DOE/EP-0040/2
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DOE/EP--0040/2

DE84 007946

Fifteenth Annual Report

Radiation Exposures For DOE and DOE Contractor Employees - 1982

February 1984

Prepared for:

U.S. Department of Energy

Assistant Secretary for Policy, Safety, and Environment
Office of Nuclear Safety
Washington, D.C. 20545

FIFTEENTH ANNUAL REPORT
RADIATION EXPOSURES FOR DOE AND DOE CONTRACTOR EMPLOYEES
1982

PREFACE

This report is one of a series of annual reports provided by the U.S. Department of Energy (DOE) summarizing occupational radiation exposures received by DOE and DOE contractor employees. These reports provide an overview of radiation exposures received each year as well as identification of trends in exposures being experienced over the years.

In 1968, the U.S. Atomic Energy Commission (AEC) established a program for reporting certain occupational radiation exposure information to a central radiation records repository. At the same time, a contract was made with Union Carbide Corporation at Oak Ridge, Tennessee, to computerize the processing of the radiation exposure reporting system. Annual summary reports were published from 1969 through 1973 (WASH-1350-R1 through WASH-1350-R6), and included information on AEC contractor employees and visitors, as well as employees and visitors of companies in the private sector licensed by the AEC.

In January 1975, with the separation of the AEC into the Energy Research and Development Agency (ERDA) and the U.S. Nuclear Regulatory Commission (NRC), each agency assumed responsibility for collecting and maintaining occupational exposure information reported by the facilities under its jurisdiction. Former AEC licensees reported to the NRC while contractors reported to ERDA. At the same time, a contract was made with Union Carbide Corporation at Oak Ridge, Tennessee, to computerize the reporting and processing of both the ERDA and NRC radiation exposure reporting systems. On October 1, 1977, DOE was formed and assumed the responsibilities of ERDA. Processing and programming of exposure information continued at Oak Ridge until October 1978, when the management and further development of the DOE radiation exposure reporting system was assigned to the System Safety Development Center, EG&G Idaho, Inc.; the NRC system remained at Oak Ridge.

Radiation exposure data for ERDA and ERDA contractor employees and visitors for 1974 through 1976 were reported in ERDA 76/119, ERDA 77-29, and DOE/EV-0011/9. The DOE and DOE contractor radiation exposure data for 1977, 1978, 1979, 1980, and 1981 were presented in DOE/EV-0066/10, 11, 12, 13, and 14 respectively. A revised version of the 1979 report was also issued. The current report contains 1982 radiation exposure data for DOE and DOE contractors.

Previous reports for AEC/ERDA/DOE government and contractor employees and visitors may be obtained from the U.S. DOE Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

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SUMMARY

All Department of Energy (DOE) and DOE contractors are required by DOE Order 5484.1, Chapter IV, to submit occupational exposure records to a central repository. The data required includes a summary of whole-body exposures to ionizing radiation, a summary of internal depositions of radioactive materials above specified limits, and occupational exposure reports for terminating employees. This report is a summary of the data submitted by DOE and DOE contractors for 1982.

A total of 85,324 DOE and DOE contractor employees were monitored for whole-body ionizing radiation exposures in 1982. This represents 56.6% of all DOE and DOE contractor employees and is an increase from the number of individuals monitored in 1981. In addition to the employees, 87,262 visitors were monitored.

Of all employees monitored, 57.4% received a dose equivalent that was less than measurable, 41.0% a measurable exposure less than 1 rem, and 1.6% an exposure greater than 1 rem. The exposure received by 86.5% of the visitors to DOE facilities was less than measurable. Only 13.5% of the visitors received a measurable exposure less than 1 rem, and <0.01% of the visitors received an exposure greater than 1 rem. No employees or visitors received a dose equivalent greater than 5 rem.

The collective dose equivalent for DOE and DOE contractor employees was 7,193 person-rem. The collective dose equivalent for visitors was 686 person-rem. The total dose equivalent for employees and visitors combined was 7,879 person-rem. The average dose equivalent for all individuals (employees and visitors) monitored was 46 mrem and the average dose equivalent for all individuals who received a measurable exposure was 164 mrem. The highest average dose equivalent for all monitored employees was observed at fuel processing facilities (250 mrem) and the lowest among visitors (8 mrem) to DOE facilities. These averages are significantly less than the DOE 5-rem/year radiation protection standard for whole-body exposures.

Four cases of internal depositions were reported in 1982. In all cases, the depositions were less than the annual dose-equivalent standard. Internal depositions were the result of accidental, not planned, exposures.

A total of 9,264 monitored employees terminated their employment in 1982. The average cumulative dose equivalent for terminated employees who worked one to two years was 0.32 rem; two to four years, 0.31 rem; four to six years, 0.77 rem; and longer than six years, 3.37 rem. The average cumulative dose equivalent for employees who terminated with more than six years of employment appears high in comparison with the other data. However, this average includes the cumulative exposure of individuals who worked for DOE or DOE contractors for over 20 years.

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INTRODUCTION

One of the basic Department of Energy (DOE) radiation protection policy objectives is that radiation exposures be maintained as low as is reasonably achievable (ALARA) and within the occupational exposure guidelines provided in DOE Order 5480.1, Chapter XI (Table 1). Assurance that occupational exposures do not exceed the guidelines is not considered, in itself, sufficient. All operations are to be conducted "in a manner to assure that radiation exposures to individuals and population groups are limited to the lowest levels technically and economically feasible."

TABLE 1. Radiation Protection Standards for External and Internal Dose Equivalents for Individuals in Controlled Areas

Type of Exposure	Exposure Period	Dose Equivalent (Dose or Dose Commitment)(rem)[a]
Whole body, head and trunk, gonads, lens of the eye,[b] red bone marrow, active blood-forming organs.	Year	5[c]
	Calendar quarter	3
Unlimited areas of the skin (except hands and forearms), other organs, tissues, and organ systems (except bone)	Year	15
	Calendar quarter	5
Bone	Year	30
	Calendar quarter	10
Forearms[d]	Year	30
	Calendar quarter	10
Hands[d] and feet	Year	75
	Calendar quarter	25

[a]To meet the dose commitment standards above, operations must be conducted in such a manner that it would be unlikely that an individual would assimilate in a critical organ, by inhalation, ingestion, or absorption, a quantity of radionuclide(s) that would commit the individual to an organ dose which exceeds the limits specified in this table.

[b]A beta exposure below a maximum energy of 700 keV will not penetrate the lens of the eye; therefore, the applicable limit for these energies would be that for the skin (15 rem/year).

[c]In special cases with the approval of the Director, Office of Nuclear Safety, a worker may exceed 5 rem/year provided his/her average exposure per year since age 18 will not exceed 5 rem/year.

[d]All reasonable effort shall be made to keep exposure of forearms and hands to the general limit for the skin.

To assist in the determination that exposures to individuals are maintained at the lowest level practicable, DOE requires the submittal of occupational radiation exposure records to a central repository. The data required includes a summary of whole-body exposure to ionizing radiation, a summary of internal depositions of radioactive materials, and occupational exposure reports for terminating employees. The central data base also includes occupational radiation exposure information for the Atomic Energy Commission (AEC) and the Energy Research and Development Agency (ERDA).

This report is a summary of the data submitted for 1982 by DOE and DOE contractor offices. For the purpose of trend analysis, the data is compared to that reported in previous years. The data used to prepare this report is presented in Appendix A, "Distribution of Whole-Body Exposures by Facility Type for Each DOE Field Organization, 1982"; Appendix B, "Distribution of Annual Whole-Body Exposures by Contractor for Each DOE Field Organization, 1982"; and Appendix C, "Distribution of Annual Whole-Body Exposures for DOE Government Employees and Visitors by DOE Field Organization, 1982."

SUMMARY OF WHOLE-BODY IONIZING RADIATION EXPOSURES

Monitoring is required by DOE Order 5480.1, Chapter XI, where the potential exists for an individual to receive a dose or dose commitment in any calendar quarter in excess of the 10% of the quarterly or annual occupational exposure guidelines shown in Table 1. Depending on the administrative policy of the contractor, monitoring may also be provided to individuals, such as clerical workers, for whom the exposure potential is extremely low.

The number of individuals who received an occupational whole-body exposure in one of 16 dose-equivalent intervals ranging from "less than measurable" to "greater than 10 rem" is provided annually by each DOE contractor and DOE office. A positive, measurable exposure is any recorded exposure greater than the minimum sensitivity of a personnel monitoring device. The data is further subdivided into one of 10 facility types.

Contractors have the option of reporting the distribution of whole-body occupational dose equivalents only for those individuals for whom monitoring is required, or for all those for whom monitoring is provided. Many contractors choose to report the latter, thus increasing the number of individuals who are considered to be radiation workers. To account for this effect, the average dose equivalent per individual receiving a measurable exposure is calculated as well as the average dose equivalent per individual monitored.

The annual collective dose equivalent is calculated by multiplying the number of individuals in each dose range by the midpoint of the range, and then summing the products. This procedure allows an estimate of the collective dose equivalent to be calculated without knowledge of each individual's annual dose. However, a source of error is introduced into the calculation by the assumption that the midpoint of the dose-equivalent range is the mean dose equivalent of the individuals reported in each dose-equivalent range. Frequently, the actual mean dose equivalent in each range is less than the assumed arithmetic mean. Thus, collective dose equivalents presented in this report may be slightly higher than the actual collective dose equivalents.

DISTRIBUTION BY DOSE INTERVAL

The number of employees and visitors who received a dose equivalent in each of 16 dose-equivalent ranges is presented in Table 2. There were no DOE employees or visitors who received a dose equivalent greater than 5 rem. A total of 85,324 DOE and DOE contractor employees were monitored for whole-body ionizing radiation exposure in 1982. This represents 56.6% of all DOE and DOE contractor employees. In addition to the employees, 87,262 visitors were monitored at DOE facilities. Visitors may include radiation workers from another DOE facility present on an interim basis.

TABLE 2. Distribution of Whole-Body Ionizing Radiation Exposures for DOE/DOE Contractor Employees and Visitors by Dose-Equivalent Interval, 1982

Dose-Equivalent Interval (rem)	Number of Persons			Collective Person-rem		
	Employees	Visitors	Total	Employees	Visitors	Total
<Measurable	48,968	75,451	124,419	0	0	0
Measurable to 0.10	25,303	11,432	36,735	1,266	572	1,838
0.10 to 0.25	4,813	247	5,060	842	43	885
0.25 to 0.50	2,918	88	3,006	1,094	33	1,127
0.50 to 0.75	1,222	27	1,249	764	17	781
0.75 to 1.00	693	10	703	606	9	615
1 to 2	1,010	5	1,015	1,515	8	1,523
2 to 3	313	2	315	783	5	788
3 to 4	56	0	56	196	0	196
4 to 5	28	0	28	126	0	126
5 to 6	0	0	0	0	0	0
6 to 7	0	0	0	0	0	0
7 to 8	0	0	0	0	0	0
8 to 9	0	0	0	0	0	0
9 to 10	0	0	0	0	0	0
>10	0	0	0	0	0	0
TOTAL	85,324	87,262	172,586	7,192	687	7,879

A comparison of DOE and DOE contractor employees, the number of employees monitored and the number of employees who did not receive a measurable dose equivalent in the last five years is presented in Figure 1. The number of employees monitored in 1982 increased slightly from the number reported in previous years (Figure 1).

Of the employees monitored in 1982, 57.4% received a dose equivalent that was less than measurable, 41.0% a measurable exposure less than 1 rem, and 1.6% an exposure greater than 1 rem (Figure 2). The exposure received by 86.5% of the visitors to DOE facilities was less than measurable. Only 13.5% of the visitors received an exposure between measurable and 1 rem, and <0.01% of the visitors received an exposure greater than 1 rem (Figure 2).

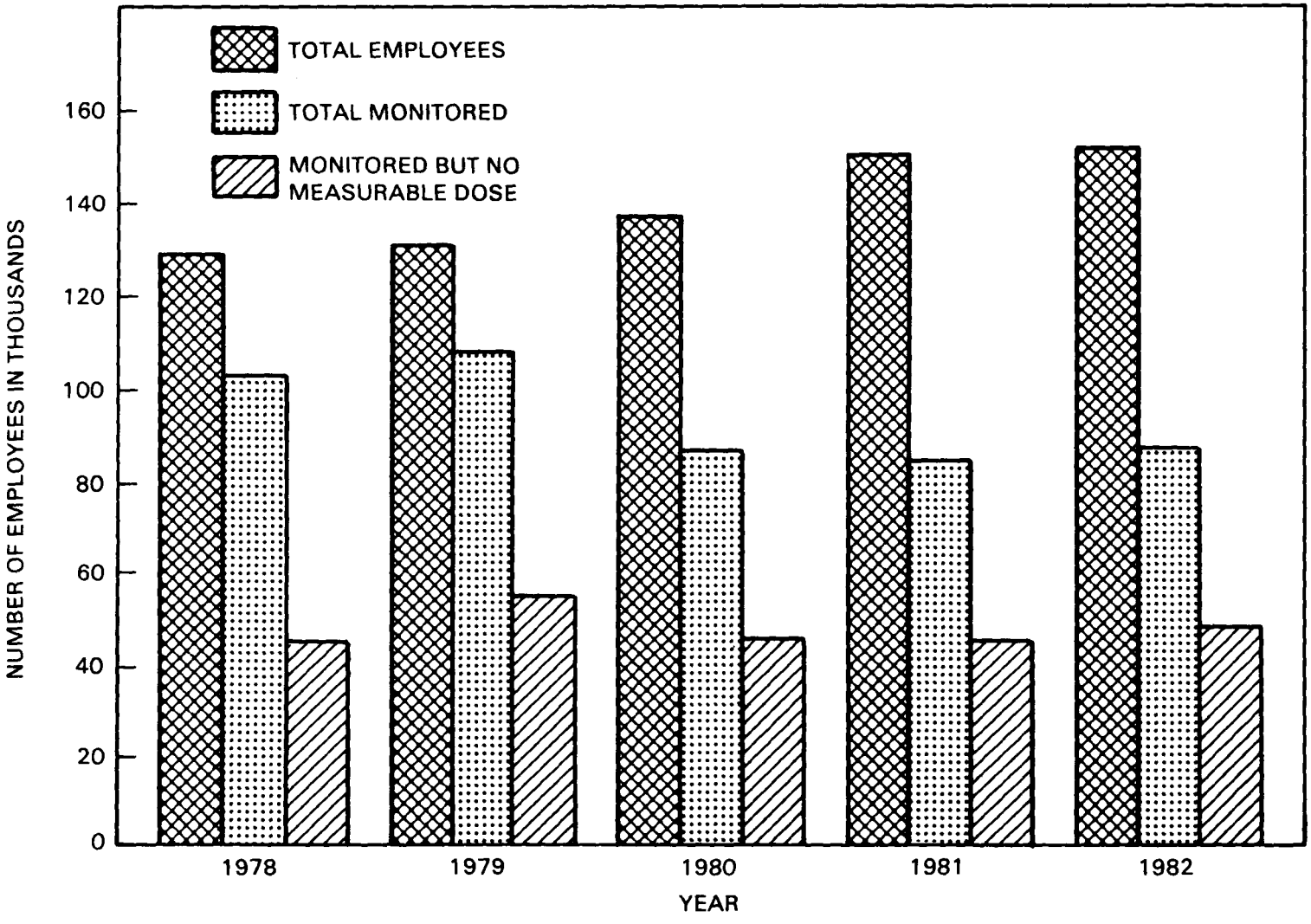

FIGURE 1. Comparison of Number of Employees, Number of Employees Monitored, and Number of Employees Monitored Who Received No Measurable Dose Equivalent

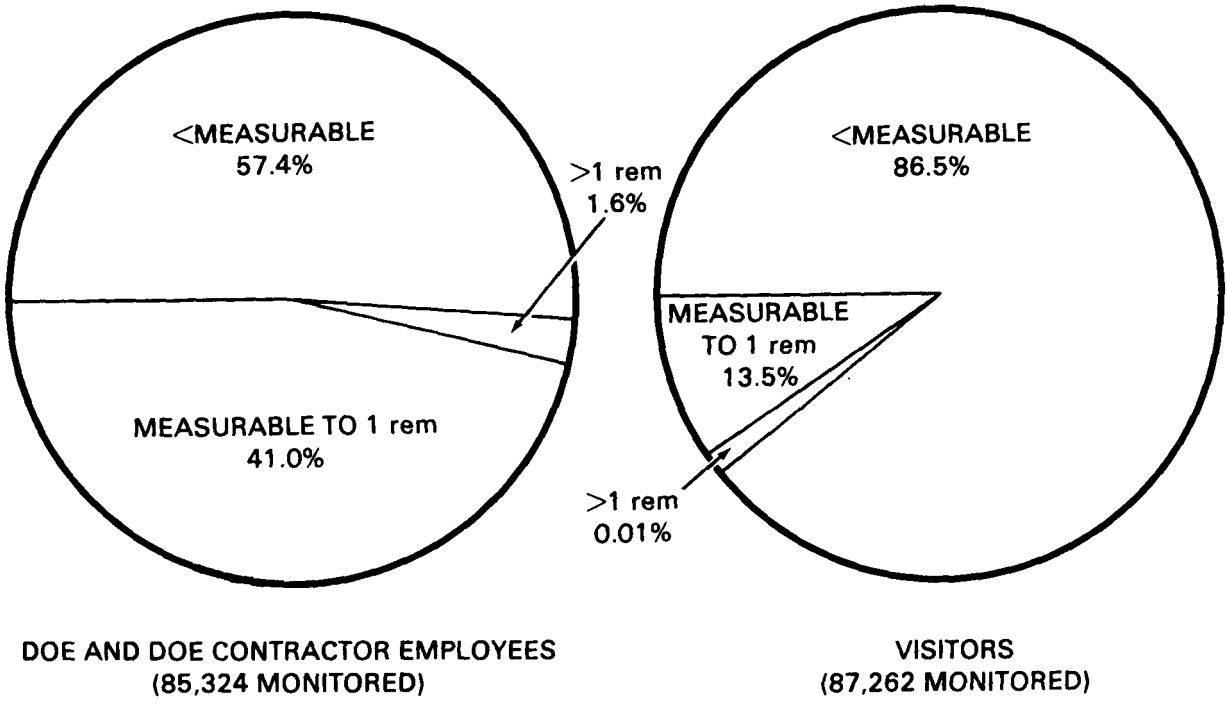

FIGURE 2. Percent of Monitored Employees and Percent of Monitored Visitors Who Received an Exposure Less Than Measurable, Measurable to 1 rem, or Greater Than 1 rem, 1982

The collective dose equivalent was 7,193 person-rem for all DOE and DOE contractor employees, and 686 person-rem for visitors to DOE facilities, for a total collective dose equivalent of 7,879 person-rem. The contribution of each dose-equivalent interval to the collective dose equivalent is shown in Figure 3. Exposure less than 1 rem contributed the greatest portion of the total person-rem.

The distribution of whole-body exposures for the years 1965-1982 is presented in Table 3. As can be observed in Table 3, the number of employees who received a dose equivalent greater than 1 rem has gradually declined since 1965. This same downward trend in the occupational exposures can be observed in Figure 4 which shows the collective dose equivalent for all individuals who received an exposure greater than 1 rem between 1965 and 1982. (The collective dose equivalent for individuals who received an exposure less than 1 rem was not included because prior to 1974, a less-than-measurable exposure was not distinguished from measurable exposures in the reporting system.) The general decline in the collective dose equivalent has been achieved even though some work was performed in older facilities which were not constructed using current design criteria. This trend reflects both changes in the nature of the work performed at DOE facilities and the consistent application of ALARA practices throughout all DOE operations. The slight increase in the collective dose equivalent observed in 1982 is due to increased operations at a major DOE facility.

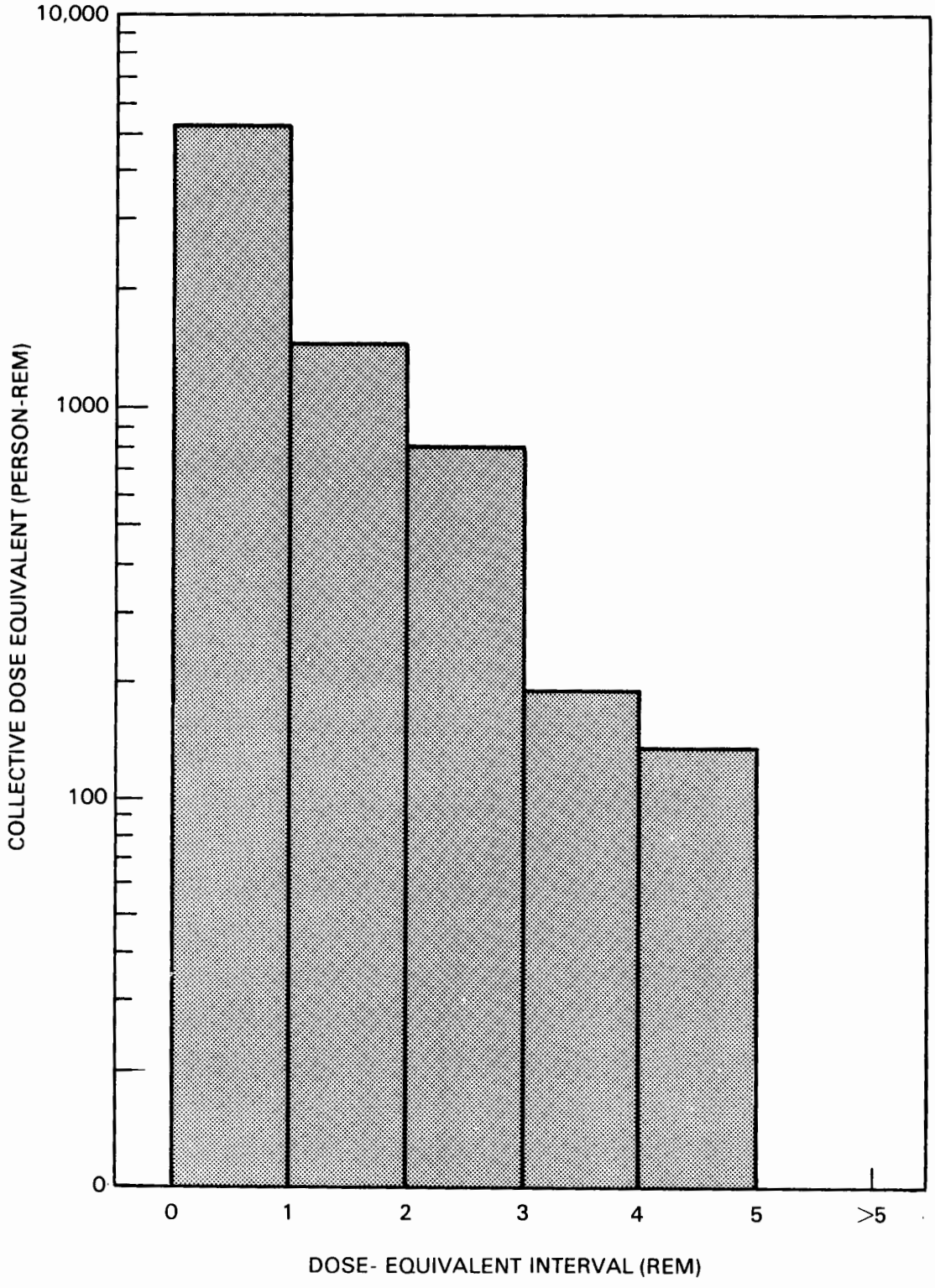

FIGURE 3. Contribution of Each Dose-Equivalent Interval to the Total Collective Dose Equivalent, 1982

TABLE 3. Distribution of Whole-Body Ionizing Radiation Exposures for DOE/DOE Contractor Employees, 1965-1982

Year	Number of Employees Receiving Exposures in Each Dose-Equivalent Range (rem)													Total Employees Monitored
	0-1(a) <Meas.	0-1(a) Meas.-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	>12	
1965	128,360		4,158	1,704	515	294	70	32	26	25	22	6	2		135,214
1966	131,522		3,706	1,630	593	313	88	47	24	6	2			1	137,932
1967	102,510		3,472	1,572	555	168	35	29	23	17	4	1			108,386
1968	103,206		2,799	1,408	425	144	3	1							107,986
1969	98,625		2,554	1,313	335	86	4					1			102,918
1970	92,185		2,698	1,329	279	158	5	4	2		1				96,661
1971	90,640		2,380	888	275	118	8	3				1		2	94,315
1972	86,077		2,130	929	219	95	8	2							89,460
1973	89,071		1,944	727	172	60	2	1							91,977
1974	43,184	32,500	1,667	688	149	40	4								78,232
1975	43,310	42,141	1,846	753	232	142				1					88,425
1976	40,083	47,886	1,679	475	70	6	1								90,200
1977	43,017	49,948	1,579	545	103	23			1	2				2	95,220
1978	44,898	55,296	1,323	439	53	11									102,020
1979(b)	50,003	53,235	1,286	416	33	10	1							2	104,986
1980	45,054	38,895	1,113	387	16										85,465
1981(b)	45,224	36,561	967	263	29	5									83,049
1982	48,968	34,949	1,010	313	56	28									85,324

(a)Separation of data prior to 1974 is unavailable.

(b)Data differs slightly from those listed in previous reports because of errors reported by individual contractors after publication of an annual report.

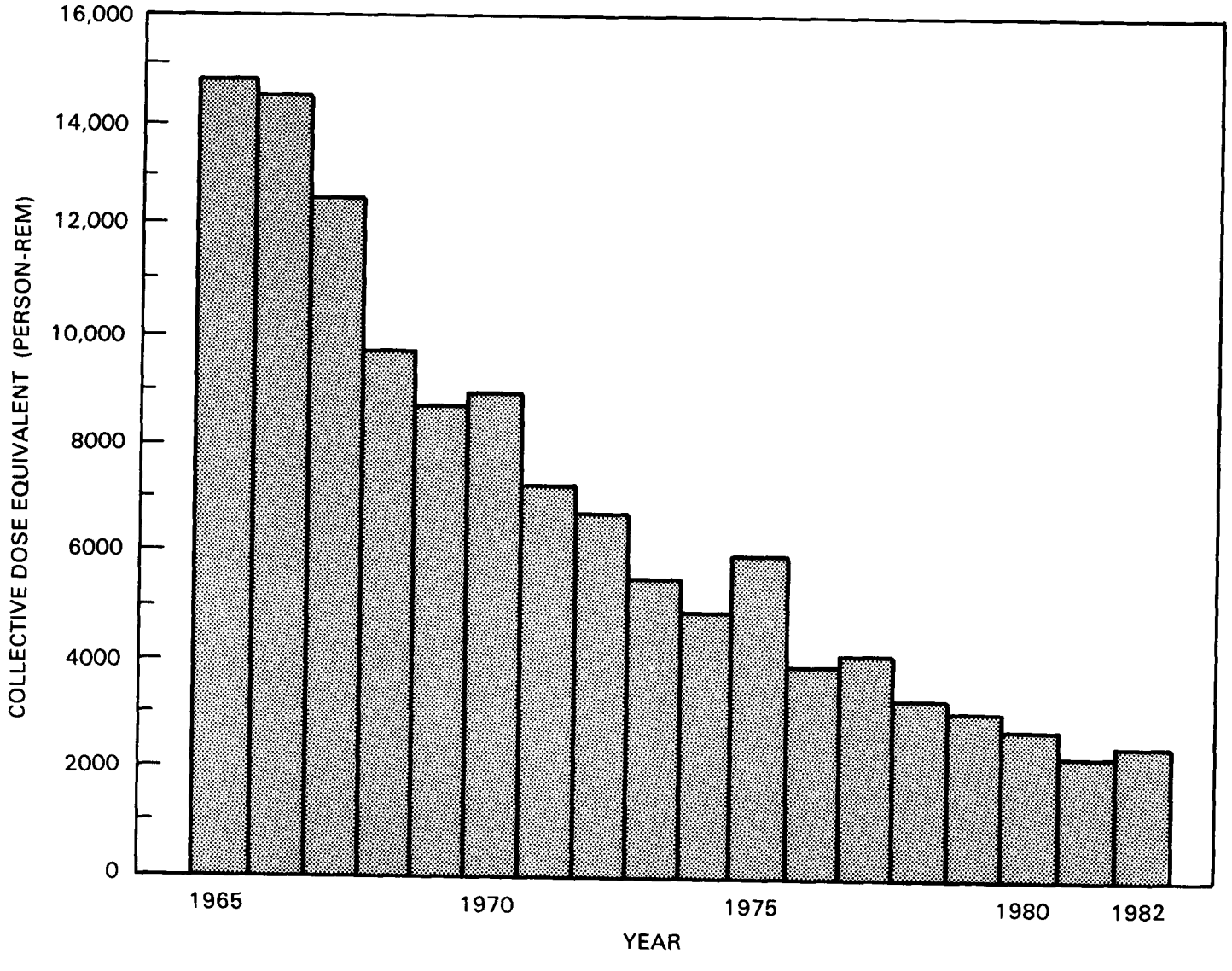

FIGURE 4. Total Collective Dose Equivalent for All DOE/DOE Contractor Employees Who Received an Exposure Greater Than 1 rem, 1965-1982

DISTRIBUTION BY FACILITY TYPE

The number of individuals and the distribution of the annual whole-body exposures in each of 10 facility categories were reported to the central repository. For the purpose of this report, visitors were considered a facility type. The contribution of each facility type to the collective dose equivalent is shown in Figure 5. The largest percentage of the total collective dose equivalent was in the category "Other." Examples of facilities included in the "Other" category include radioactive waste handling and construction. "General Research" was a close second. As would be expected, the smallest contribution was from DOE offices. A summary of the data submitted is presented in Table 4.

The average dose equivalent by facility type per individual monitored and per individual monitored with measurable exposure is shown in Table 5. The average dose equivalent per individual monitored for all facilities combined was 46 mrem. The highest average dose equivalent per individual monitored was observed at fuel processing facilities (250 mrem) and the lowest was observed for visitors to DOE facilities (8 mrem). The average dose equivalent per individual monitored with a measurable exposure was 164 mrem. The highest average dose equivalent for individuals monitored with a measurable exposure was observed at fuel processing facilities (362 mrem) and the lowest was observed for visitors (58 mrem).

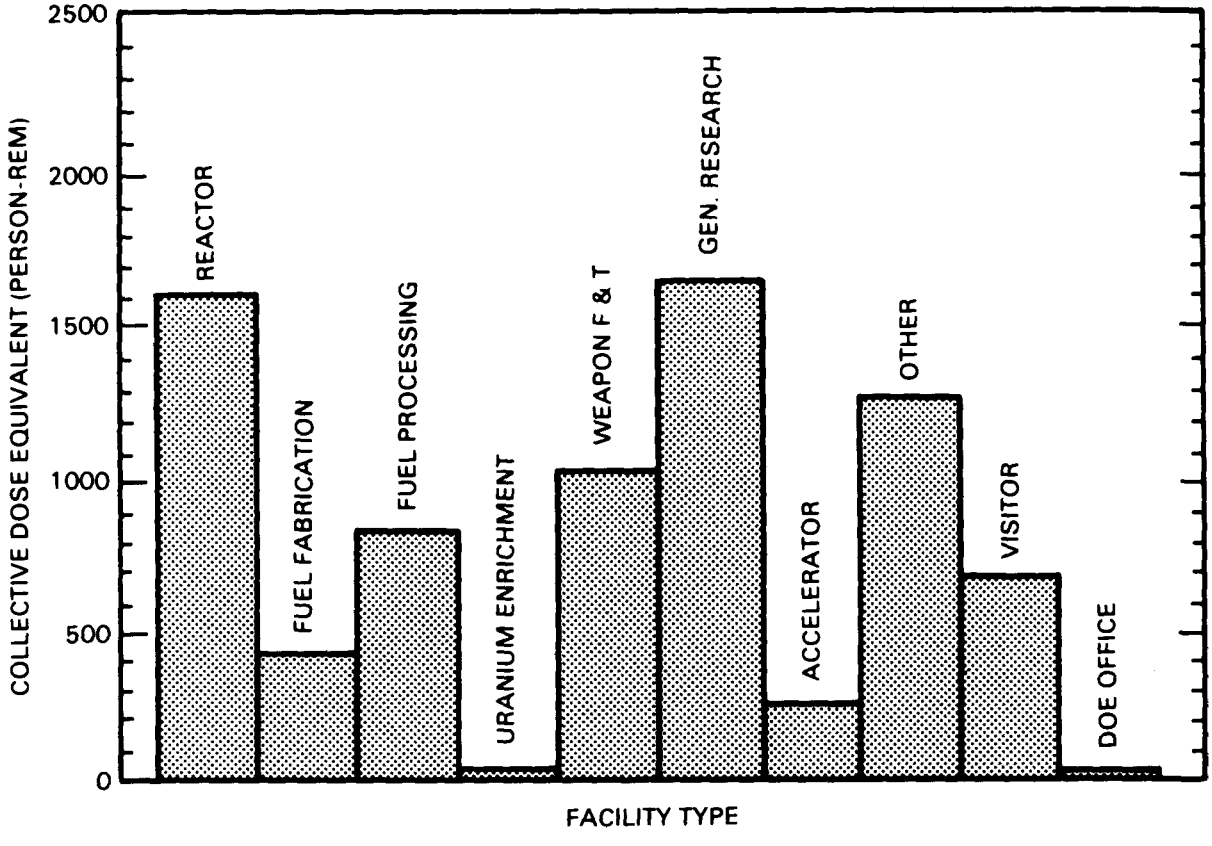

FIGURE 5. Contribution of Each Facility Type to the Total Collective Dose Equivalent, 1982

TABLE 4. Distribution of Annual Whole-Body Exposures for DOE/DOE Contractor Employees and Visitors by Facility Type, 1982

Facility Type	Total Persons Monitored	Number of Persons Receiving Exposures in Each Dose-Equivalent Range (rem)																	Total Person-rem
		<Meas.	Meas.-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	
Reactor	7,694	2,353	3,190	828	546	206	131	244	193	3										1,612
Fuel Fab.	1,776	431	655	236	229	109	53	44	4	7	8									411
Fuel Proc.	3,339	1,032	1,060	375	310	194	144	207	17											835
Uran. Enrich.	994	645	265	76	7		1													30
Weapon F&T	19,791	12,043	6,081	759	431	213	117	146	1											1,056
Gen. Research	31,425	21,459	7,648	1,087	579	243	112	185	53	39	20									1,676
Accelerator	3,446	2,230	712	239	134	56	41	31	2	1										254
Other	14,443	6,780	5,302	1,187	677	201	94	153	43	6										1,293
Visitors	87,262	75,451	11,432	247	88	27	10	5	2											686
DOE Offices	2,416	1,995	390	26	5															26
TOTAL PERSONS	172,586	124,419	36,735	5,060	3,006	1,249	703	1,015	315	56	28									7,879
TOTAL PERSON-REM		0	1,838	885	1,127	781	615	1,523	788	196	126									7,879

TABLE 5. Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors by Facility Type, 1982

Facility Type	No. Individuals Monitored	No. Individuals With Measurable Exposure	Total No. Person-rem	Average Dose Equivalent (mrem) Per Individual Monitored	Average Dose Equivalent (mrem) Per Individual Monitored With Measurable Exposures
Reactor	7,694	5,341	1,612	210	302
Fuel Fab.	1,776	1,345	411	231	306
Fuel Proc.	3,339	2,307	835	250	362
Uran. Enrich.	994	349	30	30	86
Weapon F&T	19,791	7,748	1,056	53	136
Gen. Research	31,425	9,966	1,676	53	168
Accelerator	3,446	1,216	254	74	209
Other	14,443	7,663	1,293	90	169
Visitors	87,262	11,811	686	8	58
DOE Offices	2,416	421	26	11	62
TOTAL	172,586	48,167	7,879	46	164

DISTRIBUTION BY FIELD ORGANIZATION

For each field organization, the number of employees monitored and the collective dose equivalent are shown in Table 6. Differences in the collective dose equivalent at each field organization reflect differences in the nature of the work performed and the administrative policy concerning whether the dose distribution is reported for all employees or only for those for whom monitoring is required. Table 7 provides an indication of the work done at each field organization by showing what fraction of the collective dose equivalent at each field organization is attributed to each facility type. Trends in collective dose equivalent from 1977 to 1982 can be observed for each field organization in Table 8.

TABLE 6. Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors by Field Organization, 1982

Field Organization	No. Individuals Monitored	No. Individuals With Measurable Exposure	Collective Dose Equivalent (Person-rem)	Average Dose Equivalent (mrem) Per Individual Monitored	Average Dose Equivalent (mrem) Per Individual Monitored With Measurable Exposures
Albuquerque	34,891	20,098	2,285	65	114
Chicago	16,742	3,100	587	35	189
Idaho	35,393	1,673	363	10	217
Nevada	27,209	302	29	1	96
Oak Ridge	4,188	1,600	401	96	251
Pittsburgh Naval Reactor	2,762	2,158	194	70	90
Richland	11,947	8,204	2,272	190	277
San Francisco	22,516	2,408	289	13	120
Savannah River	14,166	6,801	1,310	92	193
Schenectady Naval Reactor	2,767	1,823	147	53	81
TOTAL[a]	172,586	48,167	7,877	46	164

(a) Energy Tech Centers report 5 persons were monitored with no measurable exposure, included in total individuals monitored.

TABLE 7. Fraction of Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors Attributed to a Facility Type Within Each Field Organization, 1982

Field Organization	Facility Type									
	Reactor	Fuel Fab.	Fuel Proc.	Uran. Enrich.	Weapon F&T	Gen. Research	Acceler.	Other	Visitor	DOE Office
Albuquerque					0.42	0.36		<0.01	0.22	<0.01
Chicago	0.07					0.29	0.42	0.09	0.13	
Idaho	0.30		0.66					0.04	<0.01	<0.01
Nevada					0.66				0.31	0.03
Oak Ridge		0.31		0.07	0.17	0.38		0.04	0.03	
Pittsburgh Naval Reactor	0.38					0.57		0.02	0.03	<0.01
Richland	0.47	0.02				0.08		0.40	0.02	<0.01
San Francisco		0.44			<0.01	0.44	0.03		0.08	<0.01
Savannah River	0.16	0.08	0.46		0.01	0.06		0.22	0.01	<0.01
Schenectady Naval Reactor	0.75					0.20		0.01	0.03	0.01
ALL FIELD ORGANIZATIONS COMBINED	0.21	0.05	0.11	0.01	0.13	0.21	0.03	0.16	0.09	<0.01

TABLE 8. Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors by Field Organization, 1977-1982[a]

Field Organization	1977	1978	1979[b]	1980	1981[b]	1982
Albuquerque	2,300	2,399	1,873	1,700	2,024	2,285
Chicago	1,373	1,167	1,061	918	758	587
Idaho	929	899	876	593	302	363
Nevada	49	47	55	50	36	29
Oak Ridge	1,300	1,566	1,332	604	437	401
Pittsburgh Naval Reactor	653	252	196	186	185	194
Richland	3,197	2,596	2,571	2,256	2,093	2,272
San Francisco	334	307	264	240	171	289
Savannah River	1,298	1,289	1,343	1,391	1,401	1,310
Schenectady Naval Reactor	148	111	114	79	76	147
TOTAL	11,581	10,635	9,693	8,024	7,483	7,877

(a)Throughout this report, minor variations in collective dose-equivalent values may occur due to computer rounding.
(b)Data differs slightly from those listed in previous reports because of errors reported by individual contractors after publication of an annual report.

SUMMARY OF INTERNAL EXPOSURES

Internal body depositions of radioactive material result from accidental, not planned, exposures. A report of internal body deposition of radioactive materials is required when:

1. any uptake of radioactive material occurred during the reporting year that either independently or when added to a current burden was estimated to result in a dose commitment to the critical organ in excess of 50% of the pertinent annual dose-equivalent standard set forth in DOE Order 5484.1, Chapter XI; or when

2. any previously unreported uptake of radioactive material was determined to have been reportable according to the above criteria by reason of the most recent dose-equivalent estimates.

Table 9 gives a five-year comparison of new cases of internal body depositions. Only those cases occurring within each year are included. Cases where the effects of prior years' depositions are continuing or where a new uptake is not clearly identified are not included.

Of 10 internal deposition reports for 1982, four are considered new and are included in Table 9. The six remaining reports are not included for the following reasons. In three cases, the current burden has decreased from the measured level of previous years; these instances are judged as continued tracking of a previous uptake. In three other cases, the reported current burden was slightly higher than was previously measured, indicating either a re-evaluation of the burden, or a possible new uptake.

TABLE 9. Dose Distributions for Cases of Internal Body Depositions, 1978-1982

Year	Radionuclide	Critical Organ	Dose-Equivalent Interval (rem) 7.5-10	10-15	15-25	25-50	50-100	100-200
1978	^{239}Pu, ^{240}Pu, ^{241}Pu	Lung	1					
	^{125}I	Thyroid	1					
1979	^{234}U, ^{235}U, ^{238}U	Lung	2					
1980	^{238}Pu	Bone			3(a)	1(b)		
	^{234}U, ^{235}U, ^{238}U	Lung	1					
1981	^{238}Pu, ^{239}Pu, ^{240}Pu	Bone		1	1			
		Lung	1					
	^{234}U, ^{235}U, ^{238}U	Lung	3					
1982	^{238}Pu	Bone			1(a)	1(a)		
	^{238}Pu, ^{239}Pu, ^{240}Pu	Bone						1
		Liver	1					

(a)These previously unreported individuals exceeded 50% of the annual standard during 1980 as a result of chronic buildup due to translocation from the lungs from prior years' exposure. No acute exposure is known to have occurred.

(b)One individual exceeded 100% of the annual standard in 1980 for unknown reasons. This individual received a Type B plutonium lung exposure as a result of an incident in 1971, and has been excluded from work with plutonium since that time. Since the systemic burden was less than half the standard in 1978, this new information was also reported. This individual's case is being closely followed to see if some mechanism for the increase in systemic burden can be determined.

SUMMARY OF WORKER TERMINATIONS

A total of 9,264 monitored workers terminated their employment with DOE or DOE contractors in 1982. Table 10 gives the length of employment as well as the average cumulative dose equivalent for the workers in each time interval. These data indicate that the average cumulative dose equivalent for workers terminating in 1982 after 1 to 365 days of employment was significantly less than the 5 rem/year radiation protection standard for the whole body.

The average cumulative dose equivalent for workers who terminated after more than six years of employment was 3.37 rem. This average appears high in comparison with the average cumulative dose equivalent for employees who terminated with less than six years of employment. However, this average includes the cumulative exposure of individuals who worked for DOE or DOE contractors for more than 20 years.

TABLE 10. Average Cumulative Dose Equivalent for Individuals Terminating in 1982

Length of Employment	Number of Terminated Employees	Total Cumulative Dose Equivalent (Person-rem)	Average Cumulative Dose Equivalent Per Terminated Employee (rem)
1-90 days	2,093	299.76	0.14
90-180 days	1,318	231.67	0.18
180-365 days	769	133.86	0.17
1-2 years	1,018	326.99	0.32
2-4 years	1,066	329.83	0.31
4-6 years	644	496.18	0.77
> 6 years	2,356	7,929.11	3.37

APPENDIX A

DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE FOR EACH DOE FIELD ORGANIZATION, 1982

TABLE A.1
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
ALBUQUERQUE FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Facility Type	Total Monitored	< Meas.	Meas.-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	Total Person-rem
Reactor																		
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T	9,251	2,152	5,704	592	362	189	109	142	1									954
Gen. Research	10,263	6,900	2,593	273	174	71	49	99	45	39	20							817
Accelerator																		
Other	99	60	30	5	4													4
Visitors	14,617	5,195	9,317	68	25	7	2	2	1									499
DOE Offices	661	486	160	12	3													11
TOTAL	34,891	14,793	17,804	950	568	267	160	243	47	39	20							2,285
TOTAL PERSON-REM			890	166	213	167	140	365	118	136	90							2,285

TABLE A.2
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
CHICAGO FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Facility Type	Total Monitored	< Meas.	Meas.- <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	Total Person-rem
Reactor	247	101	71	23	23	18	5	6										41
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	4,719	3,698	678	141	125	53	13	9	2									168
Accelerator	3,252	2,094	670	231	131	53	40	30	2	1								245
Other	700	548	98	23	7	4	5	4	5	6								58
Visitors	7,800	7,181	439	115	45	13	5	1	1									75
DOE Offices	24	20	4															
TOTAL	16,742	13,642	1,960	533	331	141	68	50	10	7								587
TOTAL PERSON-REM			98	93	124	88	60	75	25	24								587

TABLE A.3
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
IDAHO FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Facility Type	Total Monitored	< Meas.	Meas.- <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	Total Person-rem
Reactor	2,297	1,513	519	165	59	27	11	3										108
Fuel Fabrication																		
Fuel Processing	1,513	791	356	129	85	50	39	57	6									238
Uran. Enrichment																		
Weapon F&T																		
Gen. Research																		
Accelerator																		
Other	226	123	68	14	19	2												14
Visitors	31,156	31,155	1															
DOE Offices	201	138	62	1														3
TOTAL	35,393	33,720	1,006	309	163	79	50	60	6									363
TOTAL PERSON-REM			50	54	61	49	44	90	15									363

TABLE A.4
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
NEVADA FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Facility Type	Total Monitored	< Meas.	Meas.- <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	Total Person-rem
Reactor																		
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T	9,874	9,676	152	35	8	3												19
Gen. Research																		
Accelerator																		
Other	448	448																
Visitors	15,862	15,766	79	13	1	2	1											9
DOE Offices	1,025	1,017	7	1														1
TOTAL	27,209	26,907	238	49	9	5	1											29
TOTAL PERSON-REM			12	9	4	3	1											29

TABLE A.5
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
OAK RIDGE FIELD ORGANIZATION
1982

Facility Type	Total Monitored	< Meas.	Dose-Equivalent Ranges (rem) Meas.-<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	Total Person-rem
Reactor																		
Fuel Fabrication	379	20	91	86	107	41	19	15										124
Fuel Processing																		
Uran. Enrichment	994	645	265	76	7		1											30
Weapon F&T	370	72	107	105	58	19	6	3										67
Gen. Research	934	502	135	110	94	49	13	28	3									153
Accelerator																		
Other	887	790	47	35	13	2												15
Visitors	624	559	42	10	7	3	1	2										12
DOE Offices																		
TOTAL	4,188	2,588	687	422	286	114	40	48	3									401
TOTAL PERSON-REM			34	74	107	71	35	72	8									401

TABLE A.6
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
PITTSBURGH NAVAL REACTOR FIELD ORGANIZATION
1982

Facility Type	Total Monitored	< Meas.	Dose-Equivalent Ranges (rem) Meas.- <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	Total Person-rem
Reactor	959	203	580	118	49	9												74
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	1,451	237	1,006	164	21	10	5	8										110
Accelerator																		
Other	83	33	46	2	2													3
Visitors	224	120	103	1														5
DOE Offices	45	11	30	3	1													2
TOTAL	2,762	604	1,765	288	73	19	5	8										194
TOTAL PERSON-REM			88	51	27	12	4	12										194

TABLE A.7
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
RICHLAND FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Facility Type	Total Monitored	< Meas.	Meas.- <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	Total Person-rem
Reactor	1,510	150	425	188	145	87	97	222	193	3								1,074
Fuel Fabrication	188	11	53	48	46	21	4	5										52
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	1,458	158	904	242	85	32	13	22	2									189
Accelerator																		
Other	6,601	1,939	3,041	767	464	142	72	138	38									914
Visitors	2,060	1,433	592	28	5	2												38
DOE Offices	130	52	70	7	1													5
TOTAL	11,947	3,743	5,085	1,280	746	284	186	387	233	3								2,272
TOTAL PERSON-REM			254	224	280	177	163	581	583	10								2,272

TABLE A.8
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
SAN FRANCISCO FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Facility Type	Total Monitored	< Meas.	Meas.- <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	Total Person-rem
Reactor																		
Fuel Fabrication	747	318	349	29	8	4	4	16	4	7	8							126
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T	108	95	7	3		2	1											3
Gen. Research	10,395	8,906	1,336	83	40	12	8	9	1									127
Accelerator	194	136	42	8	3	3	1	1										9
Other																		
Visitors	11,010	10,596	401	7	5		1											24
DOE Offices	62	57	5															
TOTAL	22,516	20,108	2,140	130	56	21	15	26	5	7	8							289
TOTAL PERSON-REM			107	23	21	13	13	39	12	25	36							289

TABLE A.9
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
SAVANNAH RIVER FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Facility Type	Total Monitored	< Meas.	Meas.- <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	Total Person-rem
Reactor	1,380	216	631	238	224	60	10	1										205
Fuel Fabrication	462	82	162	73	68	43	26	8										108
Fuel Processing	1,826	241	704	246	225	144	105	150	11									597
Uran. Enrichment																		
Weapon F&T	188	48	111	24	3		1	1										13
Gen. Research	1,150	573	441	59	40	16	11	10										82
Accelerator																		
Other	5,368	2,819	1,961	341	168	51	17	11										284
Visitors	3,549	3,184	361	4														19
DOE Offices	243	202	40	1														2
TOTAL	14,166	7,365	4,411	986	728	314	170	181	11									1,310
TOTAL PERSON-REM			221	173	273	196	149	271	27									1,310

TABLE A.10
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
SCHENECTADY NAVAL REACTOR FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rems)

Facility Type	Total Monitored	< Meas.	Meas.-<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	Total Person-rem
Reactor	1,301	170	964	96	46	5	8	12										110
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	1,050	480	555	15														30
Accelerator																		
Other	31	20	11															1
Visitors	360	262	97	1														5
DOE Offices	25	12	12	1														1
TOTAL	2,767	944	1,639	113	46	5	8	12										147
TOTAL PERSON-REM			82	20	17	3	7	18										147

APPENDIX B

DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR FOR EACH DOE FIELD ORGANIZATION, 1982

TABLE B.1
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ALBUQUERQUE FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Contractor	< Meas.	Meas.-<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	Total Person-rem
Albuquerque Misc.																	
Employees	790	62	6														4
Visitors																	
Total	790	62	6														4
General Electric Co.																	
Employees	275	113	5														7
Visitors	4	6															
Total	279	119	5														7
Inhalation Toxicology																	
Employees	239	63	6	3	1		1										7
Visitors	165																
Total	404	63	6	3	1		1										7
Mason & Hanger-Silas (Amarillo, TX)																	
Employees	621	144	67	56	19	10	33	1									113
Visitors	1,101	4															
Total	1,722	148	67	56	19	10	33	1									113
Mason & Hanger-Silas (Los Alamos, NM)																	
Employees	102	162															8
Visitors																	
Total	102	162															8
Monsanto Research Co.																	
Employees	263	1,302	98	24	3	3											96
Visitors	973	86	1														4
Total	1,236	1,388	99	24	3	3											100

TABLE B.1 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ALBUQUERQUE FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																
	< Meas.	Meas.- < 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	Total Person-rem
Rockwell International																	
Employees		4,068	416	282	167	96	109										734
Visitors		8,695															435
Total		12,763	416	282	167	96	109										1,169
Ross Aviation, Inc.																	
Employees	44	14															1
Visitors																	
Total	44	14															1
Sandia Laboratories, (Albuquerque, NM)																	
Employees	2,118	420	66	28	5	3	8	4	2	3							91
Visitors	1,802	233	14	11	4	2	2										25
Total	3,920	653	80	39	9	5	10	4	2	3							117
Sandia Laboratories, (Livermore, CA)																	
Employees	851	91	3		1												6
Visitors	126							1									3
Total	977	91	3		1			1									8
Teledyne Isotopes																	
Employees	16	16	5	4													3
Visitors																	
Total	16	16	5	4													3
The Bendix Corp.																	
Employees	203	15															1
Visitors																	
Total	203	15															1

TABLE B.1 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ALBUQUERQUE FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
The Zia Company																	
Employees	913	407	34	14	11	4	3										46
Visitors																	
Total	913	407	34	14	11	4	3										46
University of California																	
Employees	2,677	1,450	164	129	53	42	87	41	37	17							658
Visitors	1,024	293	53	14	3												31
Total	3,701	1,743	217	143	56	42	87	41	37	17							690
TOTAL ALBUQUERQUE	14,307	17,644	938	565	267	160	243	47	39	20							2,274

TABLE B.2
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
CHICAGO FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Contractor	< Meas.	Meas.-<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	Total Person-rem
Ames Laboratory																	
Employees	33	18	1														1
Visitors																	
Total	33	18	1														1
Argonne National Lab.																	
Employees	1,909	311	139	118	55	17	9										147
Visitors	3,153	48	3	2	1												4
Total	5,062	359	142	120	56	17	9										151
Brookhaven National Lab.																	
Employees	1,017	417	149	100	48	16	25	2	1								174
Visitors	185	136	49	14	4	1	1	1									28
Total	1,202	553	198	114	52	17	26	3	1								202
Chicago Misc.																	
Employees	398	215	22	12	5	9	7	5	6								74
Visitors	329	41	3														3
Total	727	256	25	12	5	9	7	5	6								77
Fermi National Accel.																	
Employees	1,451	240	92	47	16	16	4										76
Visitors	2,138	204	60	29	8	4											40
Total	3,589	444	152	76	24	20	4										116
Massachusetts Inst.																	
Employees	281	81	10	8	3	5	2										18
Visitors	1,354	10															1
Total	1,635	91	10	8	3	5	2										19

TABLE B.2 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
CHICAGO FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Princeton University																	
Employees	1,272	224	2				2	2									20
Visitors																	
Total	1,272	224	2				2	2									20
TOTAL CHICAGO	13,520	1,945	530	330	140	68	50	10	7								585

TABLE B.3
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
IDAHO FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Bendix Field Eng.																	
Employees	63	39	5														3
Visitors																	
Total	63	39	5														3
Biggers Const.																	
Employees		3	2														1
Visitors																	
Total		3	2														1
Bingham Mechanical																	
Employees	7	2		1													
Visitors																	
Total	7	2		1													
C-L Electric Company																	
Employees		1															
Visitors																	
Total		1															
EG&G, Idaho, Inc.																	
Employees	1,311	396	151	54	24	10	3										95
Visitors	22,510	1															
Total	23,821	397	151	54	24	10	3										95
Exxon Nuclear Co.																	
Employees	677	223	94	69	42	30	28	3									155
Visitors	8,645																
Total	9,322	223	94	69	42	30	28	3									155

TABLE B.3 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
IDAHO FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Idaho Miscellaneous																	
Employees	244	174	21	6	1	2	2										20
Visitors																	
Total	244	174	21	6	1	2	2										20
Lehigh Design Co.																	
Employees	14	1															
Visitors																	
Total	14	1															
Morrison-Knudsen																	
Employees	50	72	24	13	9	8	27	3									73
Visitors																	
Total	50	72	24	13	9	8	27	3									73
Ormond Const.																	
Employees	1		1														
Visitors																	
Total	1		1														
Waters Asbestos & SU																	
Employees		3	1	1	1												1
Visitors																	
Total		3	1	1	1												1
West Valley Nuclear																	
Employees	60	29	9	19	2												11
Visitors																	
Total	60	29	9	19	2												11
TOTAL IDAHO	33,582	944	308	163	79	50	60		6								360

TABLE B.4
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
NEVADA FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Contractor	< Meas.	Meas.-<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	Total Person-rem
Air Resources Lab.																	
Employees	54																
Visitors	5																
Total	59																
CER Geonuclear																	
Employees	9																
Visitors																	
Total	9																
Defense Nuclear Agency																	
Employees	514	1															
Visitors	3,964	13	3														1
Total	4,478	14	3														1
EG&G, Inc. (Las Vegas, NV)																	
Employees	1,305	39	3		1												3
Visitors	151																
Total	1,456	39	3		1												3
Environmental Protec.																	
Employees	141	3															
Visitors	5																
Total	146	3															
Fenix & Scisson, Inc.																	
Employees	388	16	9	1													3
Visitors	340	3															
Total	728	19	9	1													3

TABLE B.4 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
NEVADA FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Halliburton Services.																	
Employees	21																
Visitors	39																
Total	60																
Holmes & Narver, Inc.																	
Employees	492	6	4														1
Visitors	247																
Total	739	6	4														1
Nevada Misc.																	
Employees	785	5															
Visitors	494																
Total	1,279	5															
Reynolds Electrical																	
Employees	5,920	78	19	7	2												11
Visitors	4,194																
Total	10,114	78	19	7	2												11
U.S. Department of Interior																	
Employees	155	2															
Visitors	3																
Total	158	2															
Wackenhut Services																	
Employees	274	1															
Visitors	15																
Total	289	1															

TABLE B.4 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
NEVADA FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Westinghouse Electric																	
Employees	66	1															
Visitors	49																
Total	115	1															
TOTAL NEVADA	19,630	168	38	8	3												20

TABLE B.5
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
OAK RIDGE FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Goodyear Atomic Corp.																	
Employees	335	217	40	6		1											21
Visitors																	
Total	335	217	40	6		1											21
National Lead Co.																	
Employees		37	54	97	40	19	15										112
Visitors																	
Total		37	54	97	40	19	15										112
Oak Ridge Assoc. Univ.																	
Employees	472	83	1	3													5
Visitors																	
Total	472	83	1	3													5
Puerto Rico Nuclear Ctr.																	
Employees	73	1	2														
Visitors																	
Total	73	1	2														
RMI Company																	
Employees	20	54	32	10	1												13
Visitors																	
Total	20	54	32	10	1												13
Rust Engineering Co.																	
Employees	729	46	33	13	2												14
Visitors																	
Total	729	46	33	13	2												14

TABLE B.5 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
OAK RIDGE FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.- <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	
Union Carbide Corp./ORGDP																	
Employees	295	36	17														5
Visitors																	
Total	295	36	17														5
Union Carbide Corp./Y-12																	
Employees	67	105	104	53	18	5	2	2									67
Visitors																	
Total	67	105	104	53	18	5	2	2									67
Union Carbide Corp./ORNL																	
Employees	15	48	108	91	49	13	28	1									142
Visitors	559	42	10	7	3	1	2										12
Total	574	90	118	98	52	14	30	1									154
Union Carbide Corp./Paducah																	
Employees	15	12	19	1													4
Visitors																	
Total	15	12	19	1													4
Woven Structures, Inc.																	
Employees	8	6	2	5	1	1	1										6
Visitors																	
Total	8	6	2	5	1	1	1										6
TOTAL OAK RIDGE	2,588	687	422	286	114	40	48	3									401

TABLE B.6
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
PITTSBURGH NAVAL REACTOR FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Duquesne Light Co.																	
Employees	2	306	76	22													37
Visitors	20	39															2
Total	22	345	76	22													39
Westinghouse Electric/BAPL																	
Employees	214	810	48	13	10	5	8										76
Visitors	65	46															2
Total	279	856	48	13	10	5	8										79
Westinghouse Electric/NRF																	
Employees	224	470	158	35	9												70
Visitors	35	18	1														1
Total	259	488	159	35	9												71
Westinghouse Plant Appa.																	
Employees	33	46	2	2													3
Visitors																	
Total	33	46	2	2													3
TOTAL PITTSBURGH	593	1,735	285	72	19	5	8										192

TABLE B.7
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
RICHLAND FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas. <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	
Pacific Northwest Laboratory																	
Employees	101	680	173	52	21	6	14	2									128
Visitors	177	76	11														6
Total	278	756	184	52	21	6	14	2									134
BCS Richland Inc.																	
Employees	4	6	1	3													2
Visitors																	
Total	4	6	1	3													2
Hanford Eng. Dev. Lab.																	
Employees	314	705	130	71	15	9	8										114
Visitors	80	30	2	2													3
Total	394	735	132	73	15	9	8										116
Hanford Environ. Health Found.																	
Employees	6	14	1														1
Visitors	1	1															
Total	7	15	1														1
J. A. Jones Const. Co.																	
Employees	387	484	127	75	23	15	43	11									194
Visitors	5	6															
Total	392	490	127	75	23	15	43	11									194
Kaiser Engineers-Hanford																	
Employees	219	64	1	5													5
Visitors	1																
Total	220	64	1	5													5

TABLE B.7 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
RICHLAND FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas. <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	
Rockwell Hanford Oper.																	
Employees	1,053	1,977	562	312	90	42	84	8									553
Visitors	733	372	8	2													21
Total	1,786	2,349	570	314	90	42	84	8									574
United Nuclear Ind. Inc.																	
Employees	171	492	250	222	133	114	238	212	3								1,232
Visitors	203	67	6	1	2												6
Total	374	559	256	223	135	114	238	212	3								1,238
TOTAL RICHLAND	3,455	4,974	1,272	745	284	186	387	233	3								2,264

TABLE B.8
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SAN FRANCISCO FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Rockwell International Energy Systems Group																	
Employees	318	349	29	8	4	4	16	4	7	8							126
Visitors	237	172	3														9
Total	555	521	32	8	4	4	16	4	7	8							135
Stanford Linear Accel. Ctr.																	
Employees	136	42	7	2	2												5
Visitors																	
Total	136	42	7	2	2												5
University of California/LBL																	
Employees	1,204	528	27	8	2												35
Visitors																	
Total	1,204	528	27	8	2												35
University of California/LLNL																	
Employees	7,578	801	54	30	10	7	8	1									88
Visitors	9,290	225	2	5		1											14
Total	16,868	1,026	56	35	10	8	8	1									102
University of California/LEHR																	
Employees	80	8	1														1
Visitors																	
Total	80	8	1														1

TABLE B.8 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SAN FRANCISCO FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
University of California/LNM																	
Employees	78	4	2	3	1	2	2										7
Visitors																	
Total	78	4	2	3	1	2	2										7
University of California/MC																	
Employees	23																
Visitors																	
Total	23																
University of California/NTS																	
Employees	95	7	3		2	1											3
Visitors	1,069	4	2														1
Total	1,164	11	5		2	1											4
TOTAL SAN FRANCISCO	20,108	2,140	130	56	21	15	26	5	7	8							289

TABLE B.9
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SAVANNAH RIVER FIELD ORGANIZATION
1982

Contractor	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
E. I. Du Pont/SRP-Opns. Energy Systems Group																	
Employees	2,627	2,791	699	584	269	156	170	11									1,068
Visitors	3,184	361	4														19
Total	5,811	3,152	703	584	269	156	170	11									1,087
E. I. Du Pont/SRP-Const.																	
Employees	1,251	1,198	282	144	45	14	11										220
Visitors																	
Total	1,251	1,198	282	144	45	14	11										220
Savannah River Ecol Lab																	
Employees	43	16															1
Visitors																	
Total	43	16															1
Southern Bell Tel.																	
Employees	36	3															
Visitors																	
Total	36	3															
U. S. Forest Service																	
Employees	22	2															
Visitors																	
Total	22	2															
TOTAL SAVANNAH RIVER	7,163	4,371	985	728	314	170	181	11									1,308

TABLE B.10
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SCHENECTADY NAVAL REACTOR FIELD ORGANIZATION
1982

Dose-Equivalent Ranges (rem)

Contractor	< Meas.	Meas.-<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	Total Person-rem
General Electric Company																	
Employees	650	1,519	111	46	5	8	12										141
Visitors	262	97	1														5
Total	912	1,616	112	46	5	8	12										146
General Electric/MAO																	
Employees	20	11															1
Visitors																	
Total	20	11															1
TOTAL SCHENECTADY	932	1,627	112	46	5	8	12										146

TABLE B.11
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
MORGANTOWN ENERGY TECH. CENTER
1982

Dose-Equivalent Ranges (rem)

Contractor	< Meas.	Meas.-<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	Total Person-rem
EG&G WASC, Inc.																	
Employees	1																
Visitors																	
Total	1																
TOTAL MORGANTOWN	1																

APPENDIX C

DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES FOR DOE GOVERNMENT EMPLOYEES AND VISITORS BY FIELD ORGANIZATION, 1982

TABLE C.1
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES FOR DOE GOVERNMENT EMPLOYEES AND VISITORS BY DOE FIELD ORGANIZATION
1982

Organization	Dose-Equivalent Ranges (rem)																Total Person-rem
	< Meas.	Meas.-<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	
Albuquerque Operations	324	41															2
Amarillo Area Office	32	4	1														
Dayton Area Office	7	16															1
Kansas City Area Office	22																
Los Alamos Area Office	90	39	7	1													4
Pinellas Area Office	7	8															
Rocky Flats Area Office		52	4	2													4
Sandia Area Office	4																
TOTAL	486	160	12	3													11
Chicago Operations	20	4															
Environmental Meas. Lab.	34	1															
New Brunswick Lab.	68	10	3	1	1												2
TOTAL	122	15	3	1	1												2
Idaho Operations	136	62	1														3
West Valley Nuclear	2																
TOTAL	138	62	1														3
Morgantown Energy TE	4																
TOTAL	4																

*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-421-076/525

TABLE C.1 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES FOR DOE GOVERNMENT EMPLOYEES AND VISITORS BY DOE FIELD ORGANIZATION
1982

Organization	Dose-Equivalent Ranges (rem)																
	< Meas.	Meas.- <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	Total Person-rem
Nevada Operations	7,277	70	11	1	2	1											8
TOTAL	7,277	70	11	1	2	1											8
Oak Ridge Operations[a]																	
Pittsburgh Naval Reactors	11	30	3	1													2
TOTAL	11	30	3	1													2
Richland Operations	288	111	8	1													7
TOTAL	288	111	8	1													7
San Francisco Operations[a]																	
Savannah River Operations	202	40	1														2
TOTAL	202	40	1														2
Schenectady Naval Reactor	12	11															1
West Milton Field Office		1	1														
TOTAL	12	12	1														1

(a) Data not reported in this manner.