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ABSTRACT

Data on employee exposures, bioassay results, effluent releases, in-plant airborne radioactivities, and environmental monitoring for Rocketdyne operations during 1985 are reviewed. This review is prepared, as required by Special Nuclear Materials License No. SNM-21, to determine (1) if there are any upward trends developing in personnel exposures for identifiable categories of workers or types of operations or effluent releases, (2) if exposures and effluents might be lowered under the concept of as low as reasonably achievable, and (3) if equipment for effluent and exposure control is being properly used, maintained, and inspected.

Personnel exposures have been carefully controlled.

Effluent releases are at insignificant levels compared to regulatory standards, do not show any upward trends, and do not appear to be reducible by reasonable means.

To the extent covered by this review, equipment for effluent and exposure control was properly used, maintained, and inspected.

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CONTENTS

TABLES

TABLES

FIGURES

INTRODUCTION

In October of 1984, the Energy Systems Group (California) was merged with the Rocketdyne Division. The Rocketdyne (ex-Energy Systems Group) special nuclear materials license[1] requires that an annual report be made to the Isotopes Committee of the NSRP reviewing personnel exposure and effluent release data. The format and content of this report have been well established in prior issues.[2-11] While this report is prepared primarily to satisfy a requirement of the NRC license, all continuing ESG operations with radioactive material have been included. Subsequent reports will incorporate the pre-existing Rocketdyne operations.

These reports for the years 1975 through 1984[2-11] provide a historical basis for the identification of trends. It should be noted that, in some instances, both NRC-licensed and non-NRC-licensed activities take place in the same building. In these cases, certain measurements (e.g., ventilation air exhaust radioactivity) have not been made separately for each type of activity.

Additionally, it is not possible to separate the integrated personnel radiological doses to that attributable to either nonlicensed activities for the DOE or the activities licensed by NRC or the State of California.

The following ESG/Rocketdyne facilities and operations are specifically covered in this report:

1) <u>Rockwell International Hot Laboratory (RIHL)</u> - Building 020, Santa Susana Field Laboratories

2) <u>Nuclear Material Development Facility (NMDF)</u> - Building 055, Santa Susana Field Laboratories

3) <u>Radioactive Material Disposal Facility (RMDF)</u> - Buildings 021, 022, and related facilities at Santa Susana Field Laboratories (DOE jurisdiction)

The major work performed during 1985 consisted of decladding EBR-II blanket fuel rods from the Savannah River Plant and preparing them for shipment for processing. This work involved the licensed (by NRC and California) RUHL and the license-exempt (DOE) RMDF. In addition, some industrial radiography, involving both X-ray machines and radioisotope sources, and research and development were performed.

I. PERSONNEL DOSIMETRY

Personnel dosimetry techniques generally consist of two types: those which measure radiation incident on the body from external sources (film badges) and those which measure internal body organ accumulations of radioactivity via inhalation, ingestion, or through cuts or puncture wounds (bioassays). These measurement methods provide a natural separator of the exposure modes to (1) permit an evaluation of the more significant exposure routes and (2) to allow a differentiation between those exposure sources which are external and controllable in the future and those which may continue to irradiate the body for some time period (i.e., internal body deposits).

A. FILM/TLD DATA

1. Whole Body Monitoring

Personnel external radiation exposures for the pertinent activities for the year are shown in Figure 1 as a cumulative log-normal distribution. It should be noted (see Summary, Section VI) that all whole-body exposures were less than 2 rem and were well below the allowable annual occupational total of 12 rem for NRC and State-licensed operations and 5 rem for DOE operations.

For comparison, the distributions of exposures reported for NRC licensees[12] and DOE contractors[13] for 1983 are shown as solid curves.

The Rocketdyne dose distribution is well below the NRC distribution and generally approaches the DOE distribution. A more significant comparison can be made in terms of the group dose. The group dose received by Rocketdyne employees in 1985 amounted to 58.4 person-rem. If the distribution of doses had been that shown for NRC licensees, the group dose would have been 117 person-rem. If the doses had been those shown for DOE, the group dose would have been 37 person-rem. However, comparisons such as these should be viewed with caution because of differences in the type of work between the Rocketdyne workforce and both the NRC licensees and the DOE contractors.

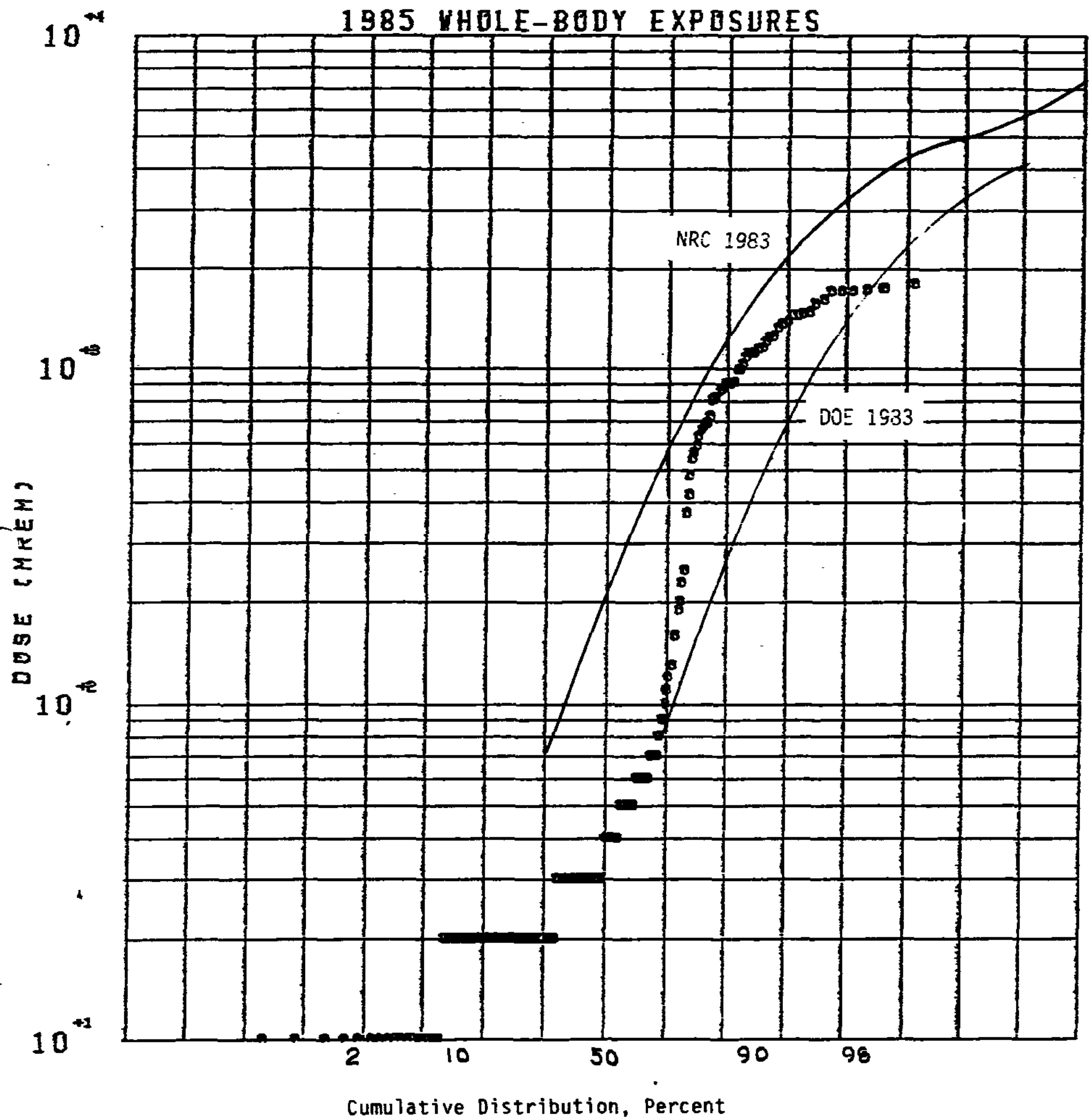

Figure 1. Cumulative Log-Normal Distribution for Whole-Body Radiation Exposures of Occupationally Exposed Individuals in 1985

2. Extremity Monitoring

Operations with radioactive material that may involve locally high exposures are conducted with additional "extremity" monitoring, usually for the hands.

All extremity exposures were below the allowable quarterly limit of 18.75 rem and the adopted administrative guides of 2 rem per quarter as shown in Figure 2, and were well below 5 rem per year. The maximum hand exposure was less than 7% of the NRC and State of California limits. This limit is less than the DOE quarterly limit of 25 rem, although it should be noted that DOE guidance is to limit hand exposure to 5 rem per quarter.

B. BIOASSAYS

Bioassays normally consist of analysis of urine and occasionally fecal samples. Personnel whose work assignments potentially expose them to respirable-sized radioactive aerosols are routinely evaluated in this manner. Normally, urinalyses are performed quarterly and fecal analysis only when gross internal contamination is suspected. A statistical summary of the results for 1985 appears in Table 1, while a detailed listing of the positive results are shown in Table 2. Only three types of analyses showed positive results this year: FP3A, FP3B, and PUA. The PUA analysis is chemically selective for plutonium and excludes Am-241, which is generally present with plutonium such as in the SEFOR fuel. The FP3A analysis is assumed to be indicative of Sr-90, although other radionuclides, such as Co-60, may also be detected. Further analysis could specifically quantify Sr-90, and identify interfering radionuclides, if significant activities were found. The FP3B analysis is radiometrically selective for Cs-137, using gamma-ray spectrometry to measure this radionuclide.

Followup results are shown, where available, to indicate the decrease of detected activity to negligible levels.

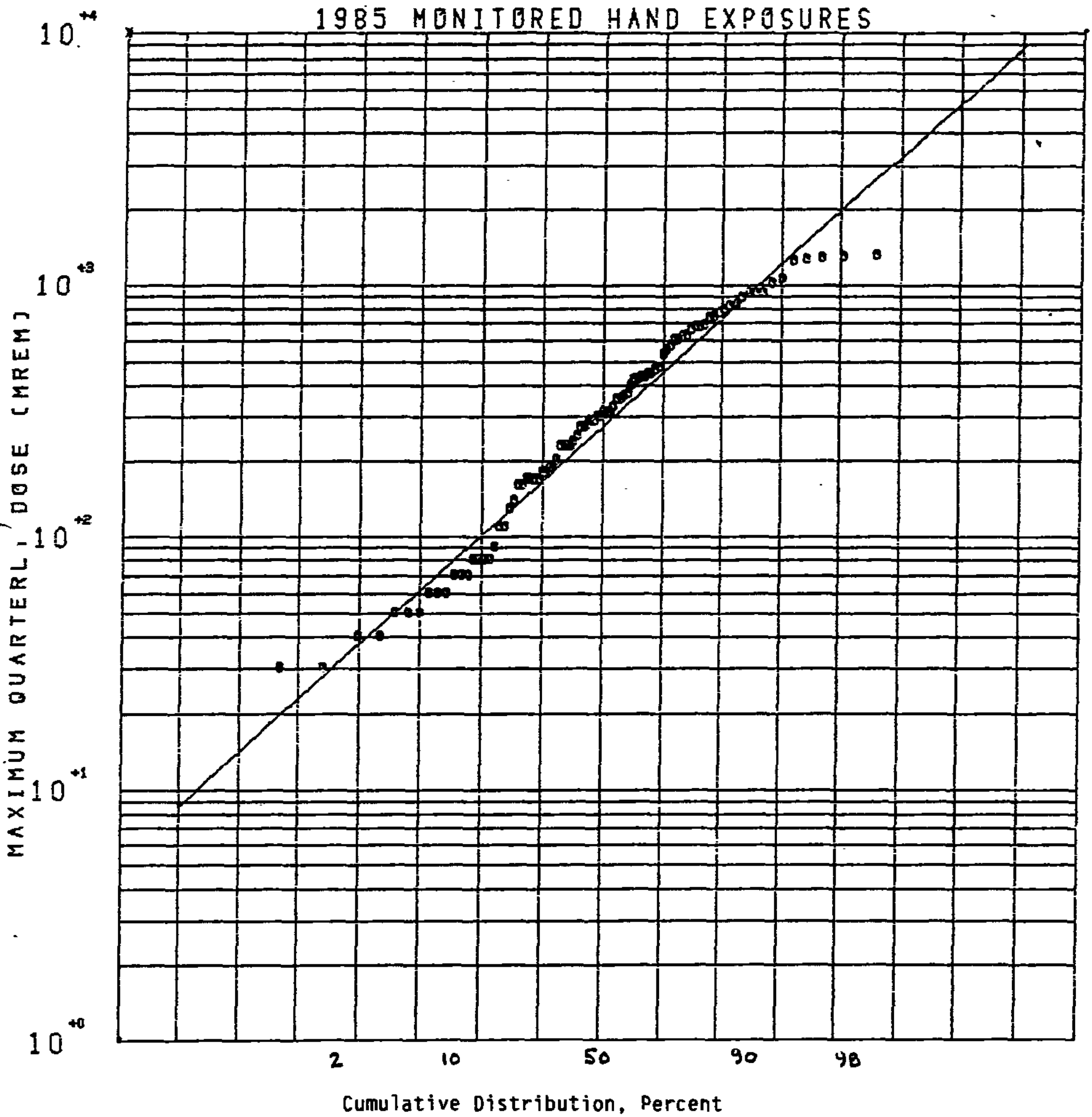

Figure 2. Cumulative Log-Normal Distribution for Quarterly Hand Exposures in 1985

TABLE 1

SUMMARY OF BIOASSAYS - 1985

Measurement Type*	Total Tests	Total Positive Results	Total Individuals With Positive Results
UF	2	0	0
UR	2	0	0
PUA	128	1	1
FP3A	256	19	18
FP3B	256	49	34
Total	644	69	53

*UF = Uranium - Fluorometric
UR = Uranium - Radiometric
PUA = Gross Plutonium-alpha
FP = Fission Products

(For a discussion of specific analytical techniques employed, as identified by "TYPE," see Appendix B in Reference 9)

TABLE 2

POSITIVE BIOASSAY RESULT SUMMARY - 1985
(Sheet 1 of 4)

H&S Number	Sample Date	Analysis Type*	Results Per Vol. Anal.	Results Per 1500 ml-day	Assumed Specific Radionuclide	Assumed Critical Nuclide Equivalent MPBB (%)
1495	051185	FP3B	9.60	72.00	Cs-137	0.01
1495	061485	FP3B	6.10	-	Cs-137	0
4904	022285	FP3B	8.06	60.45	Cs-137	0.009
4904	022585	FP3B	11.32	84.90	Cs-137	0.01
4904	051585	FP3B	8.60	64.50	Cs-137	0.01
4904	071785	FP3B	3.00	-	Cs-137	0
4904	111285	FP3A	4.41	33.11	Sr-90	0.07
4904	120885	FP3A	2.68	-	Sr-90	0
4914	021085	FP3B	14.50	108.75	Cs-137	0.02
4914	040285	FP3B	7.13	-	Cs-137	0
4914	091385	FP3B	14.51	100.82	Cs-137	0.02
4158	030585	FP3B	8.06	60.45	Cs-137	0.009
4158	042685	FP3B	13.97	104.78	Cs-137	0.02
4158	051785	FP3B	0	0	Cs-137	0
4158	062785	FP3B	19.80	148 50	Cs-137	0.02
3742	111285	FP3B	10.75	80.63	Cs-137	0.01
3742	120985	FP3B	0	0	Cs-137	0
4390	120785	FP3A	2.04	5.60	Sr-90	0.01
4390	020786	FP3A	0	0	Sr-90	0
2832	021785	FP3B	9.67	72.53	Cs-137	0.01
2832	033085	FP3B	0	0	Cs-137	0
4160	021485	FP3A	5.44	40.80	Sr-90	8.50
4160	040585	FP3A	0.08	-	Sr-90	0
2312	111485	FP3A	9.30	69.72	Sr-90	14.52
2312	010686	FP3A	3.63	27.22	Sr-90	5.67
4525	061785	FP3B	10.00	75.00	Cs-137	0.01
4525	073185	FP3B	6.45	-	Cs-137	0
4893	012085	FP3B	12.00	90.00	Cs-137	0.01
4893	051485	FP3B	2.50	-	Cs-137	0
4893	081185	FP3A	9.07	68.02	Sr-90	14.178
4893	120185	FP3A	2.26	-	Sr-90	0
4893	120185	FP3B	8.65	64.90	Cs-137	0.01
4893	120685	FP3B	0	-	Cs-137	0
4893	120685	FP3A	6.30	47.27	Sr-90	9.85
4893	031486	FP3A	2.09	15.68	Sr-90	3.27

TABLE 2

POSITIVE BIOASSAY RESULT SUMMARY - 1985
(Sheet 2 of 4)

H&S Number	Sample Date	Analysis Type*	Results Per Vol. Anal.	Results Per 1500 ml-day	Assumed Specific Radionuclide	Assumed Critical Nuclide Equivalent MPBB (%)
1166	050985	FP3B	19.30	144.75	Cs-137	0.02
1166	061785	FP3B	0	-	Cs-137	0
4943	121985	FP3A	7.20	54.02	Sr-90	11.25
4943	032886	FP3A	1.81	13.58	Sr-90	2.83
4928	051185	FP3B	8.65	64.88	Cs-137	0.01
4928	061885	FP3B	9.20	69.00	Cs-137	0.01
4928	070185	FP3B	1.00	-	Cs-137	0
4928	061885	FP3A	5.50	41.25	Sr-90	8.60
4928	070185	FP3A	1.56	-	Sr-90	0
3454	061985	FP3A	4.10	30.75	Sr-90	6.41
3454	080185	FP3A	1.90	-	Sr-90	0
3954	021185	FP3B	16.43	123.22	Cs-137	0.02
3954	040485	FP3B	0	-	Cs-137	0
3771	051285	FP3B	8.50	63.75	Cs-137	0.01
3771	061885	FP3B	6.70	-	Cs-137	0
3771	070185	FP3B	11.30	84.75	Cs-137	0.01
3771	081285	FP3B	4.84	-	Cs-137	0
3771	120685	FP3A	4.75	35.60	Sr-90	7.42
3771	031086	FP3A	1.53	11.48	Sr-90	2.39
3703	021185	FP3A	4.56	34.20	Sr-90	7.12
3703	040185	FP3A	3.57	-	Sr-90	0
4915	121185	FP3A	4.33	32.48	Sr-90	6.77
4915	011386	FP3A	0.34	2.55	Sr-90	0.53
4908	021185	FP3B	13.74	103.05	Cs-137	0.02
4908	040185	FP3B	3.40	-	Cs-137	0
4908	121285	FP3B	10.69	80.18	Cs-137	0.01
4908	011286	FP3B	1.62	12.11	Cs-137	0
4362	071585	FP3B	8.50	63.75	Cs-137	0.01
4362	091585	FP3B	0	-	Cs-137	0
1362	012485	FP3B	8.02	60.15	Cs-137	0.009
1362	022585	FP3B	0	-	Cs-137	0

TABLE 2

POSITIVE BIOASSAY RESULT SUMMARY - 1985
(Sheet 3 of 4)

H&S Number	Sample Date	Analysis Type*	Results: Per Vol. Anal.	Results: Per 1500 ml-day	Assumed Specific Radionuclide	Assumed Critical Nuclide Equivalent MPBB (%)
3499	081585	FP3B	12.22	91.62	Cs-137	0.009
3499	120585	FP3B	4.58	-	Cs-137	0
3499	120585	FP3A	5.45	40.89	Sr-90	8.52
3499	031986	FP3A	4.76	35.70	Sr-90	7.44
4942	121285	FP3B	11.92	89.40	Cs-137	0.01
3506	051285	FP3B	17.00	127.50	Cs-137	0.02
3506	061985	FP3B	0.04	-	Cs-137	0
2041	051285	FP3B	24.30	182.25	Cs-137	0.03
2041	061885	FP3B	10.30	77.25	Cs-137	0.01
2041	071485	FP3B	6.99	-	Cs-137	0
2041	120985	FP3B	9.14	68.55	Cs-137	0.01
2041	031086	FP3B	0	-	Cs-137	0
4950	091385	FP3B	11.34	85.05	Cs-137	0.01
4950	120885	FP3B	0	-	Cs-137	0
4566	021985	FP3B	13.58	101.85	Cs-137	0.02
4566	040185	FP3B	3.22	-	Cs-137	0
3726	120885	FP3B	10.75	80.63	Cs-137	0.01
3726	030986	FP3B	9.72	72.9	Cs-137	0.01
4905	041385	FP3B	17.30	129.75	Cs-137	0.02
4905	051785	FP3B	14.20	106.50	Cs-137	0.02
3930	021785	FP3B	10.69	80.18	Cs-137	0.01
3930	042685	FP3B	0	-	Cs-137	0
4955	112685	FP3A	5.24	39.34	Sr-90	8.21
2302	021285	FP3B	19.85	148.57	Cs-137	0.02
2302	040285	FP3B	4.53	-	Cs-137	0
3078	051185	FP3B	16.80	126.00	Cs-137	0.02
3078	061585	FP3B	4.20	-	Cs-137	0
1754	061785	FP3A	5.90	44.25	Sr-90	9.22
1754	080186	FP3A	0.64	-	Sr-90	0

TABLE 2

POSITIVE BIOASSAY RESULT SUMMARY - 1985
(Sheet 4 of 4)

H&S Number	Sample Date	Analysis Type*	Results Per Vol. Anal.	Results Per 1500 ml-day	Assumed Specific Radionuclide	Assumed Critical Nuclide Equivalent MPBB (%)
4907	051385	FP3B	16.70	125.25	Cs-137	0.02
4907	061785	FP3B	2.80	-	Cs-137	0
4907	061785	FP3A	5.40	40.50	Sr-90	8.44
4907	070186	FP3A	0.31	-	Sr-90	0
4404	102785	FP3B	18.12	135.90	Cs-137	0.02
4404	102885	FP3B	0	-	Cs-137	0
4404	110585	FP3B	12.22	91.65	Cs-137	0.01
4404	110785	FP3A	5.70	42.73	Sr-90	8.90
4404	110785	FP3B	28.91	216.82	Cs-137	0.03
4404	111485	FP3A	2.47	-	Sr-90	0
4404	111485	FP3B	27.07	203.02	Cs-137	0.03
4404	121085	FP3B	0.58	-	Cs-137	0
4162	120885	FP3A	8.18	61.36	Sr-90	12.79
4162	031086	FP3A	3.41	25.58	Sr-90	5.33
3939	051085	FP3B	23.20	174.00	Cs-137	0.03
3939	051085	PUA	0.0678	0.1017	Pu-239	0.08
3939	061785	FP3B	9.20	69.00	Cs-137	0.01
3939	070285	FP3B	5.10	-	Cs-137	0
3939	070885	PUA	0.0043	-	Pu-239	0
0812	021085	FP3B	9.62	72.15	Cs-137	0.01
0812	040485	FP3A	4.01	30.04	Sr-90	6.26
0812	040485	FP3B	5.60	-	Cs-137	0
0812	042885	FP3A	1.55	-	Sr-90	0
4407	012385	FP3B	13.20	100.50	Cs-137	0.02
4407	051385	FP3B	11.90	89.25	Cs-137	0.01
4407	061785	FP3B	0	-	Cs-137	0
1547	111285	FP3B	9.16	68.72	Cs-137	0.01
1547	120885	FP3B	3.40	-	Cs-137	0

Pu: Gross Plutonium
FP: Fission Products

(For a brief description of the specific analytical techniques, see Appendix B of Reference 9)

(FP3A is presumptively Sr-90; FP3B is specifically Cs-137)

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The excretion rates assumed to be indicative of 1 MPBB for various radionuclides and the minimum detectable activities (MDA) are:

Radionuclides	Standard Excretion Rate	MDA
Sr-90	480 dpm/day	30 dpm/day
Cs-137	660,000 dpm/day	60 dpm/day
Pu-239	121.4 dpm/day	0.05 dpm/day

These excretion rates are based on an assumption of equilibrium between intake and elimination. Transient elimination following an acute exposure will generally indicate a much higher body burden than actually exists.

II. RADIATION/RADIOACTIVITY MEASUREMENTS

The measurements and surveillance performed to determine local radiation levels in the working areas where licensed activities are performed are described below.

A. AREA RADIATION LEVELS

Film badges ("location badges") are placed throughout the facilities, and are kept in place during the entire calendar quarter. Some of these are in nominally low-exposure areas while some are in relatively high-exposure (but low-occupancy) areas. The average and maximum exposure rates determined for each quarter are shown in Table 3.

TABLE 3
LOCATION BADGE RADIATION EXPOSURE - 1985

	Calendar Quarter			
	Q1	Q2	Q3	Q4
	Average Exposure Rate (mR/h)			
Facility	Maximum Exposure Rate (mR/h)			
RIHL	0.15 / 0.87	0.15 / 0.56	0.14 / 0.62	0.09 / 0.63
NMDF	0 / 0.01	0 / 0	0 / 0	- / -
RMDF	0.86 / 3.32	0.64* / 1.69*	1.45 / 6.17	8.03 / 29.42

*Dosimeters judged to be defective by vendor.

The values of the RMDF for the third and fouth quarters are significantly affected by radioactive sludge accumulated at the evaporator. While this area is not usually occupied (the evaporator works automatically), these exposure rates are excessive and should be brought under control.

B. INTERIOR AIR SAMPLES - WORKING AREAS

In those working areas where the nature of the tasks being performed and the materials in use might lead to the potential for generation of respirable airborne radioactivity, periodic local air sampling is performed. A summary of these results for 1985 is given in Table 4.

TABLE 4

INTERIOR AIR SAMPLE SUMMARY - 1985

Area	Sample		Airborne Activity Concentration (μCi/ml) — Calendar Quarter Q1	Q2	Q3	Q4	MPC
RIHL	Unposted	alpha	1×10^{-15}	1×10^{-15}	1×10^{-15}	1×10^{-15}	2×10^{-12}
		beta	1×10^{-14}	1×10^{-14}	1×10^{-14}	1×10^{-14}	1×10^{-9}
	Posted	alpha	1×10^{-14}	1×10^{-14}	1×10^{-14}	1×10^{-14}	2×10^{-12}
		beta	1×10^{-13}	1×10^{-13}	1×10^{-13}	1×10^{-13}	1×10^{-9}
	Maximum	alpha	1×10^{-9}	5×10^{-13}	5×10^{-12}	3×10^{-13}	2×10^{-12}
		beta	4×10^{-7}	8×10^{-9}	5×10^{-8}	5×10^{-10}	1×10^{-9}
NMDF	Stationary Max Week		1.2×10^{-14}	9×10^{-15}	5×10^{-15}	-	1.3×10^{-12}
	Average		7×10^{-15}	3.6×10^{-15}	3.6×10^{-15}	-	1.3×10^{-12}
RMDF	T022 High Bay Ave.	beta	-	9.5×10^{-12}	1.1×10^{-11}	1.5×10^{-11}	1×10^{-9}
	Decon Room	beta	-	-	2.8×10^{-11}	5.6×10^{-11}	1×10^{-9}
	Packaging Room	beta	-	-	2.1×10^{-11}	1.7×10^{-10}	1×10^{-9}
	Average		7×10^{-15}	3.6×10^{-15}	3.6×10^{-15}	-	1.3×10^{-12}

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III. EFFLUENT MONITORING

Effluents which may contain radioactive material are generated at certain Rocketdyne facilities as a result of operations performed either under contract to DOE, or under the NRC Special Nuclear Materials License SNM-21, or under the State of California Radioactive Material License 0015-70. The specific facilities identified with the NRC license are Building 004 at the headquarters site and Buildings 020 and 055 at the SSFL at Santa Susana.

An annual report of effluent releases, prepared by Radiation & Nuclear Safety in the HS+E Department, describes in detail the monitoring program at Rocketdyne for gaseous effluents from the Rocketdyne facilities. The data reported in the 1985 edition of that report[14] for atmospherically discharged effluents for the facilities identified above is presented in Table 5. (No releases of radioactively contaminated liquids were made, either to the sewer or to the environment.)

TABLE 5

ATMOSPHERIC EMISSIONS TO UNRESTRICTED AREAS - 1985

	Approximate Emissions Volume (m^3)	Activity Monitored	Approximate Minimum Detection Level (10^{-15} μCi/ml)	Annual Average Concentration (10^{-15} μCi/ml)	Sampling Period Maximum Observed Concentration (10^{-15} μCi/ml)	Total Radio-activity Released (Ci)	Percent of Guide[a]	Percent of Samples with Activity <MDL
104 De Soto	1.3×10^8	Alpha	0.21	1.10	4.50	1.5×10^{-7}	0.04	7
		Beta	0.72	3.42	7.34	4.5×10^{-7}	0.001	20
020 SSFL	2.5×10^8	Alpha	0.09	1.77	102.80	4.5×10^{-7}	2.95	7
		Beta	0.30	354.22	22410.00	9.0×10^{-5}	1.18	0
021-022 SSFL	2.3×10^8	Alpha	0.09	0.17	1.80	3.9×10^{-8}	0.28	71
		Beta	0.30	39.13	673.28	9.0×10^{-6}	0.13	0
055 SSFL	2.2×10^8	Alpha	0.29	0.24	1.34	5.3×10^{-8}	0.40	73
		Beta	0.96	6.51	25.56	1.5×10^{-6}	0.22	4
Total	8.3×10^8				Total	1.0×10^{-4}		
Annual average ambient air radio-activity concen-centration[b] - 1985		Alpha	2.0		Ambient			
		Beta	35.0		equivalent[c]	3.1×10^{-5}		

[a]Assuming all radioactivity detected is from Rocketdyne nuclear operations.
Guide: De Soto site: 3×10^{-12} μCi/ml alpha, 3×10^{-10} μCi/ml beta; 10 CFR 20 Appendix B.
SSFL site: 6×10^{-14} μCi/ml alpha, 3×10^{-11} μCi/ml beta, 3×10^{-12} μCi/ml beta (055 only); 10 CFR 20 Appendix B, CAC-17, and DOE Order 5480.1 Chapter XI.

[b]Averaged result for 7-day (200 m^3) SSFL continuous air sampler.

[c]Natural radioactivity contained in equivalent volume of air discharged through exhaust systems after filtration.

Note: All release points are at the stack exit.

IV. ENVIRONMENTAL MONITORING PROGRAM

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

The annual report of environmental monitoring, prepared by Radiation & Nuclear Safety in the HS&E Department, describes in detail the Rocketdyne environmental monitoring program.

Some of the data reported in the 1985 edition of that report[14] are presented here. It is important to remember that the radiological activity levels reported can be attributed not only to operations at NRC licensed, DOE-sponsored, and State of California-licensed facilities, but also to external influences such as fallout from nuclear weapon testing and naturally occurring radioactive materials.

These data are:

- Soil gross radioactivity data presented in Table 6
- Soil plutonium radioactivity data presented in Table 7
- Vegetation radioactivity data presented in Table 8
- SSFL Site - Domestic water radioactivity data presented in Table 9
- Bell Creek and Rocketdyne site retention pond radioactivity data presented in Table 10
- Ambient air radioactivity data presented in Table 11 (and shown graphically in Figure 3).
- Ambient radiation data presented in Table 12.

TABLE 6

SOIL RADIOACTIVITY DATA - 1985

Area	Activity	Number of Samples	Gross Radioactivity (pCi/g)	
			Annual Average Value and Dispersion	Maximum Observed Value[a] and Month Observed
On-site (monthly)	Alpha	144	25.2 ± 7.3	48.36 (April)
	Beta	144	24.2 ± 1.9	32.7 (September)
Off-site (quarterly)	Alpha	48	26.3 ± 7.8	46.00 (July)
	Beta	48	23.9 ± 3.3	30.2 (April)

[a]Maximum value observed for single sample.

TABLE 7

SOIL PLUTONIUM RADIOACTIVITY DATA - 1985

Sample Location	26 June 1985 Survey Results		4 December 1985 Survey Results	
	^{238}Pu (pCi/g)	$^{239}Pu + ^{240}Pu$ (pCi/g)	^{238}Pu (pCi/g)	$^{239}Pu + ^{240}Pu$ (pCi/g)
S-56	0.0001 ± 0.0002	0.0009 ± 0.0003	0.0005 ± 0.0004	0.0051 ± 0.0006
S-57	0 ± 0.0001	0.0038 ± 0.0004	0.0003 ± 0.0003	0.0028 ± 0.0005
S-58	0.0001 ± 0.0001	0.0020 ± 0.0004	0 ± 0.0001	0.0048 ± 0.0006
S-59	0.0001 ± 0.0001	0.0025 ± 0.0004	0.0001 ± 0.0001	0.0017 ± 0.0004
S-60	0.0001 ± 0.0001	0.0019 ± 0.0004	0 ± 0.0002	0.0008 ± 0.0004
S-61[a]	0 ± 0.0001	0.0005 ± 0.0002	0 ± 0.0001	0.0003 ± 0.0002

[a]Off-site location

TABLE 8

VEGETATION RADIOACTIVITY DATA - 1985

Area	Activity	Number of Samples	Gross Radioactivity (pCi/g)			Percent of Samples With Activity ≥MDL[b]
			Dry Weight	Ash		
			Annual Average Value and Dispersion	Annual Average Value and Dispersion	Maximum Value[a] and Month Observed	
On-site (monthly)	Alpha	144	0.49 ± 0.58	3.76 ± 4.44	22.0 (December)	100
	Beta	144	18.5 ± 9.0	134.8 ± 53.4	268.9 (October)	0
Off-site (quarterly)	Alpha	48	1.05 ± 1.73	4.68 ± 6.25	25.3 (January)	100
	Beta	48	26.2 ± 13.7	132.8 ± 49.2	242.4 (January)	0

[a]Maximum value observed for single sample.
[b]Minimum detection level: 2.27 pCi/g alpha; 0.36 pCi/g beta (ash).

TABLE 9

SUPPLY WATER RADIOACTIVITY DATA - 1985

Area	Activity	Number of Samples	Gross Radioactivity (10^{-9} μCi/ml)	
			Average Value and Dispersion	Maximum Value[a] and Month Observed
De Soto (monthly)	Alpha	12	2.76 ± 1.82	5.73 (November)
	Beta	12	3.17 ± 0.78	4.60 (March)
SSFL (monthly)	Alpha	24	2.45 ± 2.61	8.63 (December)
	Beta	24	2.80 ± 0.51	3.95 (October)

[a]Maximum value observed for single sample.

TABLE 10

BELL CREEK AND ROCKETDYNE SITE RETENTION POND
RADIOACTIVITY DATA - 1985

Area (monthly)	Activity	Number of Samples	Gross Radioactivity Concentrations		
			Annual Average Value and Dispersion	Maximum Value[a] and Month Observed	Percent of Samples With Activity ≤MDL[b]
Bell Creek mud no. 54 (pCi/g)	Alpha	12	21.9 ± 6.5	31.9 (January)	0
	Beta	12	22.7 ± 1.1	24.7 (November)	0
Pond R-2A mud no. 55 (pCi/g)	Alpha	12	31.4 ± 6.0	43.7 (May)	0
	Beta	12	24.0 ± 1.1	25.3 (December)	0
Bell Creek vegetation no. 54 (pCi/g—ash)	Alpha	12	1.34 ± 1.25	2.82 (January)	100
	Beta	12	137.1 ± 28.6	178.8 (August)	0
Bell Creek vegetation no. 54 (pCi/g dry weight)	Alpha	12	0.23 ± 0.20	0.49 (September)	100
	Beta	12	22.4 ± 6.1	32.94 (September)	0
Bell Creek water no. 16 (10^{-9} µCi/ml)	Alpha	12	1.38 ± 7.09	19.68 (December)	100
	Beta	12	2.49 ± 0.75	3.79 (December)	0
Pond water no. 6 (10^{-9} µCi/ml)	Alpha	12	2.06 ± 4.44	13.65 (October)	100
	Beta	12	3.53 ± 0.96	4.92 (November)	0
SSFL pond R-2A water no. 12 (10^{-9} µCi/ml)	Alpha	12	3.07 ± 1.94	6.61 (April)	100
	Beta	12	3.49 ± 0.76	5.56 (October)	0

[a]Maximum value observed for single sample.
[b]Minimum detection level: Approximately 6.40 x 10^{-9} µCi/ml alpha; 0.64 x 10^{-9} µCi/ml beta for water: approximately 2.3 µCi/g alpha; 0.23 µCi/g for soil: approximately 2.3 pCi/g alpha; 0.36 µCi/gm for vegetation ash.

TABLE 11

AMBIENT AIR RADIOACTIVITY DATA - 1985

Area (monthly)	Activity	Number of Samples	Gross Radioactivity Concentrations—Femtocuries per cm^3 (10^{-15} µCi/ml)			
			Annual Average Value and Dispersion	Maximum Value[a] and Month Observed	Percent of Guide[b]	Percent of Samples With Activity <MDL[c]
De Soto on-site (2 locations)	Alpha Beta	544	2.7 ± 2.2 40.0 ± 14.0	38.0 (01/07) 180.0 (05/10)	0.09 0.01	89 2
SSFL on-site (5 locations)	Alpha Beta	1725	2.0 ± 1.6 40.0 ± 13.0	44.0 (07/04) 170.0 (07/05)	3.3 0.01	93 2
SSFL sewage treatment plant	Alpha	360	2.3 ± 1.9	25.0 (01/29)	3.8	89
SSFL control center	Alpha Beta	365	1.6 ± 1.4 38.0 ± 12.0	13.0 (07/04) 160.0 (07/15)	2.7 0.1	93 3
All locations	Alpha Beta	2994	2.1 ± 1.8 40.8 ± 15.2	44.0 (07/04) 240.0 (05/07)	0.07 0.01	92 2

[a]Maximum value observed for single sample.
[b]Guide: 3×10^{-12} µCi/ml alpha, 3×10^{-10} µCi/ml beta; 10 CFR 20 Appendix B. 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]MDL = 6.4×10^{-15} µCi/ml alpha; 1.3×10^{-14} µCi/ml beta.

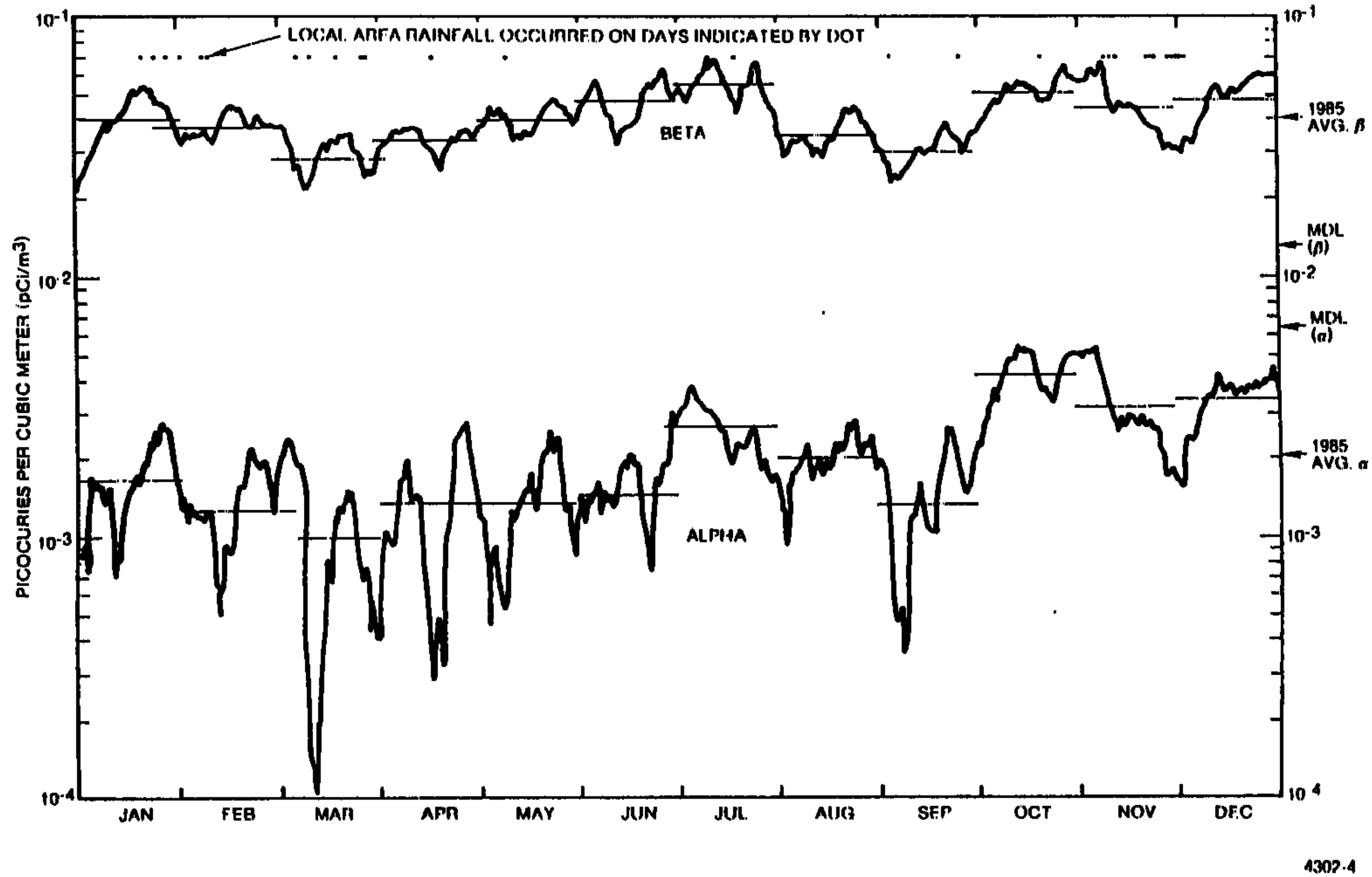

Figure 3. Average Long-Lived Airborne Radioactivity at the De Soto and Santa Susana Field Laboratories Sites - 1985

TABLE 12

DE SOTO AND SSFL SITES - AMBIENT RADIATION DOSIMETRY DATA - 1985

TLD Location	Quarterly Exposure (mrem)				Annual Exposure (mrem)	Equivalent Exposure at 1000 ft ASL	
	Q-1	Q-2	Q-3	Q-4		(mrem)	(μrem/h)
De Soto DS-1	22	31	26	28	107	109	12
DS-2	20	24	30	26	100	102	12
DS-3	20	29	26	26	101	103	12
DS-4	23	31	25	a	105	107	12
DS-5	21	28	22	25	96	98	11
DS-6	24	32	24	a	107	109	12
DS-7	20	26	21	24	91	93	11
DS-8	21	28	20	24	93	95	11
Mean value	21	29	24	26	100	102	12
SSFL SS-1	23	35	26	a	112	100	11
SS-2	20	35	30	32	117	105	12
SS-3	24	35	30	32	121	109	12
SS-4	a	33	31	32	128	115	13
SS-5	24	34	29	30	117	104	12
SS-6	26	37	30	32	125	114	13
SS-7	19	36	26	29	110	98	11
SS-8	b	38	29	32	132	120	14
SS-9	b	40	34	40	152	140	16
SS-10	b	34	28	30	123	112	13
Mean value	23	36	29	32	124	112	13
Off-site OS-1	22	32	29	29	112	114	13
OS-2	21	27	23	26	97	95	11
OS-3	20	34	24	26	104	106	12
OS-4	22	30	24	27	103	101	12
OS-5	23	32	25	30	110	111	13
Mean value	22	31	25	28	105	105	12

[a] Missing dosimeter; annual exposure estimated from data for three quarters.
[b] Dosimeter location established at the beginning of the second quarter. Annual exposure estimated from data for three quarters.

V. UNUSUAL EVENTS

There were several unusual events at facilities involving radiation or radioactive materials. These events are summarized below.

A. REPORTABLE INCIDENTS

None.

B. NONREPORTABLE INCIDENTS

The Radiation and Nuclear Safety group provides radiological monitoring and safety guidance for operations with radioactive material (including Special Nuclear Material) and radiation-producing devices. As part of this function, "Radiological Safety Incident Reports" are written and distributed. The purpose of these reports is to record incidents that were not significant enough to require formal reporting to any regulatory agency (AEC, NRC, ERDA, DOE, State of California), assure communication among the R&NS personnel, and enhance hazard awareness within the operations groups. Reporting of this sort has been done throughout the operations of Atomics International and Energy Systems Group (California) and is continuing as part of the Rocketdyne safety program. There were no reportable incidents during the time period for this review.

To promote the purpose of these reports, the reporting criteria have been deliberately left vague and general. Generally, a report is written for any injury occurring in a radioactively contaminated area, abnormal release of contamination, fire involving radioactive material, or exposure of personnel to radiation or abnormal radioactive contamination. These criteria are well below the regulatory agency reporting requirements. Judgment is required in determining when to write a report, and the goal has been both to inform workers and management and to record those events that might be questioned in the future but because of lack of consequence would not be otherwise recorded.

The reports are distributed to all members of Radiation and Nuclear Safety and generally to the individuals personally involved, their managers, and any related management. Each incident is reviewed at the time of reporting, and case-by-case corrective actions are implemented as appropriate.

During an inspection by NRC Region V Office of Inspection and Enforcement in October 1985, the inspector reviewed approximately 15 reports for the Rockwell International Hot Laboratory (RIHL) and asked Rocketdyne (as the licensee) to conduct a thorough review to determine and identify common causes and trends. This review covers the period from mid-1984 to the end of 1985 and addresses a total of 24 reports. The apparently large number and average frequency of more than one report per month should not be seen as an indication of unsafe operations but rather as evidence of attention to minor abnormal occurrences with the aim of achieving excellent performance throughout the operation. This review found no indication of a worsening of conditions or weakening of control that might lead to higher risk.

This document reports the results of the review. A formal review of this sort will be included in the "Annual Review of Radiological Controls," presented to the Isotopes Committee, starting with the report for calendar year 1986.

The RIHL is the most active of our nuclear facilities and is the only significantly active facility under the NRC Special Nuclear Materials License. Therefore, the review has been limited to reports generated at this facility. (The only other recent report involved an industrial radiography incident.)

The reported incidents are listed briefly below in chronological order. The corrective actions taken following several of these incidents are included. Incident reports up to and including No. 15 (August 12, 1985) were available for the NRC Inspector's review.

1. August 20, 1984 — Individual bumped head on metal frame in Cell 3, while in full protective clothing. A minor skin abrasion resulted but no contamination occurred.

   Corrective action: Personnel were alerted to the need to be careful in spite of the interferences in vision caused by protective clothing.

2. August 21, 1984 — While performing cleanup in Decon 3, two individuals contaminated their pants. The pants were confiscated and the employees reimbursed.

   Corrective action: Attention to administrative control of contaminated equipment was reemphasized.

3. October 15, 1984 — A small puddle of alcohol ignited when the cell atmosphere was deinerted during remote cleanup of Cell 3. The fire was quickly extinguished either by the nitrogen purge or by consumption of the fuel.

4. October 26, 1984 — One individual contaminated his hands by improperly grabbing a contaminated plastic bag of radioactive waste. His hands were completely decontaminated by scrubbing.

   Corrective action: The requirement for "coldmen" to wear labcoats and gloves was reemphasized.

5. December 6, 1984 — An individual's right forearm became contaminated due to separation of the taped glove-sleeve joint while working in Cell 1. Additional effort was required to completely clean his arm.

6. December 10, 1984 — An individual's left hand was contaminated apparently while removing protective clothing after work in Cell 1. His hand was cleaned easily.

7. December 10, 1984 — One individual received recorded exposures to the hands (7.7 rem right, 7.5 rem left) that exceeded the Rocketdyne administrative limit (4.9 rem) but did not exceed the allowable regulatory limit (18.75 rem).

   Corrective action: The individual was restricted from further radiation work during the calendar quarter. Other actions included improvement in the timeliness of extremity dosimetry, a prohibition against reuse of contaminated protective clothing or equipment, and a requirement for more thorough cell surveys before entry for work. Other modifications to cell entry procedures and extremity monitoring were also implemented.

8. December 10, 1984 — An individual contaminated his neck and left arm while working in Cell 1. The contamination was cleaned off.

9. January 14, 1985 — One individual contaminated his pants while moving a bag of radioactive waste in Decon 1. The pants were confiscated and the employee reimbursed.

   Corrective action: Personnel were reminded of the need for securely taping bags of contaminated waste.

10. January 15, 1985 — An individual cut his hand when a screwdriver slipped while he was repairing a contaminated manipulator. No contamination of the wound was detectable, but gamma spectrometry showed approximately 0.05 nCi of Cs-137. (Allowable body burden for Cs-137 is 30,000 nCi.) Bioassay showed no significant uptake.

    Corrective action: Personnel were reminded of the need to exercise care in working with sharp tools. Use of slip-proof screws where possible was recommended.

11. February 20, 1985 — An individual cut his finger on the sharp edge of a gear shaft on Cell 4 door. No contamination was found on the shaft or in the cut. Gamma spectrometry showed no activity and none was found by urinalysis.

    Corrective action: Use of heavier gloves for work such as this was advised.

12. March 4, 1985 — An individual's shoes were contaminated by water that penetrated plastic shoe covers through cuts caused by sharp debris in Cell 1. Shoes were confiscated and employee was reimbursed.

    Toe rubbers were required but not used. Personnel were advised of the need to comply with Entry Permit requirements.

13. March 20, 1985 — One individual contaminated his wrist, wristwatch, and pants when opening a contaminated drum in the Service Gallery. Wrist and wristwatch were cleaned. Pants were confiscated and employee was reimbursed.

    Corrective action: Better administrative control of contaminated waste and greater awareness by the operators were recommended.

14. June 6, 1985 — Acid solution being used for cleaning seeped through coverall sleeve onto employee's arm. After neutralizing acid, arm was cleaned with Windex and Bactine. Medical sent employee to hospital for treatment of burn.

Corrective action: Improved review and administrative control of the use of hazardous solutions were implemented.

15. August 12, 1985 — An individual received a puncture wound while packaging some contaminated glass. Slight contamination was found in the wound and small amount of activity was detected by gamma spectrometry. No significant activity was detected by urinalysis.

Corrective action: Work with contaminated glass will require leather gloves.

16. October 4, 1985 — An individual contaminated his shirt and pants while packaging radioactive waste. His pants were decontaminated, but his shirt was confiscated and he was reimbursed.

Corrective action: Personnel were reminded of need to fully comply with protective clothing specifications.

17. October 17, 1985 — An individual had his shoes contaminated by sharp metal debris that cut through plastic and canvas shoe covers. His shoes were confiscated and he was reimbursed.

Corrective action: Radiation Safety personel were reminded of need to specify the rubbers for this sort of work.

(Incident reports 18 through 23 appear to have a common cause resulting from a malfunction at the protective clothing laundry that left some residual contamination in the clean clothing.)

18. October 25, 1985 — An individual became contaminated on his arms and legs while working in-cell in heavy waterproof protective clothing (estimated activity was about 100 nCi compared to allowable internal body burden of 30,000 nCi). Suspected from protective clothing underwear.

19. November 4, 1985 One individual became contaminated on his arms while working in Cell 3 under conditions similar to No. 18. Suspected from protective clothing underwear.

20. November 13, 1985 Inside of shoes were found to be contaminated after work in Cell 3. Probably from protective clothing socks. Shoes were confiscated and employee reimbursed.

21. November 20, 1985 Inside of shoes were found to be contaminated after work in Cell 4 which had relatively low contamination. Probably from protective clothing socks. Shoes were confiscated and employee reimbursed.

22. November 21, 1985 Inside of shoes were found to be contaminated after work in Cell 3. Probably from protective clothing socks. Shoes were confiscated and employee reimbursed.

23. November 22, 1985 Inside of shoes were found to be contaminated after work in Decon 4, a relatively clean area. Probably from protective clothing socks. Shoes were confiscated and employee reimbursed.

Corrective action (18-23): Several steps were taken to alleviate this problem:

a) The laundry was contacted by phone. At that time, the equipment malfunction had been corrected.

b) Clean protective clothing on hand was surveyed, and several garments were discarded as over the acceptance limit.

c) Routine monitoring of clean protective clothing being delivered to RIHL was started.

24. December 10, 1985 An individual pinched and cut his finger while placing heavy object in disposal box. No contamination due to wearing double canvas gloves.

Corrective action: Improved work planning was recommended so that proper handling equipment is used.

The 24 incident reports are categorized as:

Personal contamination (19 incidents)

2, 4, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, (18, 19, 20, 21, 22, 23)

Injury in contaminated area (6)

1, 10, 11, 14, 15, 24

Fire (1)

3

Release of contamination (1)

13

High exposure (1)

7.

Some incidents are categorized twice (10, 13, 14, 15).

The most prevalent reported incidents are those involving personal contamination, either skin, wound, or clothing. This is true even if the epidemic of personal contamination apparently resulting from improperly laundered protective clothing (6 incidents, 18-23) is omitted.

Thus, in 18 out of 24 cases, use of protective clothing failed to achieve the desired goal, that is, to protect against injury and prevent contamination. This resulted from accidental failure of the protective clothing (Incidents 5, 8), from the protective clothing being inadequate for the job planned (Incidents 2, 10, 11, 12, 14, 15, 17) or for the job actually performed (Incidents 4, 13, 16), or from less-than-satisfactory work performance (Incidents 6, 9). The other category of protective clothing failure was when the clothing itself served as the source of contamination (Incidents 18-23).

This last problem apparently resulted from a malfunction at the laundry in which a chemical conditioner normally added to water used for rinses was omitted due to an unnoticed breakdown of the equipment. The laundry was notified but had already corrected the equipment failure. Protective clothing currently in stock was surveyed, and some garments exceeding the acceptance level were discarded. Some apparently contaminated socks escaped this survey and presumably resulted in Incidents 20-23.

The other incidents of personal contamination resulting from failure of the protective clothing system lead to two recommendations:

1. The job being planned should have more thorough discussion between Nuclear Operations and Radiation Safety personnel during development of the job plan and the entry permit (RAAEP). This discussion should consider all special hazards of the job, such as sharp metal debris, sharp tools, sharp edges, broken or breakable glass, and other conditions that could require use of more protective shoe covers or gloves. Special conditions, such as water or finely divided contamination, should also be discussed.

2. The operators and Radiation Safety should be aware of changes in working conditions that result in the job being performed differing from the job that was planned, for which appropriate protection clothing was specified. Possible changes in work should be considered and discussed in advance and adequate protective clothing used for these possibilities or decisions made to terminate the work.

In judging the appropriateness of the reporting criteria, it is important to consider the significance of the incidents that were reported. As discussed in the introduction, none required reporting to the regulatory agencies.

The fire (Incident 3) did not result in any property damage or release of radioactivity. (Whenever significant amounts of flammable material are present in a cell, the atmosphere is maintained at less than 5% oxygen. In this case, a small residual amount of alcohol ignited, perhaps due to the presence of a scrap of unreacted metallic sodium.)

Of the injury incidents (1, 10, 11, 14, 15, 24), none were OSHA-recordable.

The personal contamination incidents showed levels of contamination that were generally on the order of 10-100 times levels that are allowable for release for unrestricted use but were on very small areas. The bioassay results showed below the minimum detection level (MDL) in most cases. The highest bioassay result showed excretion equivalent to 0.03% of the allowable body burden for Cs-137 if the excretion rate had been constant. This corresponds to less than 1 mrem whole body dose.

The radiation exposure incident exceeded our administrative limit but was less than half the allowable regulatory limit of 18.75 rems.

Reimbursement costs for confiscated clothing amounted to approximately $350.

The consequences of these incidents are not significant with respect to most common measures of accident severity, and the only impact is due to the disruption of routine operations.

The number, or frequency, of incident reports is subject to several effects. First, since the criteria for reporting a nonreportable event are necessarily vague, the judgment of Radiation Safety personnel is involved. This may lead to more or less of the incidents being reported. The type and activity of work with radioactive material, particularly the amount of work being done with unencapsulated material, affects the occurrence of these events. In an attempt to normalize for these effects, several measures of the frequency of incidents have been considered.

One measure of the workload in significantly radioactive areas is the number of Restricted Access Area Entry Permits (RAAEP) prepared. For the time period considered in this review, 484 RAAEPs were prepared. If the six incidents involving a common cause (the malfunction at the laundry) resulting in personal or clothing contamination are considered to be really one event, the frequency rate is 19 incidents per 484 RAAEPs, or 0.039 incidents per entry permit.

The total group dose for the personnel involved in RIHL work during this time period was 74.6 person-rem. The normalized rate of incidents based on this measure is 19 incidents per 74.6 person-rem, or 0.255 incidents per person-rem.

The average exposure per person during this period was about 700 mrem per year. This leads to a frequency rate of 19 incidents per 107 man-years, or 0.178 incidents per man-year.

An additional means of estimating the frequency of incidents is the mean time between incidents. The time between reported nonreportable incidents varied from 0 to 78 days. For the 19 independent incidents, the mean time between incidents was 26.4 days ±5.9 (standard error of mean). Since the mean time between incidents also reflects how quickly and effectively corrective action is taken to prevent recurrences, a more appropriate measure is based on all 24 incidents. The mean time between incidents for all 24 was 20.3 days ±4.7 (standard error of mean).

Tabulated below, these measures will be tracked in the future to determine trends in the number of incidents.

Basis	Incidents	Measure	Rate
Entry Permits	19	484	0.039 inc/permit
Group Dose	19	74.6	0.255 inc/man-rem
Man-years	19	107	0.178 inc/man-year
Mean time	24	20.3 ± 4.7	days

As experience is developed, other methods of normalization may be developed.

The review of recent incident reports for the RIHL has shown that shortcomings of the protective clothing system, including specification of clothing and tasks, use, and the quality of the clothing, have contributed to the majority of the reported incidents.

Failures in the protective clothing system have resulted in contamination incidents and injuries that are trivial when considered relative to regulatory guidelines. However, these incidents disturb the routine operation of the RIHL and may affect employee morale and motivation. Use of protective clothing could be made more effective by improved communication and greater consideration for potential hazards.

VI. SUMMARY/TRENDS - EXPOSURE, EFFLUENTS

A. PERSONNEL EXPOSURES

Personnel exposures due to external radiation are summarized by year in the following table:

	Number of Persons in Exposure Range (rem)										Group	
Year	0 0.1	0.1 0.25	0.25 0.5	0.5 0.75	0.75 1.0	1.0 2.0	2.0 3.0	3.0 4.0	4.0 5.0	Total Exposed Persons	Dose (Person rems)	Average Dose (rems)
1985	134	10	4	9	12	25				194	58	0.301
1984	178	16	14	5	8	14				235	45	0.192
1983	281	9	5	4	5	13	8	2	17	344	138	0.402
1982	349	29	8	3	6	15	4	7	8	429	116	0.271
1981	192	55	13	4	6	4				274	33	0.121
1980	357	39	10	3	5	9	3			426	56*	0.131*
1979	347	39	19	10	4	15	8	2		444	91*	0.204*
1978	432	60	18	16	4	18	9	1	1	559	110*	0.197*
1977	340	31	29	7	5	11	13			436	91*	0.209*
1976	295	38	17	14	5	9	2			380	59*	0.156*
1975	170	24	12	4	5	6	1	1		223	39*	0.175*

*Determined by use of mid-point of range

Data shown for 1980 and prior years include visitors. Visitor exposures rarely exceed 0.25 rem. Data for 1981 through 1985 represent occupationally exposed Rocketdyne employees excluding certain workers in Rocketdyne operations predating the merger. The group dose was calculated exactly for these four years. This results in values that are approximately 10% lower than those calculated by use of the mid point of the exposure ranges.

Exposures during 1985 showed a significant reduction in group dose from earlier years, but the group dose increased compared to 1984. This resulted both from a change in the type of work being done (SEFOR decladding was completed in 1983; the cells were cleaned in 1985 after completion of the EBR-II decladding) and very effective implementation of the administrative limits for radiation exposure. Increases, compared to 1984, were shown in both the group dose and the average dose, and in the number of personnel exposed over 1 rem.

Internal dosimetry for the estimation of organ doses or dose commitments that have been received from internally deposited radioactive material has not been generally done. It is complicated and time consuming, and the detected amounts of radioactive material have been so small as to not warrant it.

Internal depositions of radioactive material, as monitored by the bioassay program, are shown in the table below.

Year	Number of Tests Performed	Number of Tests with Positive Results	Percent Positive
1985	644	69	10.7
1984	373	48	12.9
1983	527	30	5.7
1982	742	66	8.9
1981	768	66	8.6
1980	864	44	5.1
1979	1099	79	1.2
1978	1022	80	8.7
1977	1272	158	12.4
1976	1481	67	4.5
1975	1483	57	3.8

This table shows, for the past 11 years, all the tests performed and the number of tests that were considered to be "positive." A "positive" result is one that exceeds the minimum detectable activity (MDA) for the particular analysis. During the time covered by this series of reports, the number of bioassays has generally declined as the number of people working with unencapsulated radioactive material has decreased. Tests were increased in 1985 to provide more detailed information for the purpose of future dose evaluations. The number of positive results has stayed roughly constant for the past 5 years, resulting in an increase of the percentage of positive tests. Most of these positive results have been due to work at the RIHL, which has remained relatively steady during these years. Following tables show the distribution for the three major radionuclides tested during this time period: Cs-173 (FP3B) and Sr-90 (FP3A). While the FP3A analysis is not specifically selective for Sr-90, that is the most restrictive radionuclide likely to be present and detected.

Cs-137

Year	Number of FP3B Tests	Number with Positive Results	Fraction of Positive Results with less than 0.01% MPBB	Maximum % MPBB
1985	256	49	0.082	0.03
1984	136	30	0.656	0.72
1983	76	6	0.833	0.02
1982	171	4	0.667	0.03
1981	141	3	0	0.02
1980	116	4	0	0.04
1979	233	27	0	1.2
1978	271	22	Incomplete data	
1977	298	43	Incomplete data	
1976	171	6	0	0.02
1975	190	1	1.0	0.01

The highest results shown for Sr-90, 45%, was essentially gone 40 days later, and may have resulted from an anomaly at the laboratory, or may have represented some other beta-emitting radionuclide, such as Co-60, which has a relatively short biological half-life (9.5 days).

Sr-90

Year	Number of FP3A Tests	Number with Positive Results	Fraction of Positive Results with less than 10% MPBB	Maximum % MPBB
1985	256	19	0.842	14.5
1984	136	15	0.800	45.0
1983	74	0	None	
1982	174	32	0.407	59.8
1981	141	31	0.485	61.9
1980	116	7	0.286	58.8
1979	233	14	Incomplete data	
1978	271	45	Incomplete data	
1977	298	62	Incomplete data	
1976	169	10	0	21.7
1975	194	4	0.333	14.4

B. WORK PLACE RADIATION AND RADIOACTIVITY

The general radiation levels in the work place, as determined by readings from location badges, are summarized in the table below:

	Facility: Average Exposure Rate (mR/h) / Maximum Exposure Rate (mR/h)			
Year	Fuels	RIHL	NMDF	RMDF
1985	-	0.13 / 0.87	0 / 0	2.74 / 29.42
1984	-	0.13 / 1.15	0.03 / 0.66	1.72 / 7.06
1983	0.02 / 0.03	0.47 / 6.42	0.01 / 0.05	0.82 / 4.15
1982		0.10 / 0.21	0.02 / 1.21	4.24 / 42.4

Variations reflect changes in workload, with a significant problem at the RMDF, due to processing of radioactive water and the accumulation of the resultant sludge.

Airborne radioactivity, in terms of the average percentage of the maximum permissible (occupational) concentration (MPC) is shown for monitored areas below:

	Percent of MPC			
Year	Fuels	RIHL	NMDF	RMDF
1985	-	0.5	0.4	4.4
1984	-	0.5	0.5	-
1983	1.1	0.5	0.5	-
1982	2.8	0.06	0.2	-
1981	0.1	0.05	1.8	-
1980	5.0 (lapel)	0.20	-	-

C. ATMOSPHERIC EFFLUENT RELEASES

Atmospheric effluent releases are monitored by use of stack samplers at the major facilities. The results are shown below in terms of the total activity released. In some cases, the releases were at concentrations less than the ambient (natural) airborne radioactivity; in others, much of the activity is natural resulting from the use of unfiltered bypass air in the exhaust system.

A significant change has been made in the manner in which those releases are calculated from the effluent sampling measurements. Prior to 1982, all concentration values less than the minimum detection level (MDL) were set equal to the MDL in calculating the average concentration release. This was done on the basis of DOE requirements. It was recognized that this practice biased the reported results upwards by a considerable amount, and DOE changed its guidance. Now, all measured values, even zeroes and negative ("less than background") values, are used in the calculation.

The major fluctuation observed in the beta activity released from the RIHL is due primarily to changes in the work in the hot cells. The increase in beta activity released from the RIHL this year is mainly due to work being performed on the ventilation exhaust system and an apparently poor quality filter or filter installation. (Filters were subsequently replaced.) With these exceptions, a major fraction of the activity reported as discharged from the RIHL and the NMDF actually came from natural radioactivity in the unfiltered bypass air taken into the exhaust systems near the blowers to prevent excessive suction.

RADIOACTIVITY DISCHARGED TO ATMOSPHERE
(microcuries)

	De Soto		Santa Susana		
	101	104	RIHL	RMDF	NMDF
1985					
Alpha	-	0.15	0.45	0.04	0.05
Beta	-	0.45	9.0	9.0	1.5
1984					
Alpha	-	0.44	0.10	0.074	0.04
Beta	-	0.59	4.5	3.7	0.98
1983					
Alpha	52.0	1.1	0.024	0.047	0.08
Beta	19.0	1.1	1.3	1.1	1.1
1982					
Alpha	1.2	0.24	0.03	0.024	0.023
Beta	0.94	1.1	14.0	0.61	1.0
1981					
Alpha	2.8	0.39	0.069	0.087	0.059
Beta	2.7	4.1	14.0	4.0	2.0
1980					
Alpha	5.3	1.0	0.17	0.061	0.082
Beta	4.3	4.9	17.0	1.7	1.1
1979					
Alpha	2.1	1.1	0.18	0.085	0.053
Beta	5.8	5.7	44.0	2.7	0.21
1978					
Alpha	16.0	0.65	0.13	0.1	0.081
Beta	5.0	4.3	59.0	11.0	-
1977					
Alpha	10.0	0.88	0.1	0.11	0.15
Beta	4.1	7.5	13.0	3.0	-
1976					
Alpha	64.0	8.1	0.15	0.23	0.15
Beta	17.0	8.9	5.8	1.1	-
1975					
Alpha	3.7	5.4	0.15	0.45	0.19
Beta	2.6	12.0	6700.0*	10.0	-

*Released from burned fuel slug.

5046Y/jbv

D. AMBIENT (ENVIRONMENTAL) RADIATION EXPOSURE

Ambient (environmental) radiation exposure rates as measured by CaF_2:Mn TLDs and averaged for all locations are shown below.

	Quarterly Dose (mrem)				Annual Dose (mrem)
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	
1985	21.8	32.2	26.6	29.0	109.6
1984	29.9	30.1	25.6	19.6	105.2
1983	30.1	28.9	30.2	27.4	116.6
1982	29.1	30.8	31.8	31.9	123.8
1981	38.2	33.5	35.2	43.9	150.8
1980	35.0	34.4	37.7	49.1	157.3
1979	32.1	38.1	38.0	39.4	147.8
1978	27.3	35.5	33.4	36.6	133.1
1977	24.2	29.2	32.9	30.9	117.5
1976	21.6	24.8	22.5	25.0	93.9
1975	21.3	24.6	26.2	25.4	97.6

The quarterly doses are plotted as a histogram in Figure 4. This graph, and the tabulated annual doses, show a clear increase from 1976 to 1980, followed by a decrease for 1981, 1982, 1983, and 1984. The data for 1985 suggest a leveling off of this decline. All data prior to 1982 were obtained using an EG&G TL-3 reader. Data for 1982 and later were obtained using a Victoreen Model 2810. This is a new reader, built on the basic design of the TL-3 reader, but with modern electronics and digital adjustments and readout.

The increasing trend (from 1976 to 1980) was also observed in data for the Rocky Flats Plant, the only other DOE facility where the same type dosimeters are used, but not at any other facility. The cause has not been identified, but since the trend exists equally for the De Soto, Santa Susana, and off-site TLDs, at this time it is assumed to be either a true environmental effect, or an artifact of the TLD reading or calibration.

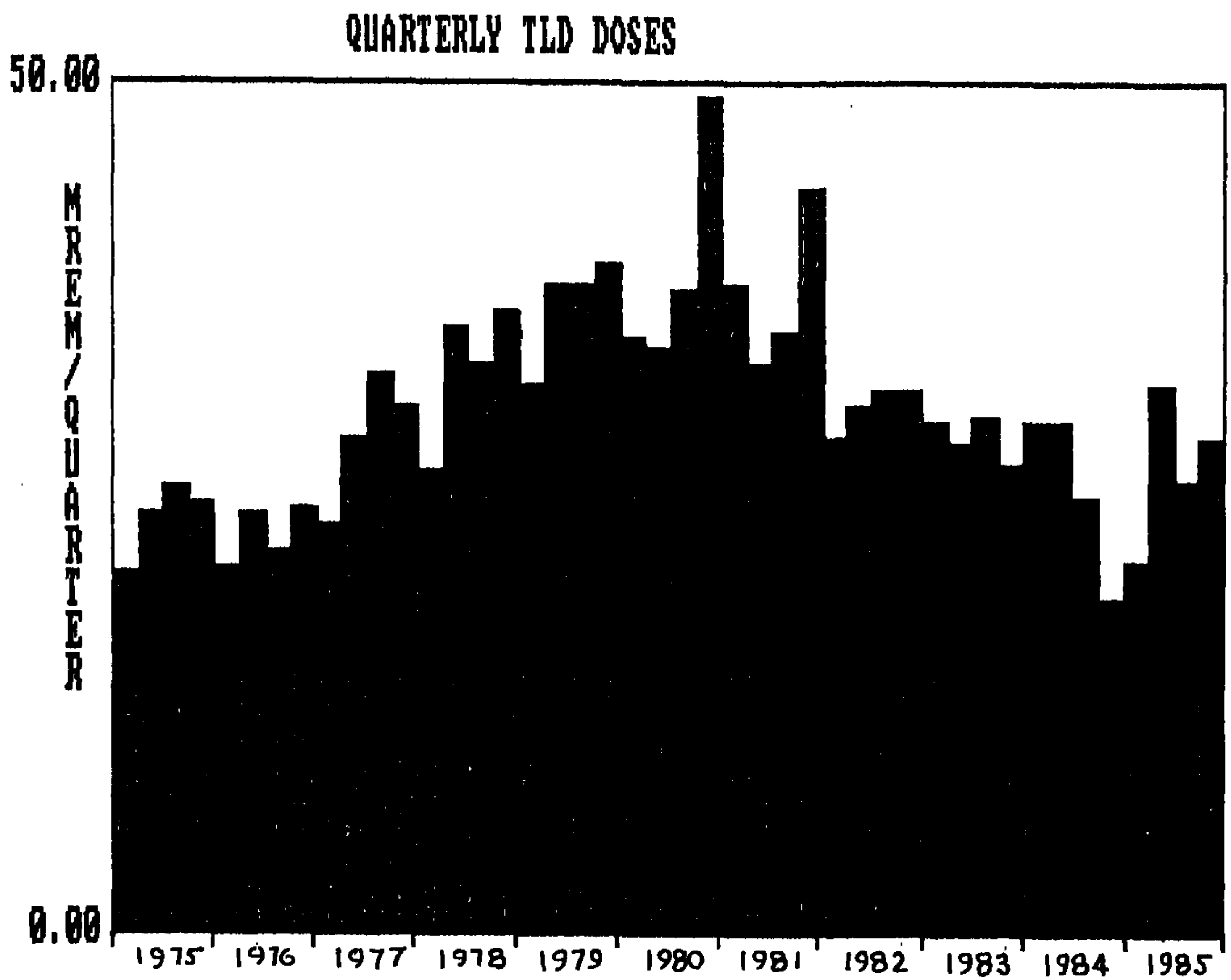

Figure 4. Averaged Quarterly Dose Recorded
by Environmental TLDs

The annual ambient exposure rates (mrem/year) measured at De Soto, SSFL, and the several offsite locations are shown below:

	De Soto		SSFL		Offsite	
Year	Average	Maximum	Average	Maximum	Average	Maximum
1985	100	107	124	152	105	112
1984	98	106	117	126	100	108
1983	110	123	126	136	115	123
1982	118	135	132	144	124	128
1981	144	159	162	188	148	162
1980	164	193	166	184	163	166
1979	138	149	161	193	131	140
1978	128	140	143	149	126	131
1977	116	125	121	138	106	108
1976	89	99	101	124	91	101
1975	96	105	104	123	94	105

Comparison of the average values and the maximum location values for the three types of sites shows the same increase from 1976 to 1980 and then a decrease to 1984. The cause of this behavior is under continuing study with no definite conclusions produced as yet. The values at SSFL are all somewhat greater than De Soto and the offsite locations due to the significantly greater elevation of the SSFL site, and possibly also due to the greater outcropping of uranium-mineral-bearing sandstone. There is no indication of significant exposure resulting from operations with radioactive material.

Average and maximum values for soil readioactivity are shown in Table 13. This table shows the change in reported alpha activity resulting from adoption of a calibration factor for thick soil samples. Prior to 1984, only relative values were reported, which served the function of monitoring for changes quite well but produced values that did not reflect the correlation of alpha and beta activity from naturally present radioactive elements (potassium, 0 alphas, 1 beta per decay; uranium chain, 8 alphas, 6 betas; thorium chain, 6 alphas, 4 betas).

Four high values of soil beta activity have been detected onsite (out of 1440 samples): those are shown as maximum values for the years 1978-1981. The maximum values for 1979 and 1980 were along the southwest side of the RMDF and may have resulted from a cleanup of the so-called "West Bank" near the RMDF just prior to these years. The 1978 and 1981 values were from samples taken near the SS Vault (T064). Follow-up surveys failed to locate additional, significant contamination. (It should be noted that only the 1980 value exceeds the working limit of 100 pCi/g gross detectable beta activity adopted for our decontamination work.)

Results for the semiannual plutonium soil analyses are shown in Tables 14 and 15. The onsite averages are generally higher than offsite but not greatly so. This may represent differences between the set of five onsite locations and the single offsite location. While plutonium is found in low concentrations everywhere as a result of atmospheric nuclear weapons tests at several different locations around the world, the concentration at a given location is affected by meteorological conditions following the test explosion and after deposition. Comparison of the onsite values shows no systematic variation with location relative to the NMDF.

TABLE 13
SOIL RADIOACTIVITY SUMMARY
1975–1985
(pCi/g)

		Onsite				Offsite			
		Alpha		Beta		Alpha		Beta	
	Year	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value
	1985	25.2 ± 7.3	48.4	24.2 ± 1.9	32.7	26.3 ± 7.8	46.0	23.9 ± 3.3	30.2
	1984	25.8 ± 6.0	43.4	24.2 ± 2.0	30.1	26.2 ± 7.2	51.3	23.3 ± 2.9	28.2
a	1983	0.6 ± 0.2	1.1	24.2 ± 2.0	29.7	0.6 ± 0.2	1.1	23.0 ± 2.8	27.8
	1982	0.7 ± 0.2	1.2	24.6 ± 2.3	30.1	0.7 ± 0.2	1.2	23.3 ± 3.7	32.9
	1981	0.7 ± 0.2	1.3	25.4 ± 3.5	38.2	0.6 ± 0.2	1.3	22.8 ± 4.5	33.2
b	1980	0.6 ± 0.2	1.1	24.0 ± 1.0	110.0	0.6 ± 0.2	1.0	23.0 ± 1.0	30.0
	1979	0.6 ± 0.2	1.1	25.0 ± 1.0	97.0	0.5 ± 0.1	0.8	23.0 ± 1.0	29.0
	1978	0.6 ± 0.2	1.0	24.0 ± 0.9	48.0	0.5 ± 0.1	1.0	24.0 ± 0.9	34.0
	1977	0.6 ± 0.2	1.1	24.0 ± 0.9	31.0	0.5 ± 0.2	0.8	23.0 ± 0.8	27.0
	1976	0.6 ± 0.2	0.8	25.0 ± 1.0	32.0	0.6 ± 0.2	1.0	24.0 ± 1.0	30.0
	1975	0.6 ± 0.1	1.0	25.0 ± 1.0	35.0	0.6 ± 0.2	1.0	24.0 ± 1.0	27.0

[a] Values reported for alpha activity in soil before 1984 are relative values only. The 1984 values reflect correction for self absorption of alpha particles by the thick soil samples.
[b] Prior to 1981, data less than the MDL were treated equal to the MDL. For 1981 and later, actual measured values were used.

5046Y/klp

TABLE 14

PLUTONIUM IN SOIL SUMMARY
1978-1985
(Pu-239 + Pu-240, fCi/g)

	Onsite		Offsite
Year	Average ± Dispersion	Maximum Value	Average ± Dispersion
1985	2.6 ± 1.5	5.1	0.4 ± 0.2
1984	3.1 ± 1.3	5.2	0.4 ± 0.2
1983	5.2 ± 4.4	14.4	7.0 ± 0.2
1982	4.0 ± 2.4	7.3	2.7 ± 3.3
1982	4.2 ± 4.5	15.9	1.2 ± 1.0
1980	8.4 ± 8.5	29.5	1.3 ± 0.9
1979	7.0 ± 6.7	18.9	2.6 ± 1.3
1978	4.5 ± 2.9	9.0	4.4 ± 1.6

TABLE 15

SUMMARY OF PLUTONIUM IN SOIL
(Pu-239 + Pu-240, fCi/g)

Location		Average ± Dispersion	Maximum Value	Date
S-56	1100 ft NW NMDF	4.7 ± 4.9	14.4	December 1983
S-57	900 ft SE NMDF	4.1 ± 2.4	9.5	June 1980
S-58	500 ft SE NMDF	5.7 ± 4.9	18.9	December 1979
S-59	900 ft ESE NMDF	5.2 ± 4.4	18.6	December 1979
S-60	2000 ft SE NMDF	6.3 ± 7.7	29.5	December 1980
S-61	2.7 mi. NE NMDF	2.8 ± 2.3	7.1	June 1983

Onsite and offsite vegetation radioactivity measurements are summarized in Table 16. As with the gross alpha determination in soil, a change was made in 1984 to more correctly report the alpha activity naturally present in vegetation. While one value for beta activity in onsite vegetation (1977) is considerably higher than the rest, the average for that year is not noticeably different from the others.

Alpha and beta radioactivity in the supply water at the De Soto and SSFL sites are shown in Table 17. Water for the De Soto site is supplied by the Los Angeles Department of Water and Power from the Metropolitan Water District. Water for the SSFL site is supplied by Ventura County Water District No. 17, with varying amounts of supplemental water (up to 100%) from onsite wells operated by Rocketdyne. The water at De Soto is consistently, but not significantly, more radioactive than that at SSFL.

A change in the method of correcting for alpha attenuation in the mineral deposit from the water samples permits more accurate reporting of the alpha activity since 1983.

Alpha and beta radioactivity in environmental waters is shown in Tables 18A and 18B. The radioactivity concentrations in all three water sources sampled are quite similar. (Pond R-2A receives runoff and effluent from the Santa Susana nuclear facilities, Pond 6 receives runoff and effluent from the other facilities, and Bell Creek appears to be mostly seepage from the Bell Creek community.) The results for the pond water are generally about 45% higher than the supply water. This may result from concentration of the natural radioactivity by evaporation and also from "nonradioactive" discharges such as floor cleaning using soaps containing natural radioactive elements. No radionuclides present at the nuclear facilities have been found.

TABLE 16
VEGETATION RADIOACTIVITY SUMMARY
1975–1985
(pCi/g ash)

	Onsite				Offsite			
	Alpha		Beta		Alpha		Beta	
Year	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value
1985	3.8 ± 4.4	22.0	135 ± 53	269	4.7 ± 6.2	25.3	133 ± 49	242
1984	4.0 ± 3.9	20.4	136 ± 47	254	4.0 ± 4.5	30.8	136 ± 45	278
1983[a]	0.18 ± 0.14	0.91	149 ± 42	241	0.24 ± 0.28	1.5	143 ± 47	227
1982	0.16 ± 0.22	1.25	140 ± 48	260	0.17 ± 0.14	0.6	130 ± 52	258
1981	0.16 ± 0.20	1.23	137 ± 52	257	0.18 ± 0.17	0.52	129 ± 58	221
1980[b]	0.25 ± 0.02	1.30	160 ± 30	271	0.14 ± 0.15	0.52	142 ± 30	221
1979	0.24 ± 0.16	1.40	139 ± 20	248	0.23 ± 0.16	0.86	134 ± 20	230
1978	0.24 ± 0.17	0.96	166 ± 30	319	0.24 ± 0.16	0.66	143 ± 30	241
1977	0.22 ± 0.17	1.10	162 ± 30	587	0.21 ± 0.16	1.00	142 ± 30	257
1976	0.19 ± 0.16	1.20	170 ± 30	299	0.22 ± 0.17	0.84	147 ± 30	274
1975	0.21 ± 0.16	0.84	155 ± 30	261	0.21 ± 0.16	0.89	141 ± 30	240

[a]Values reported for alpha activity in vegetation before 1984 are relative values only. Subsequent values reflect correction for self absorption of alpha particles by the thick ash samples.
[b]Prior to 1981, data less than the MDL were treated equal to the MDL. For 1981 and later, actual measured values were used.

5046Y/klp

TABLE 17
SUPPLY WATER RADIOACTIVITY SUMMARY
1975–1985
(pCi/g)

		De Soto				SSFL			
		Alpha		Beta		Alpha		Beta	
	Year	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value
	1985	2.76 ± 1.82	5.73	3.17 ± 0.78	4.6	2.45 ± 2.61	8.6	2.80 ± 0.52	3.95
	1984	3.82 ± 0.93	5.87	3.40 ± 0.45	4.3	3.53 ± 3.94	13.3	2.93 ± 0.60	4.01
a	1983	0.34 ± 0.23	0.88	3.53 ± 0.97	5.1	0.12 ± 0.13	0.41	3.00 ± 0.60	4.45
	1982	0.36 ± 0.23	0.79	3.97 ± 1.19	6.6	0.14 ± 0.12	0.38	3.01 ± 0.67	4.91
	1981	0.36 ± 0.20	0.77	3.78 ± 0.68	4.7	0.11 ± 0.12	0.44	2.79 ± 0.55	3.65
b	1980	not analyzed				0.22 ± 0.27	0.22	2.4 ± 0.7	3.4
	1979	not analyzed				0.23 ± 0.27	0.23	1.8 ± 0.7	3.9
	1978	not analyzed				0.26 ± 0.28	0.44	3.0 ± 0.8	3.6
	1977	not analyzed				0.25 ± 0.29	0.30	2.5 ± 0.7	3.6
	1976	not analyzed				0.25 ± 0.29	0.42	2.0 ± 0.7	2.5
	1975	not analyzed				0.24 ± 0.27	0.55	2.3 ± 0.7	3.2

[a]Values reported for alpha activity in water before 1984 are relative values only. Subsequent values reflect correction for self absorption of alpha particles by the thick mineral deposit of the counting sample.
[b]Prior to 1981, data less than the MDL were treated equal to the MDL. For 1981 and later, actual measured values were used.

5046Y/klp

TABLE 18A

ENVIRONMENTAL WATER RADIOACTIVITY SUMMARY
1975-1985
(Alpha, pCi/L)

		Pond R-2A		Pond 6		Bell Creek	
	Year	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value
	1985	3.07 ± 1.94	6.61	1.06 ± 4.44	13.6	1.38 ± 7.09	19.7
	1984	0.15 ± 1.70	2.70	4.90 ± 9.11	25.9	4.15 ± 8.30	28.7
a	1983	0.13 ± 0.12	0.35	0.12 ± 0.11	0.27	0.08 ± 0.12	0.39
	1982	0.11 ± 0.13	0.28	0.17 ± 0.08	0.35	0.03 ± 0.06	0.14
	1981	0.07 ± 0.15	0.37	0.05 ± 0.08	0.17	0.05 ± 0.06	0.20
b	1980	0.23 ± 0.27	0.23	0.23 ± 0.27	0.23	0.23 ± 0.27	0.23
	1979	0.23 ± 0.27	0.25	0.25 ± 0.28	0.55	0.23 ± 0.27	0.24
	1978	0.25 ± 0.28	0.27	0.25 ± 0.28	0.35	0.24 ± 0.28	0.24
	1977	0.25 ± 0.29	0.28	0.24 ± 0.29	0.25	0.24 ± 0.29	0.24
	1976	0.28 ± 0.30	0.53	0.24 ± 0.29	0.24	0.25 ± 0.29	0.28
	1975	0.31 ± 0.29	1.2	0.24 ± 0.27	0.55	0.22 ± 0.27	0.28

[a]Values reported for alpha activity in water before 1984 are relative values only. Subsequent values reflect correction for self absorption of alpha activity by the thick mineral deposit of the counting sample.
[b]Prior to 1981, data less than the MDL were treated as equal to the MDL. For 1981 and later, actual measured values are used.

5046Y/klp

TABLE 18B

ENVIRONMENTAL WATER RADIOACTIVITY SUMMARY
1975-1985
(Beta, pCi/L)

	Pond R-2A		Pond 6		Bell Creek	
Year	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value
1985	3.49 ± 0.79	5.56	3.58 ± 0.96	4.92	2.49 ± 0.75	3.79
1984	4.25 ± 0.85	5.87	4.58 ± 0.75	5.66	2.88 ± 0.58	4.60
1983	4.44 ± 1.84	9.15	3.57 ± 0.92	4.80	3.30 ± 0.60	4.20
1982	3.93 ± 0.83	5.81	3.91 ± 1.08	5.34	3.29 ± 0.70	4.40
1981	5.16 ± 1.22	8.30	4.25 ± 0.63	5.26	3.78 ± 0.65	5.00
a 1980	3.9 ± 0.8	5.70	2.9 ± 0.7	4.7	2.9 ± 0.8	5.2
1979	4.5 ± 0.8	10.0	3.1 ± 0.8	4.7	3.2 ± 0.9	8.2
1978	4.6 ± 0.8	6.3	4.3 ± 0.8	7.0	2.5 ± 0.8	3.5
1977	5.2 ± 0.9	13.0	4.3 ± 0.8	6.4	1.8 ± 0.8	2.6
1976	4.4 ± 0.8	7.0	4.3 ± 0.8	5.5	2.2 ± 0.8	2.9
1975	4.5 ± 0.8	5.4	4.2 ± 0.8	5.5	2.4 ± 0.8	3.4

[a]Prior to 1981, data less than the MDL were treated as equal to the MDL. For 1981 and later, actual measured values are used.

5046Y/klp

Tables 19A and 19B show the results of alpha and beta radioactivity measurements on ambient air samples. An apparent extreme decrease in alpha radioactivity after 1981 is due simply to a change in the method of treating the very low-level values. Until the end of 1981, each value that was less than the MDL for a single measurement was set equal to the MDL before inclusion in the average. This artificially elevated the average value. This effect was not nearly so great for the beta activity measurements. The beta values for De Soto, SSFL, and offsite samples are essentially identical. (The "offsite" samples are located at SSFL but at a considerable distance from the nuclear facilities.)

TABLE 19A

AMBIENT AIR RADIOACTIVITY SUMMARY
1975-1985
(Alpha, fCi/m^3)

	De Soto		SSFL		Offsite	
Year	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value
1985	2.7 ± 2.2	38	2.0 ± 1.6	44	2.0 ± 1.9	25
1984	1.9 ± 9.3	32	1.4 ± 3.4	29	1.4 ± 3.0	16
1983	2.4 ± 3.8	60	0.9 ± 5.4	24	1.2 ± 2.9	11
1982	1.7 ± 3.1	39	1.1 ± 2.6	30	1.7 ± 2.9	16
a 1981	6.9 ± 7.7	25	6.8 ± 7.9	35	6.8 ± 7.2	22
1980	6.5 ± 7.7	45	6.4 ± 7.8	25	6.3 ± 7.8	20
1979	6.6 ± 7.8	45	6.5 ± 7.6	40	6.2 ± 7.9	34
1978	8.4 ± 8.1	95	7.2 ± 7.9	21	7.2 ± 7.3	44
1977	6.6 ± 7.7	39	6.6 ± 7.5	35		
1976	6.7 ± 8.4	140	6.5 ± 7.2	53		
1975	6.3 ± 6.8	60	6.0 ± 6.3	88		

[a]Prior to 1982, data less than the MDL were treated as equal to the MDL. For 1982 and later, actual measured values are used.

5046Y/klp

TABLE 19B

AMBIENT AIR RADIOACTIVITY SUMMARY
1975-1985
(Beta, fCi/m^3)

	De Soto		SSFL		Offsite	
Year	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value	Average ± Dispersion	Maximum Value
1985	44 ± 14	180	40 ± 13	170	40 ± 14	240
1984	27 ± 27	250	23 ± 14	200	24 ± 20	200
1983	26 ± 21	130	23 ± 17	180	25 ± 12	280
1982	26 ± 14	260	21 ± 16	180	22 ± 12	88
a 1981	120 ± 20	1100	120 ± 20	1100	120 ± 20	1600
1980	39 ± 14	380	36 ± 14	450	34 ± 15	360
1979	21 ± 13	100	21 ± 13	110	19 ± 15	100
1978	91 ± 17	1400	88 ± 17	1500	86 ± 16	1300
1977	170 ± 20	3000	170 ± 20	2800		
1976	96 ± 18	3700	110 ± 20	3400		
1975	76 ± 16	460	73 ± 15	730		

[a]Prior to 1982, data less than the MDL were treated as equal to the MDL. For 1982 and later, actual measured values are used.

5046Y/klp

VII. ANTICIPATED ACTIVITIES DURING NEXT REPORTING PERIOD (1986)

Building 004

Continuation of low-level research with activated materials and operation of the Gamma Irradiation Facility.

Building 020

Complete preparation for Fermi fuel decladding, and begin disassembly and decladding operations.

Buildings 021/022

Shipment of declad EBR-II fuel and scrap. Receive, store, and transfer Fermi fuel for decladding. Storage and transfer of declad Fermi fuel and scrap.

Building 055

Clean NaK bubblers. Complete the decontamination of ventilation and liquid waste systems and ship for disposal.

Start final acceptance survey.

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