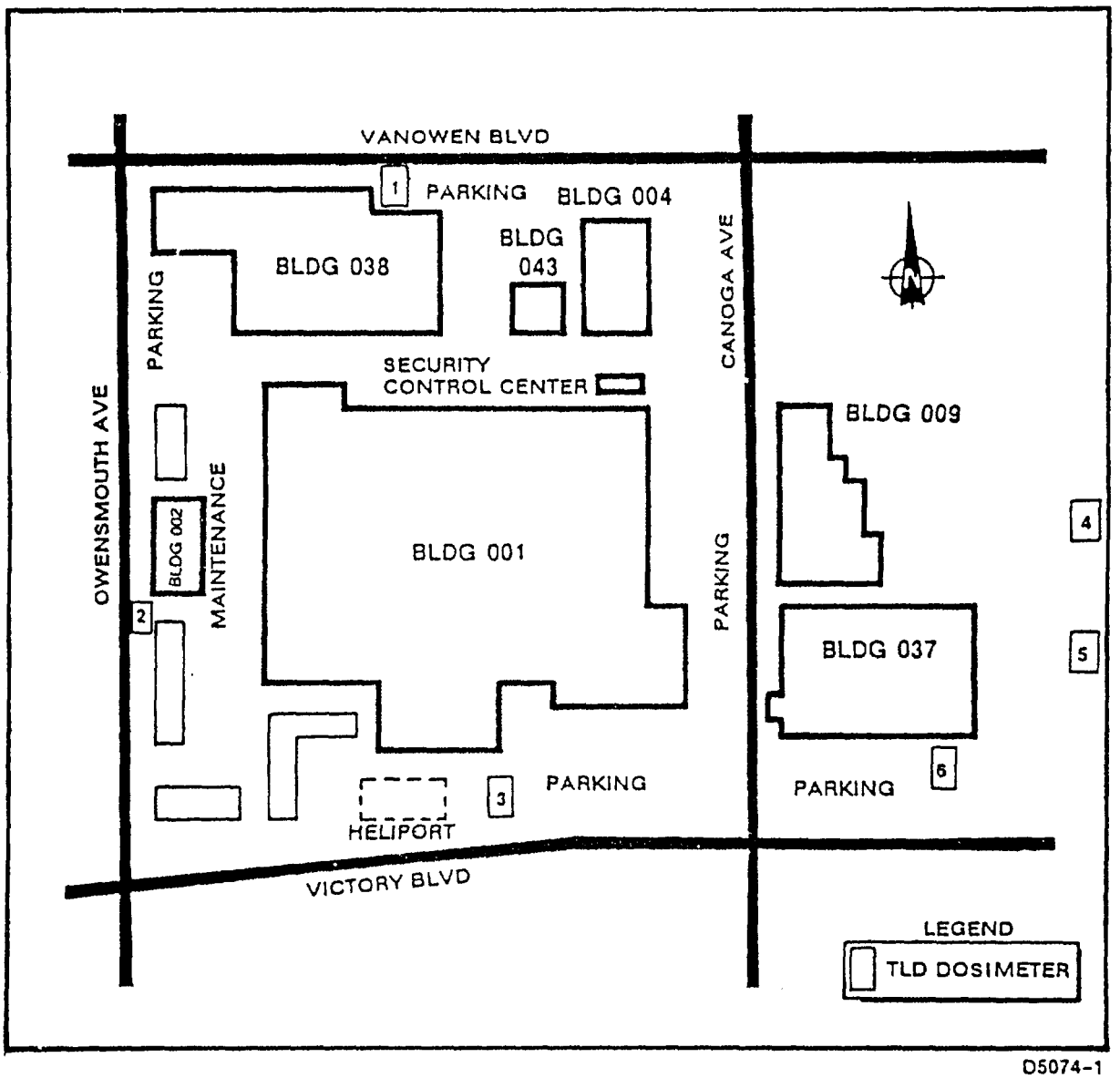

Figure 9. Map of Canoga Site TLD Locations

TABLE 8

SAMPLING LOCATION DESCRIPTION
(Sheet 1 of 5)

Station	Location	Frequency of Sampling*
S-1	SSFL Site, Building 143, southeast side	(Q)
S-2	SSFL Site, Building 003, east side	(Q)
S-3	SSFL Site, Building 064, north parking area	(Q)
S-4	SSFL Site, Building 020, at west fence	(Q)
S-5	SSFL Site, Building 363, east parking area	(Q)
S-6	SSFL Site, Interim Retention Pond, south side	(Q)
S-10	SSFL Site Access Road, at upper mobile home park entrance	(Q)
S-12	SSFL Site, Building 093, at driveway	(Q)
S-13	SSFL Site, above SRE Retention Pond	(Q)
S-14	SSFL Site, Building 028, upper parking area	(Q)
S-19	SSFL Site Entrance, Woolsey Canyon	(Q)
S-24	De Soto Site, Building 104, east side	(Q)
S-25	De Soto Avenue and Plummer Street, southeast corner	(Q)
S-26	Mason Avenue and Nordhoff Street, southeast corner	(Q)
S-27	De Soto Avenue and Parthenia Street, northeast corner	(Q)
S-28	Canoga Avenue and Nordhoff Street, northwest corner	(Q)
S-31	Simi Valley, Alamo Avenue and Sycamore Road, southeast corner	(Q)
S-40	Agoura - Kanan Road and Ventura Freeway at Frontage Road	(Q)
S-41	Calabasas - Parkway Calabasas and Ventura Freeway at Frontage Road	(Q)
S-42	SSFL Site, Building 886, at former sodium disposal facility gate	(Q)
S-47	Chatsworth Reservoir Site North Boundary at north gate	(Q)
S-51	SSFL Site, Building 029, at driveway	(Q)
S-52	SSFL Site, Burro Flats Drainage Control Sump, G Street and 17th Street	(Q)
S-53	SSFL Site, Pond R-2A	(Q)

TABLE 8

SAMPLING LOCATION DESCRIPTION
(Sheet 2 of 5)

Station	Location	Frequency of Sampling*
S-55	SSFL Site, Pond R-2A (Pond Bottom Mud), north side	(Q)
S-56	SSFL Site, F Street and 24th Street	(S)
S-57	SSFL Site, J Street, south of Building 055 exhaust stack	(S)
S-58	SSFL Site, Building 353, south of road	(S)
S-59	SSFL Site, Test Area STL-4, entrance, west side	(S)
S-60	SSFL Site, Pond R-2A, northwest side	(S)
S-61	Simi Valley, east end of Alamo Avenue	(S)
S-62	SSFL Site, near south boundary, Bell Creek Weir, Well 9	(Q)
W-6	SSFL Site Interim Retention Pond, south side	(M)
W-7	SSFL Site Domestic Water, Building 003, washroom faucet	(M)
W-11	SSFL Site Domestic Water, Building 363, washroom faucet	(M)
W-12	SSFL Site, Pond R-2A, north side	(M)
W-13	De Soto Site, Building 104, washroom faucet	(M)
W-17	SSFL Site, Pond R-2A, discharge to Bell Creek	(Seasonal)
A-1	De Soto Site, Building 102 roof	(D)
A-2	De Soto Site, Building 104 roof	(D)
A-3	SSFL Site, Building 100, east side	(D)
A-4	SSFL Site, Building 011, west side	(D)
A-5	SSFL Site, Building 600, Sewage Treatment Plant, north side	(D)
A-6	SSFL Site, Building 207, Security Control Center, north side	(D)
A-7	SSFL Site, Building 093, west side	(D)
A-8	SSFL Site, Building 163, Box Shop at east side	(D)
A-9	SSFL Site, Building 363, west side	(D)
A-10	SSFL Site, Building 100, east side - 7-day sampler	(168 h)

TABLE 8

SAMPLING LOCATION DESCRIPTION
(Sheet 3 of 5)

Station	Location	Frequency of Sampling*
On-Site--De Soto - Ambient Radiation Dosimeter Locations (TLD)		
DS-1	De Soto Site, south of Block House	(Q)
DS-2	De Soto Site, northwest corner of Building 101 (State of California TLD Location Number 2)	(Q)
DS-3	De Soto Site, southeast corner of Building 102	(Q)
DS-4	De Soto Site, northeast corner of SPEL II Laboratory Building 113	(Q)
DS-5	De Soto Site, northeast corner of Building 102	(Q)
DS-6	De Soto Site, east boundary, southeast corner of Building 105 (State of California TLD Location Number 1)	(Q)
DS-7	De Soto Site, north of Building 106	(Q)
DS-8	De Soto Site Guard Post 4, southwest corner of Building 101 (State of California TLD Location Number 7)	(Q)
On-Site--SSFL - Ambient Radiation Dosimeter Locations (TLD)		
SS-1	SSFL Site, west of emergency trailer, Building 114	(Q)
SS-2	SSFL Site, SRE Retention Pond	(Q)
SS-3	SSFL Site, Electric Substation 719 on boundary fence (State of California TLD Location Number 3)	(Q)
SS-4	SSFL Site, west boundary on H Street	(Q)
SS-5	SSFL Site, southwest boundary at property line gate	(Q)
SS-6	SSFL Site, northeast corner of Building 353 (State of California TLD Location Number 4)	(Q)
SS-7	SSFL Site, Building 363, north side on HPIC monitor (State of California TLD Location Number 8)	(Q)
SS-8	SSFL Site, Sodium Disposal Facility north boundary	(Q)
SS-9	SSFL Site, Radioactive Materials Disposal Facility, northeast boundary at Building 133	(Q)
SS-10	SSFL Site, Building 600, Sewage Treatment Plant	(Q)
SS-11	SSFL Site, RMDF northwest property line boundary (State of California TLD Location Number 9)	(Q)
SS-12	SSFL Site, RMDF northwest property line boundary	(Q)
SS-13	SSFL Site, RMDF northwest property line boundary	(Q)

TABLE 8

SAMPLING LOCATION DESCRIPTION
(Sheet 4 of 5)

Station	Location	Frequency of Sampling*
On-Site--Canoga - Ambient Radiation Dosimeter Locations (TLD)		
CA-1	Canoga Site, northeast corner of Building 038	
CA-2	Canoga Site, southwest corner of Building 002	
CA-3	Canoga Site, south of Building 001 near street entrance	
CA-4	Canoga Site, east of Building 009 on boundary fence	
CA-5	Canoga Site, east of Building 037 on boundary fence	
CA-6	Canoga Site, southeast corner of Building 037	
Off-Site (TLD)		
OS-1	Off-site, Northridge, approximately Oakdale Avenue and Lassen Street (State of California TLD Location Number 5)	(Q)
OS-2	Off-site, Simi Valley, approximately Tapo Canyon and Walnut Streets	(Q)
OS-3	Off-site, San Fernando Valley, Northridge, approximately Plummer Street and Vanalden Avenue	(Q)
OS-4	Off-site, Simi Valley, approximately Tapo Canyon and Walnut Streets	(Q)
OS-5	Off-site, Simi Valley, approximately east Los Angeles Avenue and Stow Street (State of California TLD Location Number 6)	(Q)
HPI-1	High-Pressure Ion Chamber (HPIC) Ambient Radiation Monitor at Building 207, north side	(C)
HPI-2	High-Pressure Ion Chamber (HPIC) Ambient Radiation Monitor at Building 363, north side	(C)

Codes:

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

TABLE 8

SAMPLING LOCATION DESCRIPTION
(Sheet 5 of 5)

SSFL SITE GROUNDWATER SAMPLING STATIONS
DEEP AND SHALLOW TEST AND PRODUCTION WELLS
(Sampled Quarterly or Seasonally Depending on Groundwater Recharge)

Well		Description of General Location
WS-4A	On-site:	On north boundary
WS-5	On-site:	1500 ft from southeast boundary
WS-6	On-site:	2500 ft from north boundary
WS-7	On-site:	550 ft from north boundary
WS-8	On-site:	300 ft east of Silvernale Reservoir
WS-9	On-site:	1500 ft east of Silvernale Reservoir
WS-9A	On-site:	1000 ft south of Pond R-2A in drainage channel
WS-11	On-site:	2500 ft from northwest boundary
WS-12	On-site:	800 ft from north boundary
WS-13	On-site:	200 ft from north boundary
WS-14	On-site:	On northeast boundary
OS-1	Off-site:	1350 ft from site north boundary
OS-2	Off-site:	1750 ft from site northwest boundary
OS-5	Off-site:	1100 ft from site northwest boundary
OS-8	Off-site:	1750 ft from site north boundary (Spring)
OS-10	Off-site:	4250 ft from site north boundary
OS-13	Off-site:	900 ft from site east boundary
OS-15	Off-site:	2900 ft from site northeast boundary
OS-16	Off-site:	800 ft from site northeast boundary
RS-20	On-site:	4400 ft from east boundary
RS-21	On-site:	860 ft from north boundary
RS-22	On-site:	1000 ft from north boundary

WS SSFL on-site water supply well (drilled before 1960)
OS Off-site water well for groundwater monitoring
RS SSFL on-site shallow zone groundwater monitoring well.

B. SAMPLING AND SAMPLE PREPARATION

1. Soil

Soil is analyzed for any significant increase in radioactive deposition by fallout from airborne radioactivity. Since soil is naturally radioactive and has been contaminated by atmospheric testing of nuclear weapons, a general background level of radioactivity exists. The data are monitored for increases beyond the natural variability of this background. For most radionuclides, gross alpha and beta radioactivity measurements are adequate for this purpose. Chemically specific analyses are performed for plutonium to provide improved sensitivity.

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

Sample soil preparation for gross radioactivity determination consists of transferring samples to Pyrex beakers and drying them in a muffle furnace at about 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 into stainless-steel planchets. The soil is wetted in the planchet with alcohol, evenly distributed to obtain uniform sample thickness, dried, and counted for alpha and beta radiation.

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

2. Water

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

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

3. Ambient Air

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

C. COUNTING AND CALIBRATION

Environmental soil, water, and ambient air samples are counted for alpha and beta radiation with a low-background gas flow proportional counting system. The system is capable of simultaneously counting both alpha and beta radiation. The sample-detector configuration provides a nearly 2π geometry. The thin-window detector is continually purged with argon/methane counting gas. A preset time mode of operation is used for all samples. The lower limits of detection shown in Table 9 are those for a single sample determined by using typical values for counting time, system efficiencies for detecting alpha and beta radiation, background count rates (approximately 0.05 cpm alpha and 1.0 cpm beta), and sample size. These limits of detectability, for single samples, are calculated according to U.S. NRC Regulatory Guide 4.16, and assure a 95% probability that the measured activity would be identified as "above background."

TABLE 9

LOWER LIMITS OF DETECTION (LLDs)

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

Counting system efficiencies are determined routinely with ^{99}Tc, ^{36}Cl, ^{230}Th, ^{235}U, and ^{239}Pu standard sources and with ^{40}K, in the form of standard reagent-grade KCl, which is used to simulate soil, and with soil containing known amounts of highly enriched uranium. The activities of the standard sources are traceable to the National Institute of Standards and Technology (NIST, formerly NBS).

Self-absorption standards for beta counting are made by dividing sieved KCl into samples that increase in mass by 200-mg increments, from 100 to 3000 mg. The samples are placed in planchets of the type used for environmental samples and are counted. The ratio of sample activity to the observed net count rate for each sample is plotted as a function of sample mass and a smooth curve is drawn through these points. The correction factor (ratio) corresponding to the mass of environmental samples is then obtained from the graph. The product of the correction factor and the net sample count rate yields the sample activity (dpm). This method has been proven usable by applying it to various-sized aliquots of uniformly mixed environmental samples and observing that the resultant specific activities fell within the expected statistical counting error, showing the absence of any systematic bias.

Since the observed radioactivity in environmental samples primarily results from natural sources and is at low concentrations, constituent radionuclides are not identified for each sample. However, collected samples are

composited for gamma spectrometry of accumulated sample materials. The detection of significant levels of radioactivity would lead to an investigation of the radioactive material involved, the sources, and possible causes.

D. NONRADIOACTIVE MATERIALS

The Rocketdyne Division of Rockwell International Corporation has filed a Report of Waste Discharge with the California Regional Water Quality Control Board and has been granted a National Pollutant Discharge Elimination System permit to discharge wastewater, pursuant to Section 402 of the Federal Water Pollution Control Act. The permit, NPDES No. CA0001309, which became effective 27 September 1976, was renewed with minor changes effective 17 September 1984. This permit covers discharge of overflow and storm runoff from water reclamation retention ponds into Bell Creek. Discharge generally occurs only during and immediately after periods of heavy rainfall or during extended periods of rocket engine testing that release large amounts of cooling water to the ponds.

Only one of the retention ponds receives influent from the nuclear operating areas (Area IV) of the SSFL site. It is identified as retention pond R-2A, Water Sample Station W-12 in Table 8.

The influent includes sewage treatment plant outfall and surface runoff water. Grab-type water samples taken at the retention pond prior to a discharge are analyzed by a California State certified analytical testing laboratory for nonradioactive chemical constituents and for radioactivity. Appendix C lists specific constituents which are analyzed, as well as their respective limitations in discharged wastewater. Wastewater originating from facilities located throughout the SSFL site is collected at the retention pond. The point of origin of small amounts of most nonradioactive constituents normally found in wastewater is difficult to determine. If excessive amounts of any of these materials were found in wastewater, their origin could be determined from the knowledge of facility operations involving their use.

In addition to the wastewater discharge limitations, atmospheric pollutant discharge limitations were imposed by the Ventura County Air Pollution Control District (APCD) Permit 0271 on two natural-gas/oil-fired sodium heaters operated by ETEC. The limitations for 1988 are 1.50 tons/yr for reactive organic compounds, 131.13 ton/yr for oxides of nitrogen, 3.05 tons/yr for particulates, 0.60 tons/yr for oxides of sulfur, and 40.51 tons/yr for carbon monoxide. No operations resulted in emissions exceeding these limits. These limits were increased for 1988 due to planned increases in operation of gas-fired boilers for component testing and for a new power generation facility which was brought into service during the year. The increased limits reflect anticipated increased demand and do not reflect actual release increases. The decrease in the limit for oxides of sulfur occurred because the use of fuel oil during the year was not planned.

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

V. EFFLUENT MONITORING PROGRAM

Effluents that may contain radioactive material are generated at the Rocketdyne Division facilities as the result of operations performed under contract to DOE, under NRC Special Nuclear Materials License SNM-21, and under the State of California Radioactive Material License 0015-70. The specific facilities are identified as Buildings 020 and 021-022 at SSFL, and Building 104 at the De Soto complex.

A. TREATMENT AND HANDLING

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

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

The average concentration and total radioactivity in atmospheric effluents to uncontrolled areas are shown in Table 10. The effectiveness of the air cleaning systems is evident from the fact that the atmospheric effluents are less radioactive than is the ambient air. The total shows that no significant quantities of radioactivity were released in 1988.

TABLE 10. ATMOSPHERIC EFFLUENTS TO UNCONTROLLED AREAS--1988

	De Soto 104 Research	SSFL 020 RIHL	SSFL 022 RMDF
Approximate effluent volume-cubic meters	167,100,000	408,700,000	240,900,000
Approximate lower limit of detection (LLD)			
Gross alpha fCi/m^3	0.30	0.30	0.30
Gross beta fCi/m^3	0.31	0.31	0.31
Approximate air volume sampled-cubic meters	21,400	30,300	34,200
Annual average concentration in effluent			
Gross alpha fCi/m^3	1.39	0.38	0.29
Gross beta fCi/m^3	5.61	9.31	17.20
Sampling period maximum observed concentration			
Gross alpha fCi/m^3	8.12	1.01	2.93
Gross beta fCi/m^3	32.6	35.1	258.0
Total activity released-microcuries/year			
Gross alpha	0.23	0.16	0.07
Gross beta	0.94	3.80	4.10

	Release µCi/ Year	LLD µCi/ Year	Concentration fCi/m^3	%MPCa	Release µCi/ Year	LLD µCi/ Year	Concentration fCi/m^3	%MPCa	Release µCi/ Year	LLD µCi/ Year	Concentration fCi/m^3	%MPCa
Estimate of activity released by nuclide												
Beryllium-7*	0	0.59	0		2.85	1.02	6.98		0	0.54	0	
Potassium-40*	0.37	1.41	2.22		0.44	2.43	1.08		0.64	1.27	2.66	
Cobalt-60	0	0.09	0	0	0	0.15	0	0	1.64	0.08	6.82	0.002
Strontium/Yttrium-90	0.03	0.05	0.18	0.0006	0.10	0.08	0.24	0.0008	0.21	0.04	0.87	0.003
Cesium-137	0.03	0.08	0.22	0.00004	0.12	0.13	0.28	0.00006	1.53	0.07	6.37	0.001
Polonium-210*	0.94	0.002	0.56		0.16	.003	0.39		0.06	0.001	0.24	
Uranium-234	0.13	0.0008	0.77	0.0192	0.0002	0.001	0.0004	0.00001	0.002	0.0007	0.01	0.0003
Uranium-235	0.005	0.0008	0.03	0.0008	0	0.001	0	0	0	0.0007	0	0
Uranium-238	0.002	0.0008	0.01	0.0005	0.0007	0.001	0.002	0.00006	0.002	0.0007	0.008	0.0003
Plutonium-238	0	0.002	0	0	0	0.003	0	0	0.0001	0.001	0.0004	0.0006
Plutonium-239/40	0.0001	0.002	0.0007	0.0011	0.00003	0.003	0.00008	0.00001	0.008	0.001	0.03	0.052

*Naturally occurring, not included in dose estimates.

Note; Concentrations are shown as femtocuries per cubic meter for clarity of presentation in this table. To convert to microcuries per milliliter, multiply the values by 1 x 10^{-15}.

The isotopic composition of the radioactivity deposited on the nuclear facility exhaust air sampling filters, composited for the year, is presented in Table 10. The table shows that the majority of the collected activity is caused by naturally occurring elements. The beryllium-7 collected on the RIHL filter is attributed to its presence in bypass air taken into the main exhaust system. The presence of polonium-210 is also a result of natural occurring elements in the uranium-238 decay chain. Materials used in operations conducted at the SSFL site are responsible for the fission/activation product radioactivity. The laboratory LLD for the composited filters was converted to an equivalent annual release and is shown in the table as LLD, μCi/year.

B. FACILITY DESCRIPTIONS

1. De Soto Site

a. Building 104--California State Licensed Activities

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

2. Santa Susana Field Laboratories Site

a. Building 020--NRC and California State Licensed Activities

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

performed and the history of the irradiated fuel or other material. No radioactive liquid waste is released from the facility. Prior radioactive material handled in unencapsulated form in this facility included the following radionuclides: U, Pu, as constituents in the various fuel materials; and ^{137}Cs, ^{90}Sr, ^{85}Kr, and ^{147}Pm 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 atmospheric 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 uranium and plutonium plus ^{137}Cs, ^{90}Sr, ^{85}Kr, and ^{147}Pm as mixed fission products.

3. Canoga Site

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

Other than product quality assurance inspection by X-ray and source radiography techniques, and also some limited State-licensed research work requiring the incidental use of small quantities of radioactive materials, no nuclear activities are conducted at the Canoga complex.

C. ESTIMATION OF GENERAL POPULATION DOSE ATTRIBUTABLE TO ROCKETDYNE OPERATIONS--1988

The Los Angeles basin is a semiarid region whose climate is controlled primarily by the semipermanent Pacific high-pressure cell that extends from Hawaii to the Southern California coast. The seasonal changes in the position of this cell greatly influence the weather conditions in this area. During the summer months, the high-pressure cell is displaced to the north. This results in mostly clear skies with little precipitation. During the winter,

the cell moves sufficiently southward to allow some Pacific lows with their associated frontal systems to move into the area. This produces light to moderate precipitation with northerly and northwesterly winds.

The release of airborne material at De Soto for summer season weather conditions would generally be under a subsidence inversion into an atmosphere that is typical of slight neutral to lapse conditions. Nocturnal cooling inversions, although present, are relatively shallow. During the summer, a subsidence inversion is present almost every day. The base and top of this inversion usually lie below the elevation of the SSFL site. Thus, any atmospheric release from the SSFL site under this condition would result in Pasquill Type D lofting diffusion conditions above the inversion and considerable atmospheric dispersion, prior to any diffusion through the inversion into the Simi or San Fernando Valleys. In the winter season, the Pacific high-pressure cell shifts to the south and the subsidence inversion is usually absent. The surface airflow is then dominated by frontal activity moving easterly through the area, resulting in high-pressure systems in the Great Basin region. Frontal passages through the area during winter are generally accompanied by rainfall. Diffusion characteristics are highly variable depending on the location of the front. Generally, a light to moderate southwesterly wind precedes these frontal passages, introducing a strong onshore flow of marine air and producing lapse rates that are slightly unstable. Wind speeds increase as the frontal systems approach, enhancing diffusion. The diffusion characteristics of the frontal passage are lapse conditions with light to moderate northerly winds. Locally, average wind speeds for the various stability categories range from 0 to about 4.4 m/s with the greatest frequency occurring for winds from the north to northwest sectors. Figures 10 through 12 show local population distribution estimates that were projected for 1986, based on the 1980 federal census and on direct observation of nearby residential areas around the SSFL site and out to 80 km for 16 sectors.

The downwind concentration of radioactive material emissions to the atmosphere during 1988 from each of the three major Rocketdyne nuclear facilities has been calculated with the AIRDOS-EPA computer code using site-specific

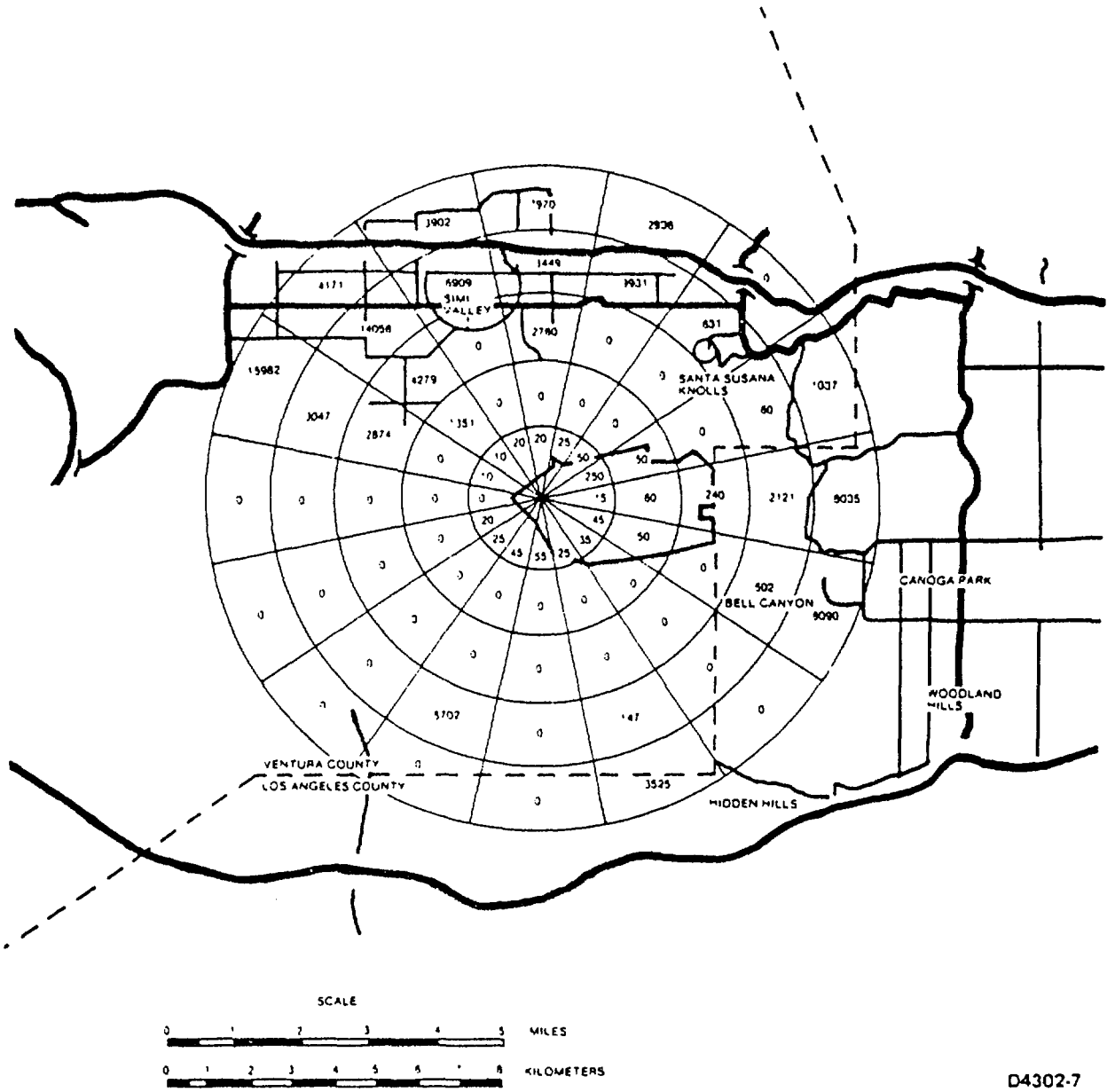

Figure 10. Santa Susana Field Laboratories Site-Centered Demography to 8 km

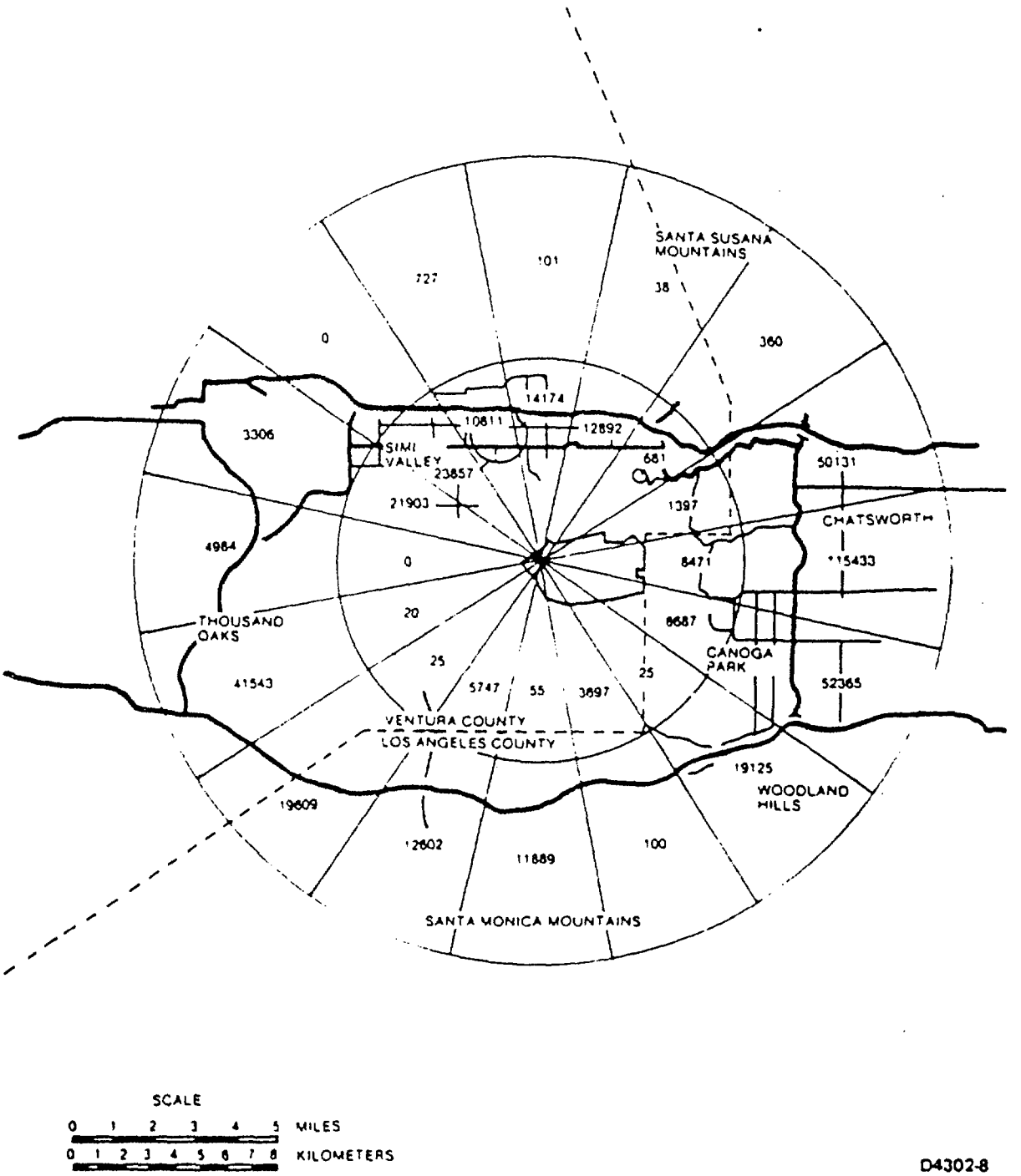

Figure 11. Santa Susana Field Laboratories Site-Centered Demography to 16 km

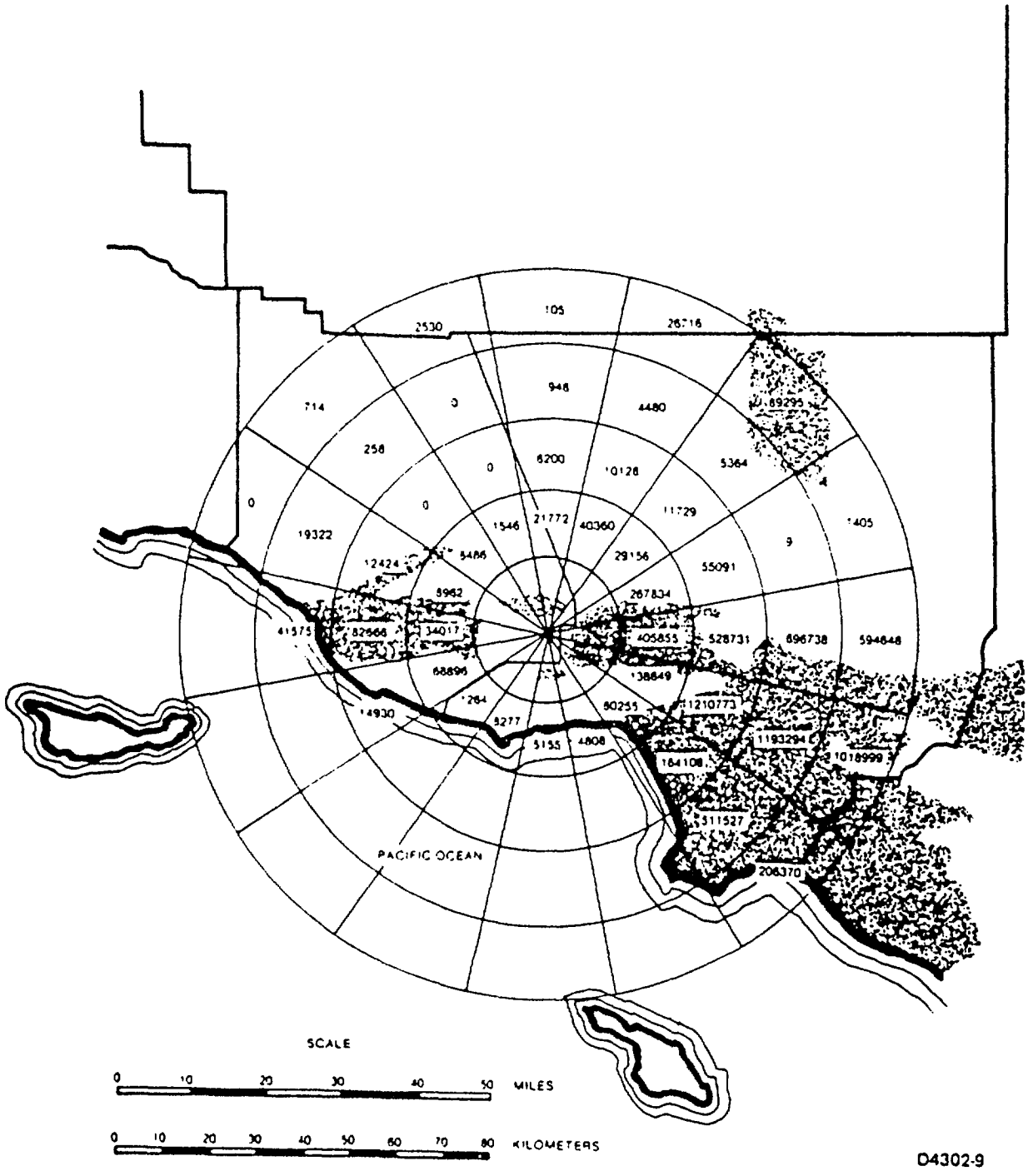

Figure 12. Santa Susana Field Laboratories Site-Centered Demography to 80 km
(heavily populated areas are shown by shading)

input data including local area windspeed, directional frequency, and stability plus facility-specific data such as stack heights and exhaust air velocity.

The radioactivity concentrations at the site boundary location nearest to each release point and at the nearest residence for each nuclear facility are shown in Table 11, and both internal and external radiation dose estimates are given in Table 12. The internal dose calculations in Table 12 assume a constant unsheltered exposure, adjusted for wind direction frequency, throughout the year and therefore considerably overestimate the actual annual-averaged doses at the nearest boundary and nearest residence. The external dose calculations assume that differences in TLD readings represent true differences in local exposure. These differences are extrapolated to the boundary and nearest residence using an inverse square distance relation from an assumed source of radiation. The estimated doses are far below the applicable limits of DOE, EPA, NRC, and the State of California.

TABLE 11

ANNUAL AVERAGED PLUME CONCENTRATIONS
OF ATMOSPHERIC EMISSIONS--1988

Facility	Release Rate (Ci/year)	Distance (m) to		Downwind Concentration (10^{-18} µCi/ml)		
		Boundary	Residence	Boundary	Residence	80 km
B/104	9.4×10^{-7}	187 E	315 SW	0.07	0.02	0.004
B/020	3.8×10^{-6}	302 NW	1900 SE	0.20	0.04	0.0006
B/022	4.1×10^{-6}	118 NW	2300 SE	0.05	0.03	0.0007

Except for the nearest boundary line exposure for the Radioactive Materials Disposal Facility (RMDF), the estimated off-site doses are extremely low compared to the maximum permissible exposures recommended for the general population in the vicinity of DOE facilities. The effective dose equivalent for any member of the public, for all pathways, shall not exceed 500 mrem/yr for occasional exposures, and 100 mrem/yr for prolonged periods of exposure. For

TABLE 12

ESTIMATED DOSE TO THE PUBLIC IN THE VICINITY OF ROCKETDYNE FACILITIES--1988 (rem)

Exposure Mode	De Soto Building 104		SSFL-T/020 (RIHL)		SSFL-T/021-022 (RMDF)	
	Boundary	Residence	Boundary	Residence	Boundary	Residence
Air Pathway Organ						
Gonads	2.5×10^{-13}	6.0×10^{-14}	1.3×10^{-12}	2.5×10^{-13}	2.0×10^{-12}	1.0×10^{-12}
Breast	1.3×10^{-13}	3.1×10^{-14}	6.7×10^{-13}	1.3×10^{-13}	1.1×10^{-12}	5.1×10^{-13}
Red bone marrow	2.9×10^{-11}	6.6×10^{-12}	1.1×10^{-11}	2.1×10^{-12}	$.8 \times 10^{-11}$	1.4×10^{-11}
Lungs	9.9×10^{-9}	2.4×10^{-9}	1.5×10^{-11}	2.9×10^{-12}	1.1×10^{-10}	5.8×10^{-11}
Thyroid	2.6×10^{-14}	6.2×10^{-15}	1.3×10^{-13}	2.6×10^{-14}	1.4×10^{-13}	7.0×10^{-14}
Bone surfaces	1.0×10^{-10}	2.4×10^{-11}	7.3×10^{-12}	1.4×10^{-12}	8.1×10^{-11}	4.2×10^{-11}
Liver	3.0×10^{-12}	7.3×10^{-13}	7.3×10^{-13}	1.4×10^{-13}	3.6×10^{-11}	1.9×10^{-11}
Kidney	0	0	0	0	0	0
Spleen	0	0	0	0	0	0
Thymus	0	0	0	0	0	0
Adrenals	0	0	0	0	0	0
Pancreas	0	0	0	0	0	0
Stomach	0	0	0	0	0	0
Small intestine	6.0×10^{-14}	1.5×10^{-14}	3.1×10^{-13}	6.1×10^{-14}	3.2×10^{-13}	1.6×10^{-13}
ULI + LLI	6.0×10^{-14}	1.5×10^{-14}	3.1×10^{-13}	6.1×10^{-14}	6.2×10^{-13}	3.2×10^{-13}
Remainder	6.2×10^{-14}	1.5×10^{-14}	3.2×10^{-13}	6.3×10^{-14}	6.3×10^{-13}	3.2×10^{-13}
Air Pathway Whole Body						
50-yr committed effective whole body dose equivalent	1.0×10^{-8}	2.4×10^{-9}	3.6×10^{-11}	7.1×10^{-12}	2.6×10^{-10}	1.4×10^{-10}
Direct Radiation						
Whole Body	0	0	5.6×10^{-6}	2.2×10^{-9}	4.0×10^{-2}	4.5×10^{-8}
Total estimated dose	1.0×10^{-8}	2.4×10^{-9}	5.6×10^{-6}	2.2×10^{-9}	4.0×10^{-2}	4.5×10^{-8}
SI equivalent-Sv	1.0×10^{-10}	2.4×10^{-11}	5.6×10^{-8}	2.2×10^{-11}	4.0×10^{-4}	4.5×10^{-10}

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the air pathway only, the limits are 25 mrem/yr for whole body doses, and 75 mrem/yr for any organ doses. The RMDF boundary to the north of the facility received an estimated "property line" exposure of 40 mrem for the year. However, this does not constitute a dose to the general public since it lies within an isolated area without direct public access. No members of the general public were present at the site boundary during any significant portion of the year. The maximum estimated internal and external exposures to an individual for 1988 at the De Soto and SSFL site boundaries and also at the nearest residence are shown in Table 12. Estimated internal radiation doses due to atmospheric emission of radioactive materials from De Soto and the SSFL nuclear facilities are several orders of magnitude below the radiation standards and are far below doses from internal exposure to natural radioactivity in air.

The external exposures, above background, are based on the greatest exposure adjusted to a constant altitude (1000-ft ASL) measured by a single dosimeter compared with average adjusted off-site measurements. The mean adjusted value for five off-site dosimeters was 78 mR with a maximum annually observed value for a single location of 88 mR. Boundary dose estimates assume 100% occupancy, whereas the actual presence of persons at the boundary is rare or nonexistent. These data indicate that the derived values, except for the RMDF, do not differ significantly from zero, as shown by the uncertainties being near the reported value, but result from assumptions in the analysis.

The general population person-rem dose estimates are calculated from the demographic distribution and the sector total inhalation intake (person-pCi/year) generated by AIRDOS-EPA. This code uses release rate, wind speed, wind direction and frequency, inversion, lapse, and effective stack height parameters as input data. Population dose estimates centered on the SSFL site are presented in Table 13. Inhalation is the only potentially significant exposure pathway likely to exist. The doses reported for SSFL site emissions are summed for all release points and nuclides.

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TABLE 13
POPULATION DOSE ESTIMATES FOR ATMOSPHERIC EMISSIONS
FROM SSFL FACILITIES--1988

22.5-Degree Sector	Dose to Receptor Population Segment (person-rem)						
	0-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	6.6×10^{-6}	1.8×10^{-8}	1.7×10^{-6}	2.8×10^{-7}	3.0×10^{-8}	2.5×10^{-9}	8.6×10^{-6}
NNW	3.0×10^{-6}	8.0×10^{-8}	7.5×10^{-8}	0	0	3.7×10^{-8}	3.2×10^{-6}
NW	7.8×10^{-6}	0	4.4×10^{-7}	0	5.6×10^{-9}	1.2×10^{-8}	8.3×10^{-6}
WNW	1.1×10^{-5}	7.5×10^{-7}	9.6×10^{-7}	8.0×10^{-7}	8.8×10^{-7}	0	1.4×10^{-5}
W	0	6.7×10^{-7}	2.2×10^{-6}	3.2×10^{-6}	1.2×10^{-6}	0	7.3×10^{-6}
WSW	7.4×10^{-9}	2.9×10^{-6}	2.3×10^{-6}	3.0×10^{-7}	5.6×10^{-8}	0	5.6×10^{-6}
SW	5.3×10^{-9}	1.0×10^{-6}	3.2×10^{-8}	0	0	0	1.0×10^{-6}
SSW	7.6×10^{-7}	7.3×10^{-7}	2.3×10^{-7}	0	0	0	1.7×10^{-6}
S	3.0×10^{-8}	1.5×10^{-6}	3.1×10^{-7}	0	0	0	1.8×10^{-6}
SSE	1.0×10^{-6}	1.4×10^{-8}	3.4×10^{-7}	0	0	0	1.4×10^{-6}
SE	1.8×10^{-8}	2.6×10^{-6}	5.3×10^{-6}	6.7×10^{-6}	1.5×10^{-5}	4.6×10^{-6}	3.4×10^{-5}
ESE	1.8×10^{-6}	5.7×10^{-6}	7.2×10^{-6}	3.8×10^{-5}	2.7×10^{-5}	1.8×10^{-5}	9.7×10^{-5}
E	1.2×10^{-6}	8.4×10^{-6}	1.4×10^{-5}	1.1×10^{-5}	1.1×10^{-5}	7.0×10^{-6}	5.2×10^{-5}
ENE	2.2×10^{-7}	2.4×10^{-6}	6.1×10^{-6}	7.6×10^{-7}	8.9×10^{-11}	1.1×10^{-8}	9.5×10^{-6}
NE	1.4×10^{-7}	2.4×10^{-8}	9.1×10^{-7}	2.2×10^{-7}	7.2×10^{-8}	7.2×10^{-7}	2.1×10^{-6}
NNE	3.1×10^{-6}	3.8×10^{-9}	1.8×10^{-6}	2.7×10^{-7}	8.5×10^{-8}	3.9×10^{-7}	5.7×10^{-6}
Total	3.7×10^{-5}	2.7×10^{-5}	4.4×10^{-5}	6.2×10^{-5}	5.4×10^{-5}	3.1×10^{-5}	2.5×10^{-4}

Average individual dose = 3.2×10^{-11} rem for the 80-km radius area total population.

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APPENDIX A

COMPARISON OF ENVIRONMENTAL RADIOACTIVITY DATA FOR 1988 WITH PREVIOUS YEARS

This section compares environmental monitoring results for the calendar year 1988 with previous annual data.

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

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

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

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

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

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

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

TABLE A-1

SOIL RADIOACTIVITY DATA--1969 THROUGH 1988

	On-site Average (pCi/g)			Off-site Average (pCi/g)		
Year	Number of Samples	Alpha	Beta	Number of Samples	Alpha	Beta
1988*	48	29.1	26	48	25.6	24
1987*	48	27.1	25	48	25.7	24
1986*	48	26.7	26	48	25.1	25
1985*	144	25.2	24	48	26.3	24
1984*	144	25.8	24	48	26.2	23
1983	144	0.61	24	48	0.59	23
1982	144	0.69	25	48	0.68	23
1981	144	0.69	25	48	0.64	23
1980	144	0.60	24	48	0.58	23
1979	144	0.64	25	48	0.50	23
1978	144	0.63	24	48	0.51	24
1977	144	0.56	24	48	0.53	23
1976	144	0.56	25	48	0.56	24
1975	144	0.60	25	48	0.58	24
1974	144	0.60	25	48	0.54	24
1973	144	0.57	25	48	0.51	24
1972	144	0.56	25	48	0.57	24
1971	144	0.55	25	48	0.53	23
1970	144	0.47	27	48	0.48	25
1969	144	0.42	27	48	0.42	25

*The change in alpha activity after 1983 is the result of an improved calibration method that provides a true measure of alpha activity in thick samples rather than the relative values used previously. This is discussed in detail in Section III, Part A. Values for 1988 using the prior method would be 0.83 for the on-site average and 0.73 for the off-site average.

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TABLE A-2

SSFL SITE SUPPLY WATER RADIOACTIVITY DATA--
1969 THROUGH 1988

Year	Number of Samples	Average Alpha (10^{-9} µCi/ml)	Average Beta (10^{-9} µCi/ml)
1988*	24	5.40	3.9
1987*	24	5.10	3.6
1986*	24	6.55	3.6
1985*	24	2.05	2.8
1984*	24	3.53	2.9
1983	24	0.12	3.0
1982	24	0.14	3.0
1981	24	0.24	2.8
1980	24	0.22	2.4
1979	24	0.23	2.8
1978	24	0.26	3.0
1977	24	0.25	2.5
1976	24	0.25	2.0
1975	24	0.24	2.3
1974	24	0.24	2.7
1973	24	0.26	3.4
1972	24	0.22	3.7
1971	24	0.28	4.9
1970	24	0.18	5.3
1969	24	0.11	5.0

*The change in alpha activity after 1983 is the result of an improved calibration method that provides a true measure of alpha activity in thick samples rather than the relative values used previously. This is discussed in detail in Section III, Part A. The value for 1988 using the prior method would be 0.38.

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TABLE A-3

ROCKETDYNE DIVISION RETENTION POND RADIOACTIVITY DATA--1969 THROUGH 1988

	Interim Retention Pond Water 6			Final Retention Pond R-2A Water 12		
		Average (10^{-9} µCi/ml)			Average (10^{-9} µCi/ml)	
Year	Number of Samples	Alpha	Beta	Number of Samples	Alpha	Beta
1988*	12	2.04	4.2	12	4.47	4.5
1987*	12	1.75	4.7	12	2.78	4.4
1986*	12	2.51	2.9	12	4.18	3.6
1985*	12	2.06	3.5	12	3.07	3.5
1984*	12	2.07	4.6	12	0.15	4.2
1983	12	0.12	3.6	12	0.13	4.4
1982	12	0.17	3.9	12	0.11	3.9
1981	12	<0.23	4.3	12	<0.25	5.2
1980	12	<0.22	2.9	12	<0.22	3.9
1979	12	<0.25	3.1	12	<0.23	4.5
1978	12	<0.25	4.3	12	<0.25	4.6
1977	12	<0.24	4.3	12	<0.25	5.2
1976	12	<0.24	4.3	12	<0.28	4.4
1975	12	<0.24	4.2	12	<0.31	4.5
1974	12	<0.22	4.2	12	<0.21	4.5
1973	12	<0.23	4.5	12	<0.37	5.6
1972	12	0.22	5.3	12	0.22	5.5
1971	12	0.18	6.2	12	0.16	6.4
1970	12	0.15	6.9	12	0.12	7.4
1969	12	0.07	5.9	11	0.10	5.7

*The change in alpha activity after 1983 is the result of an improved calibration method that provides a true measure of alpha activity in thick samples rather than the relative values used previously. Values for 1988 using the prior method would be as follows:

Interim retention pond: 0.14
Final retention pond: 0.28

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TABLE A-4
AMBIENT AIR RADIOACTIVITY CONCENTRATION DATA--1969 THROUGH 1988

	De Soto Average (10^{-12} µCi/ml)			SSFL Average (10^{-12} µCi/ml)		
Year	Number of Samples	Alpha	Beta	Number of Samples	Alpha	Beta
1988	680	0.0024	0.034	2397	0.0020	0.031
1987	690	0.0019	0.027	2460	0.0019	0.027
1986	687	0.0029	0.058	2415	0.0028	0.061
1985	544	0.0026	0.044	2450	0.0020	0.040
1984	712	0.0019	0.027	2461	0.0014	0.024
1983	644	0.0024	0.026	2328	0.0010	0.023
1982	727	0.0017	0.026	2347	0.0013	0.022
1981	704	0.0069	0.12	2518	0.0068	0.12
1980	685	0.0065	0.039	2342	0.0064	0.035
1979	697	0.0066	0.021	2519	0.0065	0.020
1978	713	0.0084	0.091	2402	0.0072	0.088
1977	729	0.0066	0.17	2438	0.0066	0.17
1976	719	0.0067	0.096	2520	0.0065	0.11
1975	709	0.0063	0.076	2450	0.0060	0.073
1974	663	0.0056	0.16	2477	0.0057	0.16
1973	715	0.0075	0.041	2311	0.0072	0.038
1972	708	0.0085	0.14	2430	0.0086	0.14
1971*	730	0.0087	0.30	2476	0.0086	0.33
1970	668	-	0.34	2434	-	0.36
1969	687	-	0.27	2364	-	0.26

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

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

For all types of samples, the data indicate that there is no concentrated local source of unnatural radioactivity in the environment. Also, the similarity between on-site and off-site results further indicates that Rocketdyne operations contribute essentially nothing to general environmental radioactivity.

APPENDIX B
ENVIRONMENTAL MONITORING PROGRAM QUALITY CONTROL

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

PROCEDURES

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

RECORDS

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

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

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

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

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

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

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

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

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

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

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

APPENDIX C

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 C-1 is prohibited.

TABLE C-1

NPDES NO. CA00-01309, ORDER 84-85, EFFECTIVE 17 SEPTEMBER 1984

	Discharge Rate (lb/day)[a]	Concentration Limit (mg/liter)
Constituent	30-Day Average	Maximum
Total dissolved solids	1,267,680	950
Chloride	200,160	150
Sulfate	400,320	300
Suspended solids[b]	66,720	-
Settleable solids[b]	-	-
BOD_5	26,690	30
Oil and grease	13,350	15
Chromium	6.67	-
Fluoride	1,340	1.0
Boron	1,340	1.0
Residual chlorine	-	0.1
Surfactants (as MBAS)	667	0.5
pH		6.0 to 9.0

[a]Based on a total waste flow of 160×10^6 gal/day.
[b]Not applicable to discharges containing rainfall runoff during or immediately after periods of rainfall.

APPENDIX D

BIBLIOGRAPHY

1. DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements" (7 January 1987)

2. DOE Order 5480.1A, "Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities" (3 September 1985)

3. DOE/EP-0023, "A Guide For: Environmental Radiological Surveillance at U.S. Department of Energy Installations"

4. Code of Federal Regulations, Title 10, Part 20 (10 CFR 20), "Standards for Protection Against Radiation"

5. California Radiation Control Regulations, California Administrative Code, Title 17, Public Health

6. California Regional Water Quality Control Board, Los Angeles Region, Order No. 84-85, NPDES No. CA0001309 (Effective 17 September 1984)

7. R. E. Moore, 1979. "AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Doses to Man from Airborne Releases of Radionuclides," ORNL-5532

8. AI-76-21, "Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21" (30 April 1976)

9. ESG-82-32, Supplement to AI-76-21, "Environmental Assessment of Operations at Energy Systems Group of Rockwell International Under Special Nuclear Materials License SNM-21" (1982 Supplement to AI-76-21, 25 August 1982)

10. NUREG-1077, "Environmental Impact Appraisal for Renewal of Special Nuclear Material License No. SNM-21" (June 1984)

11. U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, "Environmental Impact Appraisal of the Atomics International (AI) Commercial Nuclear Fuel Fabrication Facilities Canoga Park and Chatsworth, California" (September 1977)

12. ESG-DOE-13288, "Environmental Analysis of Decommissioned Facilities at Santa Susana Field Laboratory"

13. J. D. Moore, "Radiological Environmental Monitoring Program," N00105P000001, Rocketdyne Division, Rockwell International (9 July 1984)

14. J. D. Moore, "Radiological Environmental Monitoring Program Sampling Procedures, Analysis Procedures, and Radioactivity Measurement Methods," N001DWP000008, Rocketdyne Division, Rockwell International (9 July 1984)

15. J. D. Moore, "Radiological Environmental Monitoring Program Quality Assurance," N001DWP000009, Rocketdyne Division, Rockwell International (25 September 1984)

16. "Investigation of Hydrogeologic Conditions - Santa Susana Field Laboratory, Ventura County, California," Hargis & Associates, Inc., Tucson, Arizona (22 February 1985)

17. HASL-300, EML Procedures Manual 2nd Edition, Environmental Measurements Laboratory, U.S. Department of Energy

18. DOE/EH-0071, "Internal Dose Conversion Factors for Calculation of Dose to the Public," July 1988

APPENDIX E

EXTERNAL DISTRIBUTION

	Copies
U.S. Department of Energy, EH-23 1000 Independence Avenue Washington, D.C. 20585	1
U.S. Department of Energy Environmental Measurements Laboratory New York, NY 10014	1
County of Ventura Fire Protection District Hazardous Material Section 395 Willis Avenue Camarillo, CA 93010	1
U.S. Environmental Protection Agency Regional Radiation Representative, Region IX 215 Fremont Street San Francisco, CA 94105	1
California State Department of Health Services Radiologic Health Branch 714 "P" Street Sacramento, CA 95201	1
Los Angeles County Health Department Occupational Health and Radiation Management Los Angeles, CA 90007	1
County of Ventura Resource Management Agency Ventura, CA 93009	1
U.S. Department of Energy, ESQA 1333 Broadway Oakland, CA 94612	20
Rocky Flats Plant Health, Safety, and Environment Golden, Colorado 80402-0464	1

	Copies
California Regional Water Quality Control Board Region 7 73-271 Highway 111, Suite 21 Palm Desert, CA 92260	1
U.S. Department of Energy Office of Operational Safety, EP-32 Technical Information Center 1000 Independence Avenue Washington, D.C. 20585	1
U.S. Nuclear Regulatory Commission Office for Analysis and Evaluation of Operational Data Washington, D.C. 20555	3
U.S. Nuclear Regulatory Commission Office of Radiation Safety and Safeguards Region V 1450 Maria Lane, Suite 210 Walnut Creek, CA 94596-5368	1
California State Department of Health Services Environmental Radiation Surveillance Unit 1449 West Temple Street, Room 222 Los Angeles, CA 90026	1
California State Department of Health Services Toxic Substances Control Division Radiological Monitoring 2151 Berkeley Way, Annex 7 Berkeley, CA 94704	1

APPENDIX F

ALTERNATIVE UNITS FOR RADIOLOGICAL DATA

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

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

APPENDIX G

ADDITIONAL ENVIRONMENTAL INFORMATION

This appendix presents additional information generally related to non-radiological environmental concerns for DOE operations on the government-op:ioned land in Area IV at SSFL.

In May 1988 a major environmental survey was conducted by a team of experts established by the DOE Office of Environment, Safety, and Health. This survey found no environmental problems that represent an immediate threat to human life. A few areas were identified with possible contamination by hazardous or radioactive materials. The results of this survey are reported in detail in DOE/EH/OEV-33-P, "Environmental Survey Preliminary Report--DOE Activities at Santa Susana Field Laboratories, Ventura County, California--February 1989." Steps to remedy the findings of this survey have been proposed to DOE-SAN.

A groundwater monitoring program has been established at the SSFL site. This has been accomplished by the construction of a total of 82 on-site shallow zone wells, sampling subsurface soils at over 150 locations, and routine periodic sampling of groundwater from 49 shallow zone wells. Surface water sampling has been done as needed. These data have been summarized in numerous reports. Shallow groundwater conditions do not occur in most of Area IV. Of eight shallow zone wells constructed in Area IV, groundwater was encountered consistently in only two wells.

A RCRA Part B permit application was submitted for sodium and similar waste material treatment at Building T/133. This application is under review by the California Department of Health Services. Sodium combustion is continuing under the existing permit with the concurrence of the Department of Health Services and the U.S. EPA. A release of sodium hydroxide solution from the sodium treatment facility was reported to the Department of Health Services on September 23, 1988. Approximately 5 gal of a dilute solution of

sodium hydroxide was released to the ground. Contaminated soil and associated hardware were recovered and disposed of as hazardous waste.

A discharge exceedance occurred on September 22, 1988, from the R-2A retention pond. Monitoring indicated sulfate levels of 332 ppm, which exceeded Rocketdyne's NPDES discharge permit limit of 300 ppm. The high sulfate level was attributed to operations at the Sodium Component Test Installation (SCTI) in which blowdown water from cooling towers was concentrated up to four times the influent sulfate concentration due to evaporation. The plant shifted to water supplied by Ventura County District 17, which reduced the sulfate concentration to permitted levels.

A major effort was begun in June 1988 to eliminate the risk of soil contamination by radioactive materials at Building T/059. This involved removal and disposal at a DOE radioactive waste disposal site of the activated sand and much of an activated vacuum duct in the Pipe Chase Room. Groundwater had leaked into this room and became contaminated. Out-leakage was prevented by pumping water out and evaporating the water at the RMDF. Sludge from the evaporation process was disposed at a DOE radioactive material disposal site.

On August 3, 1988, ETEC operations were reviewed by an inspector from the Ventura County Air Pollution Control District. There were no adverse findings.

A Spill Prevention and Control Countermeasure (SPCC) plan was started in 1988. The U.S EPA requires the preparation of an SPCC plan by those facilities which, because of their location, could reasonably be expected to discharge oil in harmful quantities into or upon navigable waters. The SPCC plan for SSFL facilities, including ETEC facilities, is currently under review for updating purposes by Rocketdyne Division. Additional comments provided by the Ventura County Health Department have been included into the plan and will be submitted to the county by June 1989.

An undergound storage tank program has been implemented at Rocketdyne Division within the guidelines of California Assembly Bills 2013 and 1362 and under the direction of the State Water Resources Control Board. The bills

require all owners of underground tanks to register them with the Control Board and also requires the tank owners to install a leak detection system on all existing tanks. For the new tank installations, secondary containment of the tank and piping are to be installed in addition to the leak detection system. Any underground tank abandonment requires a permit to remove and clean the tank and also to check the underlying soil for past leakage. The Ventura County Environmental Health Department is the local regulatory agency responsible for enforcement of these requirements.

A Rocketdyne procedure outlined in the Environmental Control Manual defines and assigns specific responsibilities relative to the use, storage, identification, transportation, handling, disposal, and inspection of sources of PCB bearing materials. The Rocketdyne PCB control program is based on the requirements of the U.S. EPA CFR Title 40, Part 61 regulations.

Asbestos control at Rocketdyne is conducted under the requirements of Titles 29, 40, and 49 of the Code of Federal Regulations, in addition to any state or local regulations that apply to any asbestos abatement program. Several steps in managing an asbestos program have been incorporated into facility renovation and demolition. These generally include assessment or identification of asbestos-containing materials (ACM), abatement activities such as worker protection and surveillance, and clearance requirements such as cleanup and disposal. Within Area IV, approximately 75% of the buildings have been surveyed and materials in question have been analyzed for asbestos. Where required, asbestos abatement will occur when renovation or demolition projects are identified.