

EIGHTH ANNUAL OCCUPATIONAL RADIATION EXPOSURE REPORT 1975

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SUMMARY

This is a report by the U. S. Nuclear Regulatory Commission on the operation of the Commission's centralized repository of personnel occupational radiation exposure information. The bulk of the information was obtained from annual and termination reports submitted by certain types of NRC licensees (i.e., operating nuclear power reactors; industrial radiographers; fuel processors, fabricators, and reprocessors; commercial processors and distributors of specified quantities of byproduct materials) pursuant to Part 20.407 and Part 20.408 of Title 10, Chapter 1, Code of Federal Regulations, respectively. Annual reports were received from 387 covered licensees indicating that some 78,713 individuals, having an average exposure of 0.36 rems, were monitored for exposure to radiation during 1975 and that 21,601 individuals terminated their employment or work assignment with covered licensees in 1975.

Information on incidents involving personnel overexposures to radiation or radioactive materials is obtained from reports submitted by all NRC licensees pursuant to Parts 20.403 and 20.405 of Title 10, Chapter 1, Code of Federal Regulations. The number of personnel overexposures reported in 1975 decreased from previous years. The most significant overexposures which occurred in 1975 are summarized.

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EIGHTH ANNUAL
OCCUPATIONAL RADIATION EXPOSURE REPORT
1975

INTRODUCTION

On November 4, 1968, the U. S. Atomic Energy Commission (AEC) approved a program for the reporting of certain occupational radiation exposure information to a central repository. This information was to be required of four categories¹ of AEC licensees, as defined in 10 CFR 20.407, and of AEC contractors exempt from licensing. The reporting requirements were implemented by the promulgation of 10 CFR 20.407, 10 CFR 20.408 and the Immediate Action Directive 0525-19. It was also decided that certain information contained in personnel overexposure reports submitted by all types of Commission licensees and contractors pursuant to 10 CFR 20.403, 10 CFR 20.405 and AEC Manual Chapter 0502 should be maintained in the repository. As of December 31, 1973, these six types of reports had provided information on a total of approximately 150,000 occupationally exposed persons. This information for the period of 1969 through 1973 has been summarized and published in the six documents designated as WASH-1350-R1 through WASH-1350-R6.

¹Operating nuclear power reactors; industrial radiographers, fuel processors, fabricators and reprocessors; commercial processors and distributors of specified quantities of byproduct material.

With the division of the AEC into the two agencies, the Energy Research and Development Administration (ERDA) and the U.S. Nuclear Regulatory Commission (NRC), in January 1975, each agency assumed responsibility for collecting and maintaining occupational exposure information relating to its own activities. Both agencies have continued to retain similar data and computer systems at the Union Carbide Computing Technology Center, Oak Ridge, Tennessee. Comparable information for ERDA facilities and contractors may be obtained from ERDA's Division of Safety, Standards and Compliance at Germantown, Maryland.

I. ANNUAL REPORTS - 10 CFR 20.407

Exposure Distributions

On February 4, 1974, 10 CFR 20.407 was amended to require the four categories of covered licensees to submit an annual statistical report which indicates the distribution of the whole body exposures incurred by their employees. It should be borne in mind that all of the figures compiled in this report are based on radiation exposures as determined by various types of personnel monitoring devices, all of which have their own inherent uncertainties. Figure 1 is a compilation of the reports submitted for calendar year 1975. As can be seen from this figure, nearly 50% of the 78,713 individuals monitored during 1975 received exposures that were too small to be detected by personnel radiation monitoring devices and more than 99% of the exposures were less than 5 rems.

It should be pointed out that very few of the annual exposures that exceed 5 rems are personnel overexposures. Although 5 rems is the annual limit set forth in Paragraph (a) of 10 CFR 20.101, Paragraph (b) permits a licensee, under certain conditions, to allow a worker to receive a whole body dose of 3 rems per calendar quarter (or 12 rems annually). The conditions are that (1) the licensee must have determined and recorded the worker's accumulated occupational dose to the whole body and that (2) the worker's whole body dose does not exceed $5(N-18)$ rems where "N" equals the individual's age in years.

Figure 1

DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
REPORTED BY COVERED LICENSEES-1975

Covered Categories of NRC Licensees	Total No. Monitored	Exposure Ranges (Rems)																	
		Less than Measurable	Meas'ble ≤ 0.10	0.10 0.25	0.25 0.50	0.50 0.75	0.75 1.00	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	≥ 12
Power Reactors	54763	26729	10606	4081	2948	1772	1384	3932	1873	692	424	169	60	24	12	0	1	0	0
Industrial Radiography	9178	4405	1811	813	614	346	263	538	171	64	35	21	8	1	3	1	2	1	1
* Fuel Processing & Fabrication	11405	5910	1968	1102	1021	433	241	381	153	77	40	30	11	9	14	15	0	0	0
Manufacturing & Distribution	3367	1508	644	532	214	88	67	140	65	43	39	11	12	3	0	1	0	0	0
Totals	78713	30632	15029	6528	4747	2645	1955	5041	2262	876	538	231	91	37	29	17	3	1	1

A summary of the annual whole body exposures reported to the repository during the past eight years is presented in Figure 2. One can see that more than 95% of the exposures have consistently remained less than 2 rems and that few exposures have exceeded 12 rems. Annual exposures that exceed 12 rems indicate that an overexposure has occurred; however, not all overexposures must exceed 12 rems in order for them to be reported. A discussion of various types of overexposures that have occurred is given in Section III.

FIGURE 2
SUMMARY OF ANNUAL WHOLE BODY EXPOSURES
FOR COVERED LICENSEES
1968 - 1975

<u>Year</u>	<u>Total Number Monitored</u>	<u>Percent of Exposures < 2 Rems</u>	<u>Number of Annual Exposures > 12 Rems</u>
1968	36,836	97.2%	3
1969	31,176	96.5%	7
1970	36,164	96.1%	0
1971	36,311	95.3%	1
1972	44,690	95.7%	8
1973	67,852	95.0%	1
1974	95,097	96.4%	1
1975	78,713	94.8%	1

Man-rems per Category

The statistical data contained in the annual reports required by 10 CFR 20.407 permit an estimate of the number of man-rems accumu-

lated by the four covered categories to be made. This was done by taking each licensee's annual report and summing the products obtained by multiplying the numbers of individuals in each of the exposure ranges (shown in Figure 1) by the midpoint exposure of each range. These numbers developed for each licensee in the four categories were then totaled to yield the information shown in Figure 3. Also shown are two values indicating the average annual exposure per individual. The lower values were obtained by dividing the total number of man-rem's by the total number of individuals monitored and the higher values were obtained by dividing the same total number of man-rem's by the number of those individuals reported as having received a measurable exposure. In most cases it is thought that this latter average is the better value to be used for radiation workers because the minimal exposures of many individuals who are monitored for convenience or identification are deleted. In 1975 the average exposure for workers employed by licensees in three of the four categories increased slightly from last year's values as did the overall average. However, the averages consistently remain less than one rem.

Licensed Power Reactor Facilities

Fifty percent or more of the individuals annually reported as being monitored during the last four years have been employed at nuclear power facilities. There is now a separate publication, "Occupational Radiation Exposures at Light Water Cooled Power Reactors, 1969-1975",

Figure 3

MAN-REMS ACCUMULATED BY CATEGORIES OF COVERED LICENSEES

Covered Categories of NPC Licensees	Calendar Year	Number of Licensees Per Category	Total No. Individuals Monitored	No. individuals With Measurable Exposure	Total No. Man-rems	Average Exposure (Rems) Per Individual (Based on All Exposures)	Average Exposure (Rems) Per Individual (Based on Measurable Exposures)
Commercial Power Reactors	1975	54	54,763	28,034	21,270	0.39	0.76
	1974	53	62,044	21,904	14,093	0.23	0.64
	1973	41	44,795	16,558	14,337	0.32	0.87
Industrial Radiography	1975	291	9,178	4,693	2,796	0.30	0.60
	1974	319	8,792	4,943	2,938	0.33	0.59
	1973	341	8,206	5,328	3,354	0.41	0.63
Fuel Processing and Fabrication	1975	23	11,405	5,495	3,125	0.27	0.56
	1974	25	10,921	4,617	2,739	0.25	0.59
	1973	27	10,610	5,056	2,400	0.23	0.47
Processing and Distribution of Byproduct Material	1975	19	3,362	1,859	1,188	0.35	0.63
	1974	24	3,340	1,877	1,050	0.31	0.57
	1973	34	4,251	1,925	1,177	0.28	0.61
Totals and Overall Averages	1975	387	78,713	40,091	28,379	0.36	0.71
	1974	421	85,097	33,291	20,810	0.24	0.63
	1973	443	67,862	28,867	21,268	0.31	0.74

NUREG-0109, that contains a more detailed analysis of the annual personnel exposures submitted by power reactors pursuant to 10 CFR 20.407 and Regulatory Guide 1.16. A brief summary of the annual data submitted during the last seven years and of a portion of the information found in NUREG-0109 is presented in Figure 4 and Figure 5.

FIGURE 4
SUMMARY OF ANNUAL EXPOSURES
REPORTED BY NUCLEAR POWER FACILITIES
1969 - 1975

<u>Year</u>	<u>Number of Operating Facilities</u>	<u>Total Number Monitored</u>	<u>Percent of Exposures < 2 Rems</u>
1969	14	6,332	66.2%
1970	20	12,042	83.6%
1971	23	14,516	90.1%
1972	30	21,288	94.3%
1973	41	44,735	94.0%
1974	53	62,044	96.5%
1975	54	54,763	94.1%

Figure 4 illustrates the growth in the number of operating power reactors and the corresponding increase in the number of individuals monitored by these facilities during the last seven years. The decrease in the number of individuals monitored in 1975 from the number monitored in 1974 was primarily due to a significant drop in the number of individuals who were reported as having less than measurable exposure. These are usually individuals who are monitored while touring or visiting nuclear power facilities for short periods

of time. As can be seen from Figure 3, this is further evidenced by an increase in the reported number of individuals who were monitored and found to have measurable exposures and by the corresponding increase in the number of man-rem.

Figure 5 provides an indication of the distribution of the cumulative doses (man-rem) among the major work functions of the workers at power reactor facilities during the last two years. Routine maintenance continues to be the major contributor.

FIGURE 5
MAN-REMS PER WORK FUNCTION

Work Function	Percent of Cumulative Dose	
	1974	1975
Reactor Operations and Surveillance	14.0%	10.8%
Routine Maintenance	45.4%	52.6%
Inservice Inspection	2.7%	3.0%
Special Maintenance	20.4%	19.0%
Waste Processing	3.5%	6.9%
Refueling	14.0%	7.7%

II. TERMINATIONS - 10 CFR 20.408

Terminations - 1975

During 1975 some 30,133 reports of termination of employment or work assignment at covered licensed facilities were received which provided personal identification, employment and exposure information on a total of 21,601 individuals. Both figures reflect an increase of about 20% over those reported in 1974. The difference in the figures given for the number of reports and for the number of individuals indicates that about 4,000 reports were received for individuals who terminated employment more than once during the year.

Terminations - 1969-1975

During the years that the repository has been in operation, some 110,000 reports of terminations have been received from covered licensees. These reports provided information for approximately 74,000 individuals. Again the difference in the two figures indicates that several thousand individuals have terminated more than once over the years. More than 50% of the termination reports continue to be for individuals working at nuclear power facilities.

Transient Workers

Since more than 30% of the termination reports are for individuals whose period of employment was less than 90 days, it would be possible for several thousand individuals to be employed by two or

more licensees during one quarter. The exposures of these "transient workers" (i.e., individuals who began and terminated two or more employments with different employers within the same calendar quarter) are periodically examined to determine whether or not they are excessive. Figure 6 demonstrates that although the number of these workers increases every year, the average individual quarterly exposure continues to be less than 20% of the quarterly limit of three rems.

FIGURE 6
TRANSIENT WORKERS
1969-1975

	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>Totals</u>
Number of Workers Terminating employment with Two or More Employers in One Quarter	8	28	14	66	154	313	530	1113
Total Number of Man-rems	5.4	12.6	2.9	58.2	127.4	160.7	330.8	698.0
Average Individual Quarterly Exposure	0.67	0.45	0.20	0.88	0.83	0.51	0.62	0.63

Career Doses

Another possible use of the termination data is to determine the total whole body dose that a worker might expect to receive during his period of employment in the nuclear industry. This might be done by summing each individual's periods of employment and each of his corresponding whole body doses to give the cumulative dose that

the individual has received during his career. However, it should be pointed out that the data are limited in several ways:

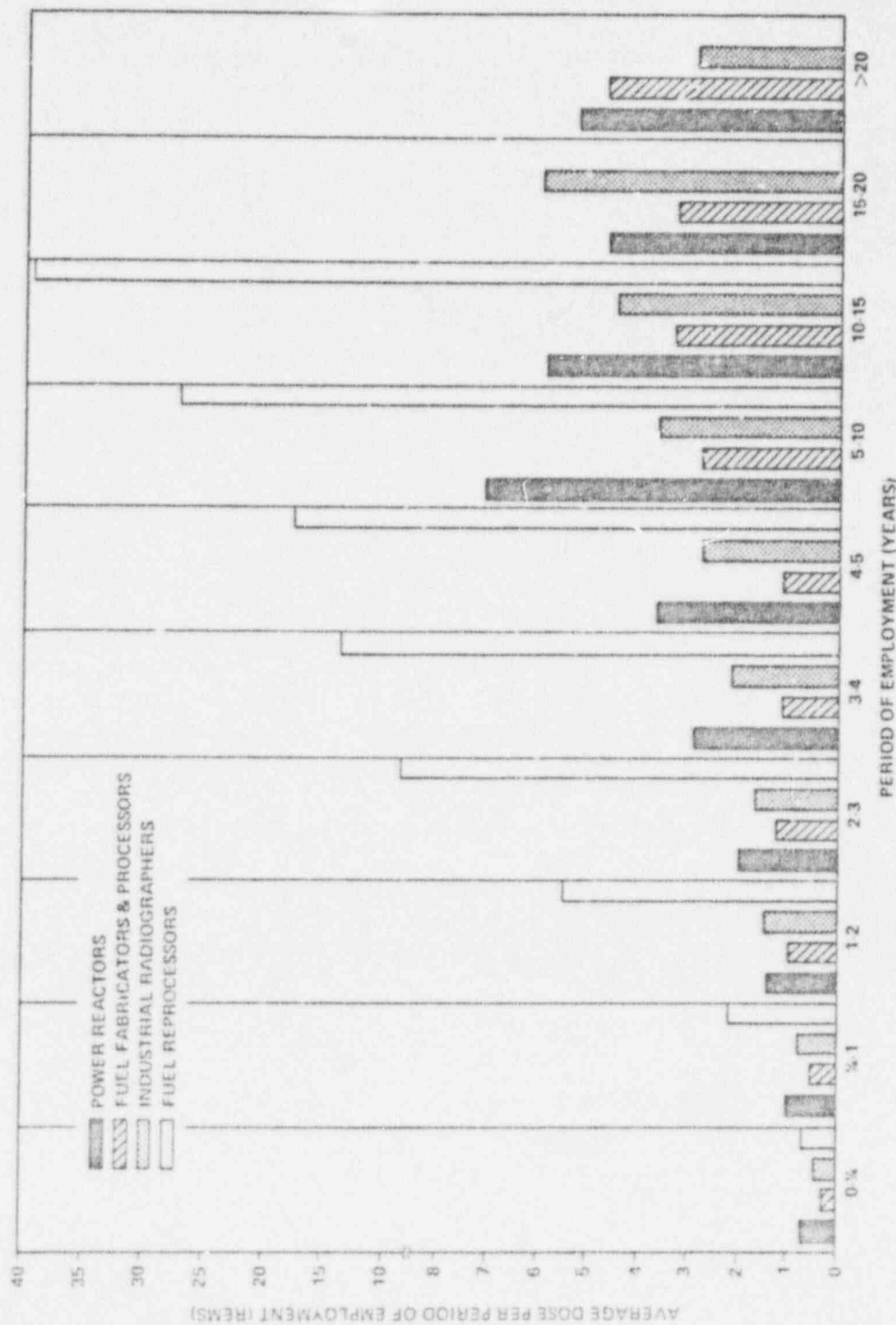
(1) Termination information is submitted to the repository only for those individuals that are employed by the types of NRC licensees previously described on page 1. (2) It is not always known whether the dates given in the termination reports indicate the individual's complete period of employment or just the period that the worker was monitored while he was assigned to work in radiation areas. However, for the majority of the individuals, the two periods are identical.

The termination information submitted by four types of covered licensees (power reactors, fuel fabricators and processors, industrial radiographers and fuel reprocessors) for 51,285 individuals were examined. The individuals' periods of employment and whole body doses were summed as described above and were broken down into ten ranges of employment periods: 0 - 90 days; 90 days - 1 year; 1 - 2 years; 3 - 4 years; 4 - 5 years; 5 - 10 years; 10 - 15 years; 15 - 20 years; greater than 20 years. As can be seen in Appendix A, the whole body doses received by the number of individuals whose total period of employment fell within these ranges were summed and indicated as total number of man-rems. The division of the number of man-rems by the total number of individuals employed for that period yielded the average dose received by each individual during that period. However, as mentioned previously, some of the individuals included in this total figure were monitored for the sake of

convenience. Most of these individuals would have a cumulative dose so small that it would be reported as minimal or zero. If one subtracts the number of these individuals from the total number of individuals monitored, the number of workers having measurable doses remains. Since these workers are more likely to be routinely employed in radiation areas, the average doses shown in Appendix A were calculated by dividing the total number of man-rem by the number of individuals with measurable doses.

Figure 7 graphically displays the average career doses for workers employed by NRC licensed power reactors, fuel fabricators and processors, industrial radiographers and fuel reprocessors. One can see that in every instance, the average dose is less than the 5 rem annual average dose limit specified for radiation workers.

FIGURE 7
AVERAGE CAREER DOSES



III. PERSONNEL OVEREXPOSURES - 10 CFR 20.403 and 10 CFR 20.405

One of the requirements of the above-referenced sections of Part 20, Title 10, Chapter 1, Code of Federal Regulations, is that all facilities or individuals having radioactive material licensed by the NRC must submit reports of all incidents involving personnel exposures to radiation that exceed certain levels. Based on the magnitude of the exposure, the reports may be placed into one of three categories:

- A. 10 CFR 20.403(a) - Exposure of the whole body of any individual to 25 rems or more; exposure of the skin of the whole body of any individual to 150 rems or more; or exposure of the extremities (feet, ankles, hands or forearms) of any individual to 375 rems or more. The Commission must be notified immediately of these events.
- B. 10 CFR 20.403(b) - Exposure of the whole body of any individual to 5 rems or more; exposure of the skin of the whole body of any individual to 30 rems or more; or exposure of the extremities to 75 rems or more. The Commission must be notified within 24 hours of these events.
- C. 10 CFR 20.405 - Exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit in Part 20 or in the licensee's license. This includes reports of exposures of the whole body that exceed 1.25 rems, or that exceed 3 rems, as previously discussed on page 3. It also includes exposures of the skin of the whole body that exceed 7.5

rem and exposures of the extremities that exceed 18.75 rem. Reports of exposures of individuals to concentrations in excess of the levels given in 10 CFR 20, Appendix B, usually fall into this category. These reports must be submitted to the Commission within 30 days of the occurrence.

Figure 8 summarizes the personnel overexposures to external sources of radiation reported by Commission licensees pursuant to 10 CFR 20.403 and 20.405 for the years 1971 through 1975. Column 2 of this figure indicates the part of body overexposed; Column 3 indicates the total number of overexposures reported for each part of body; Column 4 indicates a total of all the doses, in rem, reported for each part of the body (the total of the doses to the whole body could be called man-rem); Column 5 breaks down the total number of overexposures and the total of the doses, as shown in the two previous columns, into the number of overexposures and the sum of these doses, shown in parentheses, reported by various types of licensees. Those types of licensees included in the column "Other" consist primarily of test reactors and research and educational facilities.

Personnel exposures to excessive concentrations (usually airborne) of radioactive materials are summarized in Figure 9. Although there are more reports of exposures to excessive concentrations than there are reports of overexposures to external sources, the magnitude of the majority of them is quite small. Less than 5% of these reports

FIGURE B
SUMMARY OF OVEREXPOSURES TO EXTERNAL SOURCES OF RADIATION

1 Calendar Year	2 Part of Body	3 Total No. of Overexposures	4 Total of Doses in Rems	5 No. of Overexposures and (Sum of the Doses in Rems) Per Licensed Activity				
				Industrial Radiography	Power Reactors	Manufacturing & Distribution	Medical	Other
1971	Whole Body	43	189.7	20 (99.2 rems)	2 (4.5 rems)	5 (21.4 rems)	13 (58.4 rems)	3 (5.2 rems)
	Skin	2	22.1	--	--	--	--	2 (22.1 rems)
	Extremity	13	4,681	5 (4,444 rems)	--	5 (135 rems)	--	3 (102 rems)
1972	Whole Body	47	466.8	18 (372.3 rems)	16 (49.7 rems)	3 (6.3 rems)	--	10 (38.5 rems)
	Skin	1	40.1	--	--	--	--	1 (40.1 rems)
	Extremity	12	10,760	4 (10,516 rems)	--	6 (134 rems)	--	2 (110 rems)
1973	Whole Body	58	210.3	23 (101.8 rems)	19 (61.2 rems)	2 (4.9 rems)	9 (28.1 rems)	14 (14.3 rems)
	Skin	2	23.5	--	--	--	--	2 (23.5 rems)
	Extremity	5	172	1 (86 rems)	--	2 (44 rems)	--	2 (42 rems)
1974	Whole Body	95*	1,000.3	29 (367.2 rems)	43 (155.5 rems)	6 (25.9 rems)	8 (34.2 rems)	7 (417.1 rems)
	Skin	1	8.9	--	--	--	--	1 (8.9 rems)
	Extremity	7	208	--	--	6 (196 rems)	1 (22 rems)	--
1975	Whole Body	31	121.2	11 (59.8 rems)	14 (44.2 rems)	3 (8.5 rems)	2 (1.3 rems)	1 (5.4 rems)
	Skin	1	8.1	--	--	--	--	1 (8.1 rems)
	Extremity	7	198	2 (74 rems)	3 (83 rems)	2 (41 rems)	--	--

*40 Overexposures were reported by one power reactor when there were unanticipated discrepancies between the self-reading and film dosimeters.

FIGURE 9

SUMMARY OF EXPOSURES TO EXCESSIVE CONCENTRATIONS

Reported by NRC licensees pursuant to 10 CFR20.403 and 20.405

Calendar Year	Nuclides Involved	Number of Individuals	Number of Exposures per Licensed Activity					
			Power Reactors	Fuel Fab. & Processing	Fuel Reprocess.	Manuf. & Distrib.	Medical	Other
1971	I-125, -131, -133	27	17	--	--	9	--	1
	Uranium	35	--	26	6	--	--	3
	Pu-239	62	--	47	15	--	--	--
	H-3, C-14	6	--	--	--	3	--	3
	Mixture (Am, Sr, Pb, Ra, Cs, Co)	24	4	13	7	--	--	--
1972	I-125, -131	13	--	--	--	13	--	--
	Uranium	110	--	99	9	--	--	2
	Pu-239	34	--	25	--	--	--	9
	H-3	6	--	--	--	6	--	--
	Mixture (Am, Sr, Nb, Zr, Co, Pu)	4	1	1	1	1	--	--
1973	I-125, -131	7	--	--	--	4	--	3
	Uranium	45	--	26	19	--	--	--
	Pu-239	17	--	15	--	--	--	2
	H-3	4	--	--	--	4	--	--
	Mixture (Am, Sr, Co, Pu)	3	--	--	1	--	--	2
1974	I-125, -131	5	--	--	--	2	1	2
	Uranium	48	--	30	7	--	--	11
	Pu-239	10	--	10	--	--	--	--
	H-3	1	--	--	--	--	--	1
	Mixture (HFP, Am, Pu)	20	12	--	--	4	--	4
1975	I-125, -131	9	2	--	--	3	2	2
	Uranium	24	--	24	--	--	--	--
	Pu-239	23	--	21	--	--	--	2
	H-3	1	--	--	--	--	--	1
	Co-60	4	4	--	--	--	--	--
	Mixture (HFP)	1	1	--	--	--	--	--

indicate that radiation workers were in an atmosphere containing concentrations of radioactive materials for the equivalent of a period of time that exceeded the 2000 hours per year that a worker could be permitted to spend in such an atmosphere.

During calendar year 1975, there were six overexposures reported to the Commission that could be placed in Category A or B or that could have resulted from the worker being present in an atmosphere containing the maximum permissible concentrations of radioactive materials for a time greater than 2000 hours. A paragraph summarizing the circumstances and the results of the Staff's investigations of each of these six incidents is contained in Appendix B.

APPENDIX A
CAREER DOSES FOR RADIATION WORKERS TERMINATING DURING
THE YEARS 1969-1975

NUCLEAR POWER REACTORS

<u>Total Length of Employment</u>	<u>Number of Monitored Individuals</u>	<u>Number of Individuals with Measurable Doses</u>	<u>Total Number of Man-rems</u>	<u>Average Dose (rems) for the Period of Employment</u>
0-90 Days	10,066	10,939	7,219.3	0.67
90 Days - 1 yr.	7,530	5,286	5,282.5	0.99
1-2 yrs.	1,276	1,022	1,552.4	1.52
2-3 yrs.	325	277	540.3	1.95
3-4 yrs.	161	137	392.2	2.86
4-5 yrs.	79	65	235.5	3.62
5-10 yrs.	155	137	874.4	6.38
10-15 yrs.	62	52	301.8	5.80
15-20 yrs.	10	10	46.9	4.69
> 20 yrs.	20	16	84.0	5.25
Totals	27,684	17,991	16,529.3	

NRC LICENSED INDUSTRIAL RADIOGRAPHERS

0-90 Days	1,919	1,323	479.2	0.35
90 Days - 1 yr.	2,764	2,143	1,697.7	0.79
1-2 yrs.	1,962	1,501	2,157.6	1.44
2-3 yrs.	1,279	1,024	1,734.9	1.69
3-4 yrs.	938	753	1,640.6	2.18
4-5 yrs.	740	627	1,698.5	2.71
5-10 yrs.	2,088	1,975	7,169.8	3.63
10-15 yrs.	1,622	1,469	6,646.6	4.52
15-20 yrs.	429	389	2,337.7	6.01
> 20 yrs.	2,300	1,839	5,296.3	2.88
Totals	16,061	13,103	30,852.9	

APPENDIX A (CONT.)

FUEL FABRICATORS AND PROCESSORS

<u>Total Length of Employment</u>	<u>Number of Monitored Individuals</u>	<u>Number of Individuals with Measurable Doses</u>	<u>Total Number of Man-rem</u>	<u>Average Dose (rem) for the Period of Employment</u>
0-90 Days	1,259	538	120.5	0.22
90 Days - 1 yr.	1,257	1,009	507.7	0.50
1-2 yrs.	735	677	609.0	0.90
2-3 yrs.	431	409	510.2	1.25
3-4 yrs.	342	332	372.2	1.12
4-5 yrs.	180	174	200.2	1.15
5-10 yrs.	468	438	1,214.7	2.77
10-15 yrs.	262	246	806.5	3.28
15-20 yrs.	114	93	319.9	3.26
> 20 yrs.	63	54	257.2	4.76
Totals	5,111	3,975	4,918.1	

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FUEL REPROCESSORS

0-90 Days	1,346	1,315	844.1	0.65
90 Days - 1 yr.	725	724	1,586.6	2.19
1-2 yrs.	134	133	737.2	5.54
2-3 yrs.	71	71	634.6	8.93
3-4 yrs.	34	34	469.9	13.82
4-5 yrs.	29	29	500.2	17.25
5-10 yrs.	83	83	2,254.2	27.16
10-15 yrs.	7	7	275.5	39.36
15-20 yrs.	----	----	-----	-----
> 20 yrs.	----	----	-----	-----
Totals	2,429	2,396	7,302.3	

APPENDIX B

OVEREXPOSURE SUMMARIES

1975

Radiotherapy Activities - License Number 21-00215-04

While working in the radiotherapy department, an intern at a hospital received a whole body dose of 5.40 rems during the month of May. The bulk of the intern's duties involved routine radium implants that would not have contributed more than a few hundred millirems to this dose. The only unusual incident that occurred during this time was one in which the intern thought that a radium tube was lost and she searched the entire inventory of radium tubes without following proper procedures. Corrective actions included a review of the procedures and handling techniques to be used if a radioactive source is thought to be lost.

Industrial Radiography - License Number 45-10927-02

On November 11, after completing radiography operations at a field site, a radiographer discovered that his self-reading pocket dosimeter was offscale. His other required dosimeter, a film badge, was immediately sent to be processed. The film badge indicated that the radiographer may have received a whole body dose of 28 rems.

Investigations revealed that it would have been possible for the radiographer to have received such a dose if the radioactive source had been in certain unshielded positions while he was handling the

APPENDIX B (CONT.)

equipment. Evidently the proper methods were not used in performing required surveys. The radiographer was removed from duties in radiation areas for the remainder of the quarter. Extensive medical studies could not detect any abnormalities and could not confirm or deny that a whole body dose of this magnitude had been incurred. Corrective actions included improvement of the licensee's training and management programs and the licensee's requiring that their radiographers wear audible radiation detection devices.

Industrial Radiography - License Number 52-13632-01

While conducting radiography operations at a field site a radiographer's film dosimeter indicated that he had received a whole body dose of 5.76 rems during the period of February 15 to April 14. Investigations failed to reveal the exact cause of the overexposure. The exposure devices were found to be in proper working order and the logs of the daily readings of personnel pocket dosimeters did not support a cumulative exposure of this magnitude. However it was assumed that the exposure was the result of infractions to the operating safety standards and the following corrective measures were implemented. The frequency of processing the film dosimeters was increased from monthly to biweekly and the personnel were required to review the radiation safety procedures.

APPENDIX B (CONT.)

Medical Facility - License Number 37-00697-31

On December 5 the routine monitoring of nuclear medicine personnel at a hospital revealed that one employee had an elevated thyroid burden of iodine 131. Since none of the other employees were found to have iodine burdens and the work area was found to be free of contamination, the iodine must have been ingested by the individual. It is possible that a diagnostic dose of 100 microcuries of liquid iodine 131 that had been prepared for a patient who failed to arrive was poured into the individual's coffee. The resulting thyroid dose was estimated to be 40 rems. A thyroid dose of this magnitude is routinely incurred by individuals undergoing diagnostic procedures and would not be expected to produce any observable radiation injury. The licensee strengthened the internal accounting system for unused patient doses.

Nuclear Power Facility - License Number DPR-18

On April 18, while plugging tubes in a steam generator, an individual was exposed to excessive concentrations of airborne radioactive materials. Although the individual was wearing a supplied air mask and had signed a special work permit indicating he understood the requirements for the job, he became contaminated with radioactive material. His contamination was detected when he attempted to exit from the controlled area. He was immediately decontaminated and scheduled for a whole body count to determine if any of the radio-

APPENDIX B (CONT.)

active material had become internally deposited. The body count indicated that his exposure would result in a maximum annual dose to the lungs of 13.5 rems, where the nuclides of cobalt 58, cobalt 60 and zirconium 95 were the major contributors to the dose. A lung dose of this magnitude is less than the annual limit promulgated by radiological protection societies and would not be expected to produce any observable injuries. Corrective actions included the implementation of a training program for the use of masks at the plant for contractor employees and the increased supervision of contract personnel when they are working in areas of high airborne activity.

Fuel Processing Operations - License Number SNM-414

While preparing low-level contaminated waste for shipment to a burial site, three workers became contaminated with plutonium when they handled an improperly packaged piece of contaminated equipment. The workers' external contamination was removed and they were placed on a bioassay program to better evaluate their exposures. The results indicated that the workers had been in an environment containing the maximum permissible concentrations of plutonium for the equivalent of 2360 hours or less. This slightly exceeds the 2000 hours that a worker may be allowed to work in such a concentration per year. Conservative dose calculations indicated that the maximum annual dose to the workers' bones and lungs would be about 1 rem and

APPENDIX B (CONT.)

that the total dose that would be incurred by these organs during the next fifty years would be about 29 rems. Such a dose is not expected to produce observable signs of radiation injury. Corrective actions included the modification of the inspection and monitoring procedures for the shipping of contaminated equipment; the establishment of improved controls for the areas where contaminated equipment is stored; and initiation of training programs to certify personnel in proper bagging procedures.

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