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Sixteenth Annual Report

Radiation Exposures For DOE and DOE Contractor Employees - 1983

October 1984

Prepared for:

U.S. Department of Energy

Assistant Secretary for
Environmental Protection, Safety,
and Emergency Preparedness
Office of Nuclear Safety
Washington, D.C. 20545

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Pacific Northwest Laboratory
Richland, Washington 99352

SIXTEENTH ANNUAL REPORT
RADIATION EXPOSURES FOR DOE AND DOE CONTRACTOR EMPLOYEES
1983

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, 1981, and 1982 were presented in DOE/EV-0066/10, 11, 12, 13, and 14 and DOE/EP-0040/2 respectively. A revised version of the 1979 report was issued. This report contains 1983 radiation exposure data for DOE and DOE contractor employees and visitors.

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.

SUMMARY

All Department of Energy (DOE) and DOE contractor facilities 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 1983.

A total of 88,283 DOE and DOE contractor employees were monitored for whole-body ionizing radiation exposures in 1983. This represents 56.6 percent of all DOE and DOE contractor employees and is an increase from the number of individuals monitored in 1982. In addition to the employees, 84,851 visitors were monitored.

Of all employees monitored, 56.5 percent received a dose equivalent that was less than measurable, 41.6 percent a measurable exposure less than 1 rem, and 1.9 percent an exposure greater than 1 rem. The exposure received by 94.6 percent of the visitors to DOE facilities was less than measurable. Only 5.4 percent of the visitors received a measurable exposure less than 1 rem, and <0.01 percent 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 7,858 person-rem. The collective dose equivalent for visitors was 300 person-rem. The total dose equivalent for employees and visitors combined was 8,158 person-rem. The average dose equivalent for all individuals (employees and visitors) monitored was 47 mrem and the average dose equivalent for all individuals who received a measurable exposure was 190 mrem. The highest average dose equivalent for all monitored employees was observed at fuel fabrication facilities (235 mrem) and the lowest among visitors (4 mrem) to DOE facilities. These averages are significantly less than the DOE 5-rem/year radiation protection standard for whole-body exposures.

Five cases of internal depositions were reported in 1983. 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 7,449 monitored employees terminated their employment in 1983. The average cumulative dose equivalent for terminated employees who worked one to two years was 0.33 rem; two to four years, 0.30 rem; four to six years, 0.41 rem; and longer than six years, 3.70 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,[c] red bone marrow, active blood-forming organs.	Year	5[b]
	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) In special cases with the approval of the Director, Division of Operational and Environmental Safety, a worker may exceed 5 rem/year provided his/her average exposure per year since age 18 will not exceed 5 rem/year.

(c) 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).

(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 1983 by DOE and DOE contractor facilities. 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, 1983"; Appendix B, "Distribution of Annual Whole-Body Exposures by Contractor for Each DOE Field Organization, 1983"; and Appendix C, "Distribution of Annual Whole-Body Exposures for DOE Government Employees and Visitors by DOE Field Organization, 1983."

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 percent 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 and DOE contractor facility. 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 numerical 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 88,283 DOE and DOE contractor employees were monitored for whole-body ionizing radiation exposure in 1983. This represents 56.6 percent of all DOE and DOE contractor employees. In addition to the employees, 84,851 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, 1983

Dose-Equivalent Interval (rem)	Number of Persons			Collective Person-rem		
	Employees	Visitors	Total	Employees	Visitors	Total
<Measurable	49,871	80,285	130,156	0	0	0
Measurable to 0.10	26,528	4,244	30,772	1,327	212	1,539
0.10 to 0.25	4,903	238	5,141	858	42	900
0.25 to 0.50	3,218	51	3,269	1,207	19	1,226
0.50 to 0.75	1,353	22	1,375	845	14	859
0.75 to 1.00	766	7	773	670	6	676
1 to 2	1,270	3	1,273	1,905	5	1,910
2 to 3	294	1	295	736	2	738
3 to 4	49	0	49	171	0	171
4 to 5	31	0	31	139	0	139
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	88,283	84,851	173,134	7,858	300	8,158

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 1983 increased slightly from the number reported in previous years (Figure 1).

Of the employees monitored in 1983, 56.5 percent received a dose equivalent that was less than measurable, 41.6 percent a measurable exposure less than 1 rem, and 1.9 percent an exposure greater than 1 rem (Figure 2). The exposure received by 94.6 percent of the visitors to DOE facilities was less than measurable. Only 5.4 percent of the visitors received an exposure between measurable and 1 rem, and <0.01 percent of the visitors received an exposure greater than 1 rem (Figure 2).

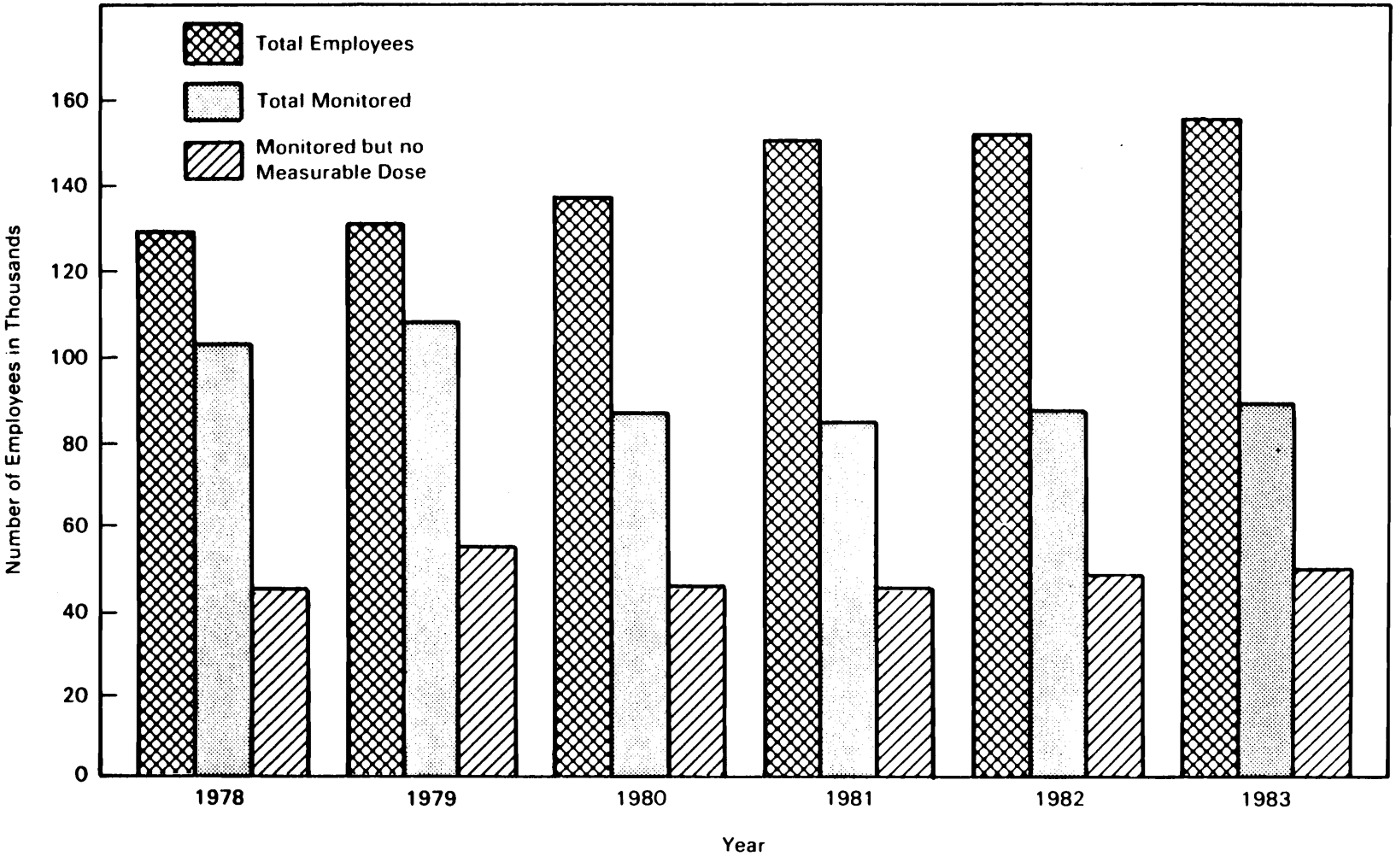

FIGURE 1. Comparison of Number of Employees, Number of Employees Monitored, and Number of Employees Monitored Who Received No Measurable Dose Equivalent

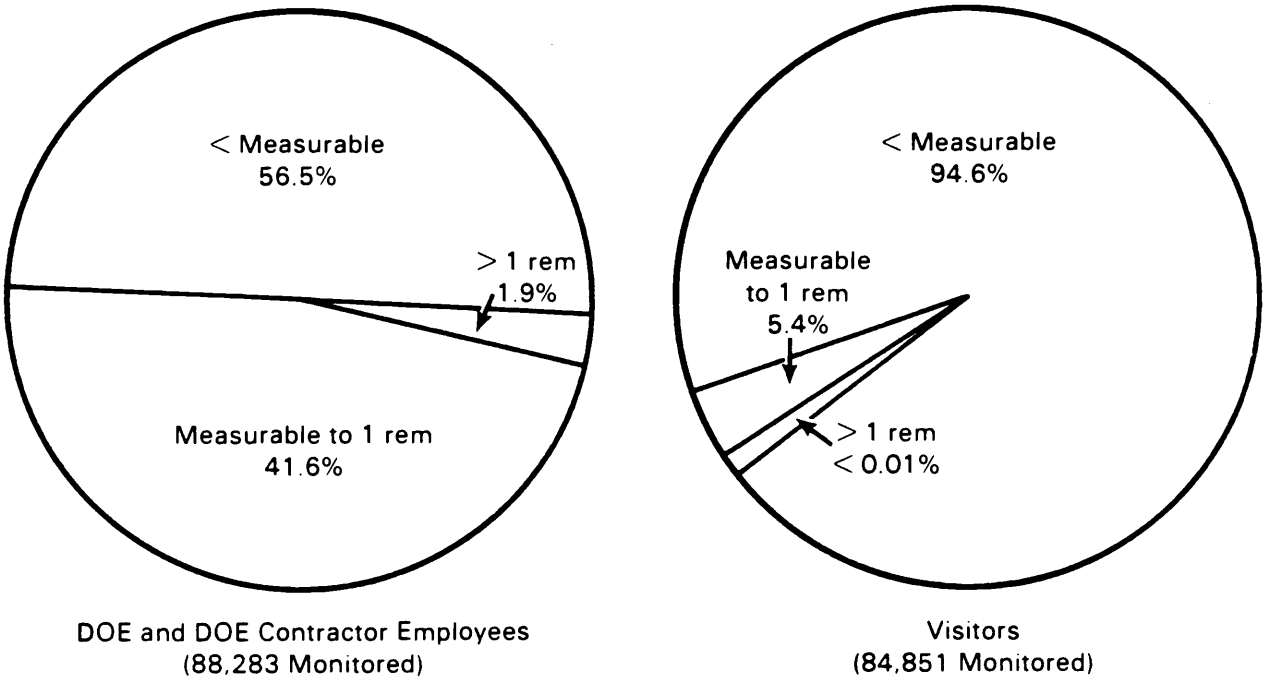

FIGURE 2. Percentage of Monitored Employees and Percentage of Monitored Visitors Who Received an Exposure Less Than Measurable, Measurable to 1 rem, or Greater Than 1 rem, 1983

The collective dose equivalent was 7,858 person-rem for all DOE and DOE contractor employees, and 300 person-rem for visitors to DOE facilities, for a total collective dose equivalent of 8,158 person-rem. The contribution of the individuals in each dose-equivalent interval to the collective dose equivalent is shown in Figure 3. Individuals whose exposure was less than 1 rem contributed the greatest portion of the total person-rem.

The distribution of whole-body exposures for the years 1965-1983 is presented in Table 3. As can be seen 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 seen in Figure 4, which shows the collective dose equivalent for all individuals from 1965 to 1983 who received an exposure greater than 1 rem. 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. This decrease in the collective dose equivalent has been achieved even though some work was performed in older facilities that 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.

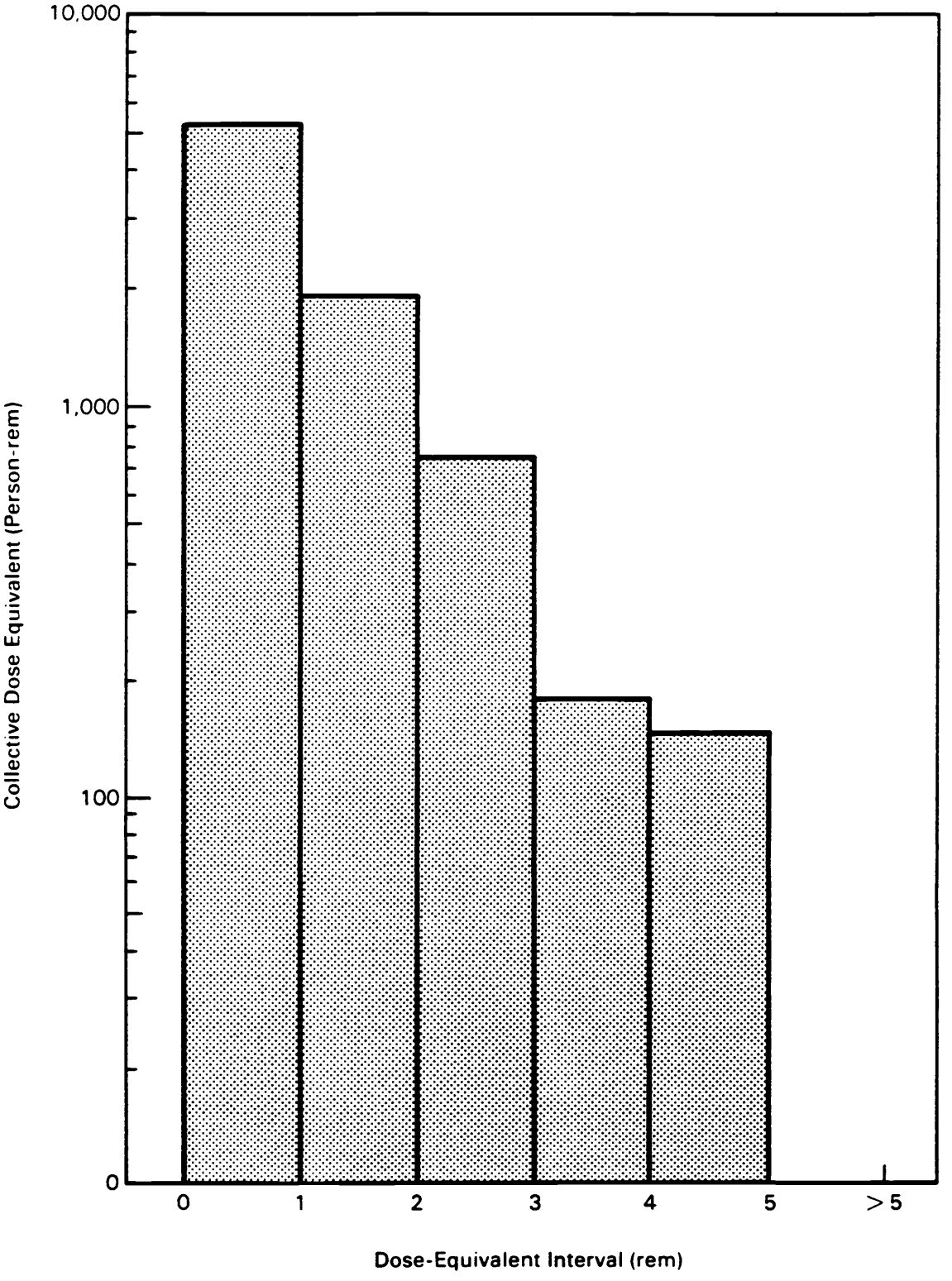

FIGURE 3. Contribution of Each Dose-Equivalent Interval to the Total Collective Dose Equivalent, 1983

TABLE 3. Distribution of Whole-Body Ionizing Radiation Exposures for DOE/DOE Contractor Employees, 1965-1983

	Number of Employees Receiving Exposures in Each Dose-Equivalent Range (rem)														
Year	0-1[a] <Meas.	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	Total Employees Monitored
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	45,224	36,561	967	263	29	5									83,049
1982	48,968	34,949	1,010	313	56	28									85,324
1983	49,871	36,768	1,270	294	49	31									88,283

(a)Separation of data prior to 1974 is unavailable.
(b)The 1979 data differ slightly from those listed in the original 1979 report because of an error in the dose-equivalent calculation by a contractor.

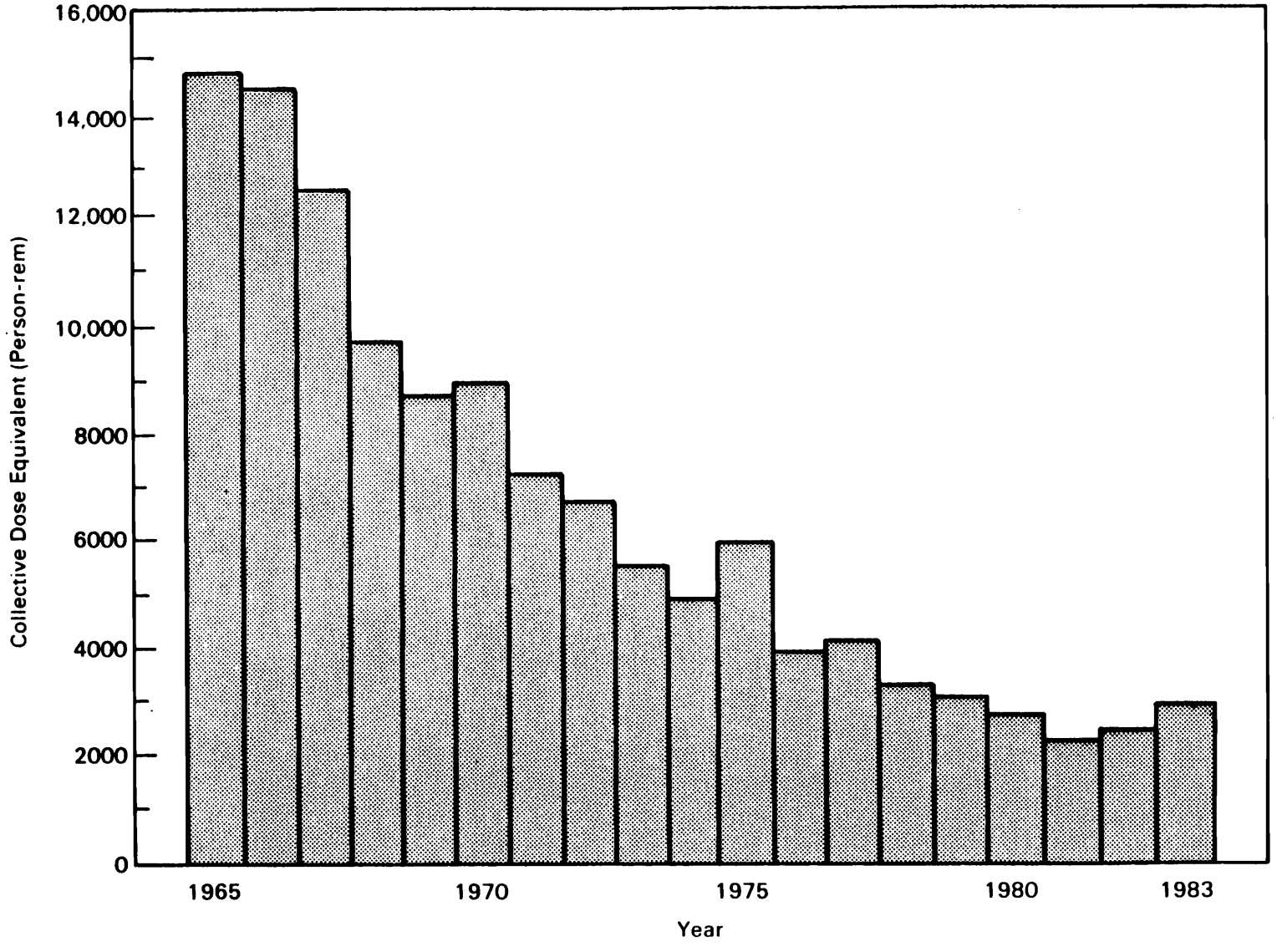

FIGURE 4. Total Collective Dose Equivalent for All DOE/DOE Contractor Employees Who Received an Exposure Greater Than 1 rem, 1965-1983

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 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 "Reactor." "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 47 mrem. The highest average dose equivalent per individual monitored was observed at fuel fabrication facilities (235 mrem) and the lowest was observed for visitors to DOE facilities (4 mrem). The average dose equivalent per individual monitored with a measurable exposure was 190 mrem. The highest average dose equivalent for individuals monitored with a measurable exposure was observed at fuel fabrication facilities (321 mrem) and the lowest was observed for visitors (66 mrem).

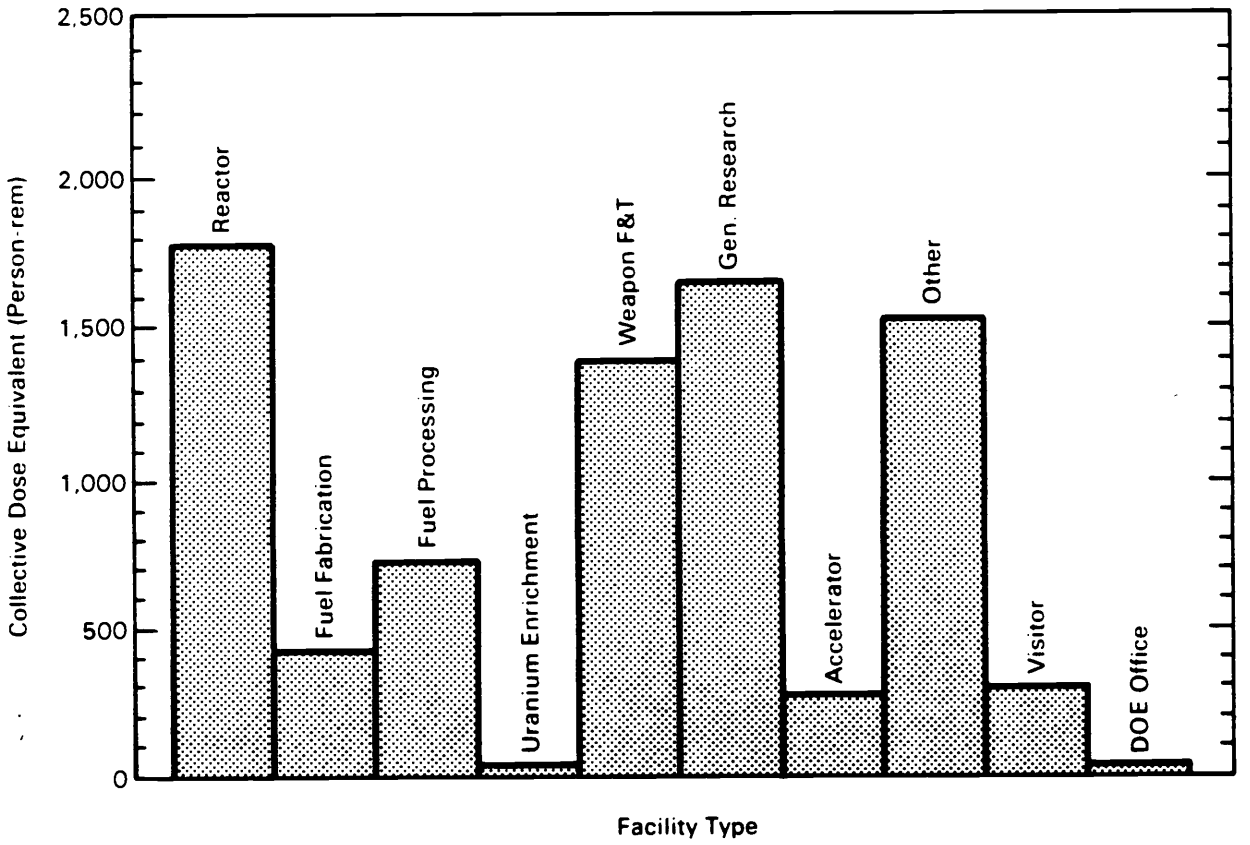

FIGURE 5. Contribution of Each Facility Type to the Total Collective Dose Equivalent, 1983

TABLE 4. Distribution of Annual Whole-Body Exposures for DOE/DOE Contractor Employees and Visitors by Facility Type, 1983

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	8,386	2,689	2,998	1,022	752	299	158	327	139	2										1,781
Fuel Fab.	1,850	499	596	277	270	102	51	27	9	2	17									434
Fuel Proc.	3,727	1,286	1,196	393	370	224	109	149												726
Uran. Enrich.	1,155	766	317	61	10	1														31
Weapon F&T	20,497	11,091	7,361	937	473	213	135	279	8											1,399
Gen. Research	31,041	21,207	7,713	928	513	206	129	239	61	34	11									1,662
Accelerator	3,366	2,117	817	175	122	51	29	42	10	3										273
Other	15,926	8,407	5,027	1,091	704	257	155	207	67	8	3									1,522
Visitors	84,851	80,285	4,244	238	51	22	7	3	1											300
DOE Offices	2,335	1,809	503	19	4															30
TOTAL PERSONS	173,134	130,156	30,772	5,141	3,269	1,375	773	1,273	295	49	31									
TOTAL PERSON-REM		0	1,539	900	1,226	859	676	1,910	737	172	139									8,158

TABLE 5. Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors by Facility Type, 1983

Facility Type	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 Exposure
Reactor	8,386	5,697	1,781	212	313
Fuel Fab.	1,850	1,351	434	235	321
Fuel Proc.	3,727	2,441	726	195	297
Uran. Enrich.	1,155	389	31	27	80
Weapon F&T	20,497	9,406	1,399	68	149
Gen. Research	31,041	9,834	1,662	54	169
Accelerator	3,366	1,249	273	81	219
Other	15,926	7,519	1,522	96	202
Visitors	84,851	4,566	300	4	66
DOE Offices	2,335	526	30	13	57
TOTAL	173,134	42,978	8,158	47	190

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 1983 for each field organization are in Table 8.

TABLE 6. Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors by Field Organization, 1983

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 Exposure
Albuquerque	30,002	15,968	2,332	78	146
Chicago	16,528	3,854	623	38	162
Energy Tech. Centers	13	1	0	0	0
Idaho	35,074	1,685	353	10	209
Nevada	27,684	237	25	1	105
Oak Ridge	3,969	1,578	371	93	235
Pittsburgh Naval Reactor	2,918	2,250	220	75	98
Richland	12,422	6,720	2,458	198	366
San Francisco	22,879	1,734	267	12	154
Savannah River	19,061	7,230	1,293	68	179
Schenectady Naval Reactor	2,584	1,721	217	84	126
TOTAL	173,134	42,978	8,159	47	190

TABLE 7. Fraction of Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors Attributed to a Facility Type Within Each Field Organization, 1983

Field Organization	Facility Type									
	Reactor	Fuel Fab.	Fuel Proc.	Uran. Enrich.	Weapon F&T	Gen. Research	Acceler.	Other	Visitor	DOE Office
Albuquerque					0.57	0.34		<0.01	0.08	0.01
Chicago	0.10					0.26	0.43	0.11	0.10	
Energy Tech. Centers						0.00				
Idaho	0.35		0.48					0.15	0.00	0.01
Nevada					0.68			0.04	0.28	<0.01
Oak Ridge		0.27		0.08	0.12	0.45		0.05	0.03	
Pittsburgh Naval Reactor	0.38					0.59		<0.01	0.02	0.01
Richland	0.46	0.03				0.08		0.42	0.01	<0.01
San Francisco		0.55			0.01	0.37	0.03		0.04	<0.01
Savannah River	0.15	0.08	0.43		0.01	0.06		0.27	<0.01	<0.01
Schenectady Naval Reactor	0.85					0.14		<0.01	0.01	<0.01
ALL FIELD ORGANIZATIONS COMBINED	0.22	0.05	0.09	<0.01	0.17	0.20	0.03	0.19	0.04	<0.01

TABLE 8. Collective Dose Equivalent for DOE/DOE Contractor Employees and Visitors by Field Organization, 1977-1983[a]

Field Organization	1977	1978	1979[b]	1980	1981	1982	1983
Albuquerque	2,300	2,399	1,873	1,700	2,024	2,285	2,332
Chicago	1,373	1,167	1,061	918	758	587	623
Idaho	929	899	876	593	302	363	353
Nevada	49	47	55	50	36	29	25
Oak Ridge	1,300	1,566	1,332	604	437	401	371
Pittsburgh Naval Reactor	653	252	196	186	185	194	220
Richland	3,197	2,596	2,571	2,256	2,093	2,272	2,458
San Francisco	334	307	264	240	171	289	267
Savannah River	1,298	1,289	1,343	1,391	1,401	1,310	1,293
Schenectady Naval Reactor	148	111	114	79	76	147	217
TOTAL	11,581	10,635	9,693	8,024	7,483	7,879	8,158

(a)Throughout this report, minor variations in collective dose-equivalent values may occur due to computer rounding.
(b)The 1979 data differ slightly from those listed in the 1979 report because of an error in the dose-equivalent calculation by a contractor.

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 percent 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 1983, five are considered new and are included in Table 9. The five 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 two other cases, the reported burden was not in excess of 50 percent of the pertinent annual dose-equivalent standard.

TABLE 9. Dose Distributions for Cases of Internal Body Depositions, 1979-1983

Year	Radionuclide	Critical Organ	Dose-Equivalent Interval (rem) 7.5-10	10-15	15-25	25-50	50-100	100-200
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					
1983	^{239}Pu, ^{240}Pu, ^{241}Am	Bone			1			
	^{234}U, ^{235}U	Lung	4					

(a) These previously unreported individuals exceeded 50 percent 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 percent 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 7,449 monitored workers terminated their employment with DOE or DOE contractors in 1983. 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 1983 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 3.70 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 1983

Length of Employment	Number of Terminated Employees	Total Cumulative Dose Equivalent (Person-rem)	Average Cumulative Dose Equivalent Per Terminated Employee (rem)
1-90 days	2,035	978.63	0.48
90-180 days	1,063	489.23	0.46
180-365 days	685	400.31	0.58
1-2 years	708	233.95	0.33
2-4 years	844	256.31	0.30
4-6 years	462	187.30	0.41
>6 years	1,652	6,112.75	3.70

APPENDIX A

DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE FOR EACH DOE FIELD ORGANIZATION, 1983

TABLE A.1
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
ALBUQUERQUE FIELD ORGANIZATION
1983

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	10,135	1,268	7,054	780	410	202	134	279	8									1,325
Gen. Research	10,418	6,929	2,668	326	163	65	51	127	46	32	11							804
Accelerator																		
Other	139	106	24	8	1													3
Visitors	8,590	5,331	3,172	74	8	1	1	3										181
DOE Offices	720	400	305	11	4													19
TOTAL	30,002	14,034	13,223	1,199	586	268	186	409	54	32	11							2,332
TOTAL PERSON-REM			661	210	220	168	163	614	135	112	49							2,332

TABLE A.2
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
CHICAGO FIELD ORGANIZATION
1983

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	449	197	120	62	38	21	2	8		1								61
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	4,661	3,026	1,404	121	64	21	10	11	4									164
Accelerator	3,167	1,960	788	169	119	50	28	40	10	3								265
Other	609	461	102	11	12	4	3	2	4	7	3							68
Visitors	7,618	7,008	460	108	24	15	2		1									65
DOE Offices	24	22	2															
TOTAL	16,528	12,674	2,876	471	257	111	45	61	19	11	3							623
TOTAL PERSON-REM			144	82	96	69	39	92	48	39	14							623

TABLE A.3
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
ENERGY TECHNOLOGY CENTERS
1983

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																		
Gen. Research	13	12	0	1														
Accelerator																		
Other																		
Visitors																		
DOE Offices																		
TOTAL	13	12	0	1														
TOTAL PERSON-REM		0	0	0														

TABLE A.4
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
IDAHO FIELD ORGANIZATION
1983

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	2,084	1,420	394	127	77	39	17	10										125
Fuel Fabrication																		
Fuel Processing	1,679	948	354	159	125	53	23	17										171
Uran. Enrichment																		
Weapon F&T																		
Gen. Research																		
Accelerator																		
Other	533	299	143	23	28	19	18	3										54
Visitors	30,609	30,609																
DOE Offices	169	113	54	2														3
TOTAL	35,074	33,389	945	311	230	111	58	30										353
TOTAL PERSON-REM			47	55	86	69	51	45										353

TABLE A.5
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
NEVADA FIELD ORGANIZATION
1983

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	9,752	9,595	110	33	12	2												17
Gen. Research																		
Accelerator																		
Other	910	904	4	2														1
Visitors	16,168	16,096	55	11	6													7
DOE Offices	854	852	2															
TOTAL	27,684	27,447	171	46	18	2												25
TOTAL PERSON-REM			9	8	7	1												25

TABLE A.6
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
OAK RIDGE FIELD ORGANIZATION
1983

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	429	38	93	123	146	26	2	1										100
Fuel Processing																		
Uran. Enrichment	1,155	766	317	61	10	1												31
Weapon F&T	359	87	116	108	38	9	1											45
Gen. Research	524	161	114	40	87	58	25	35	4									166
Accelerator																		
Other	964	860	51	35	15	1	2											17
Visitors	538	479	30	15	8	3	3											12
DOE Offices																		
TOTAL	3,969	2,391	721	382	304	98	33	36	4									371
TOTAL PERSON-REM			36	67	114	61	29	54	10									371

TABLE A.7
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
PITTSBURGH NAVAL REACTOR FIELD ORGANIZATION
1983

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	891	93	603	103	89	3												83
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	1,487	197	1,035	168	61	9	10	7										129
Accelerator																		
Other	140	117	23															1
Visitors	347	250	97															5
DOE Offices	53	11	40	2														2
TOTAL	2,918	668	1,798	273	150	12	10	7										220
TOTAL PERSON-REM			90	48	56	7	9	10										220

TABLE A.8
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
RICHLAND FIELD ORGANIZATION
1983

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	2,324	547	501	332	274	138	121	271	139	1								1,136
Fuel Fabrication	258	32	66	57	45	31	17	9	1									80
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	1,408	607	513	110	75	32	20	43	6	2								197
Accelerator																		
Other	6,250	2,568	2,195	508	409	191	121	195	62	1								1,028
Visitors	2,058	1,868	176	9	1	3	1											14
DOE Offices	124	80	41	3														3
TOTAL	12,422	5,702	3,492	1,019	804	395	280	518	208	4								2,458
TOTAL PERSON-REM			175	178	302	247	245	777	520	14								2,458

TABLE A.9
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
SAN FRANCISCO FIELD ORGANIZATION
1983

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	619	308	249	8	5	4	5	13	8	2	17							146
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T	118	105	6	3	4													2
Gen. Research	10,235	9,052	1,051	82	26	13	4	6	1									100
Accelerator	199	157	29	6	3	1	1	2										8
Other																		
Visitors	11,640	11,458	169	11	2													11
DOE Offices	68	65	3															
TOTAL	22,879	21,145	1,507	110	40	18	10	21	9	2	17							267
TOTAL PERSON-REM			75	19	15	11	9	32	23	7	76							267

TABLE A.10
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
SAVANNAH RIVER FIELD ORGANIZATION
1983

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	1,411	320	573	266	179	65	8											190
Fuel Fabrication	544	121	188	89	74	41	27	4										108
Fuel Processing	2,048	338	842	234	245	171	86	132										555
Uran. Enrichment																		
Weapon F&T	133	36	75	13	9													9
Gen. Research	1,273	715	424	70	37	8	9	10										75
Accelerator																		
Other	6,342	3,071	2,468	503	239	42	11	7	1									350
Visitors	7,014	6,975	27	10	2													4
DOE Offices	296	255	41															2
TOTAL	19,061	11,831	4,638	1,185	785	327	141	153	1									1,293
TOTAL PERSON-REM			232	207	294	204	123	230	3									1,293

TABLE A.11
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY FACILITY TYPE
SCHENECTADY NAVAL REACTOR FIELD ORGANIZATION
1983

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	1,227	112	807	132	95	33	10	38										185
Fuel Fabrication																		
Fuel Processing																		
Uran. Enrichment																		
Weapon F&T																		
Gen. Research	1,022	508	504	10														27
Accelerator																		
Other	39	21	17	1														1
Visitors	269	211	58															3
DOE Offices	27	11	15	1														1
TOTAL	2,584	863	1,401	144	95	33	10	38										217
TOTAL PERSON-REM			70	25	36	20	9	57										217

APPENDIX B

DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR FOR EACH DOE FIELD ORGANIZATION, 1983

TABLE B.1
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ALBUQUERQUE FIELD ORGANIZATION
1983

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	
Albuquerque Misc.																	
Employees	94	1,142	31	3													64
Visitors																	
Total	94	1,142	31	3													64
General Electric Co.																	
Employees	242	113	5	6													9
Visitors	16	2															
Total	258	115	5	6													9
Inhalation Toxicology																	
Employees	277	39	5	3	1												5
Visitors	348	6															
Total	625	45	5	3	1												5
Jacobs Engineering G																	
Employees	22	2															
Visitors																	
Total	22	2															
Jacobs Engr. Subcontractors																	
Employees	5																
Visitors																	
Total	5																
Mason & Hanger-Silas (Amarillo, TX)																	
Employees	635	152	85	39	22	6	28	5									111
Visitors	1,213	120	1														6
Total	1,848	272	86	39	22	6	28	5									117

TABLE B.1 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ALBUQUERQUE FIELD ORGANIZATION
1983

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	
Mason & Hanger-Silas (Los Alamos, NM)																	
Employees	208	63	1														3
Visitors																	
Total	208	63	1														3
Monsanto Research Co.																	
Employees	88	1,468	110	16	3	3											103
Visitors	842	232															12
Total	930	1,700	110	16	3	3											115
Morrison-Knudsen Co.																	
Employees	7	6															
Visitors																	
Total	7	6															
Morrison-Knudsen Subcontractors																	
Employees	13	2															
Visitors																	
Total	13	2															
Rockwell International																	
Employees		4,173	548	345	177	125	251	3									1,038
Visitors		1,973															99
Total		6,146	548	345	177	125	251	3									1,137
Ross Aviation, Inc.																	
Employees	51	12	2														1
Visitors																	
Total	51	12	2														1

TABLE B.1 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ALBUQUERQUE FIELD ORGANIZATION
1983

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	
Sandia Laboratories (Albuquerque, NM)																	
Employees	2,090	495	66	16	4	4	2	6	1	1							74
Visitors	1,714	496	34	4	1		1										34
Total	3,804	991	100	20	5	4	3	6	1	1							108
Sandia Laboratories (Livermore, CA)																	
Employees	914	58	3		1												4
Visitors	163																
Total	1,077	58	3		1												4
Teledyne Isotopes																	
Employees	8	2	6	1													2
Visitors																	
Total	8	2	6	1													2
The Bendix Corp.																	
Employees	209	6	1	1													1
Visitors																	
Total	209	6	1	1													1
The Zia Company																	
Employees	908	477	29	22	5	4	2										47
Visitors																	
Total	908	477	29	22	5	4	2										47

TABLE B.1 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ALBUQUERQUE FIELD ORGANIZATION
1983

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																	
Employees	2,532	1,536	222	122	54	43	123	40	31	10							671
Visitors	1,035	343	39	4		1	2										29
Total	3,567	1,879	261	126	54	44	125	40	31	10							700
TOTAL ALBUQUERQUE	13,634	12,918	1,188	582	268	186	409	54	32	11							2,313

TABLE B.2
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
CHICAGO FIELD ORGANIZATION
1983

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	3	41															2
Visitors																	
Total	3	41															2
Argonne National Lab.																	
Employees	1,876	317	123	75	26	8	8	4									111
Visitors	3,158	43		1													3
Total	5,034	360	123	76	26	8	8	4									114
Brookhaven National Lab.																	
Employees	879	518	116	88	47	24	47	10	4								239
Visitors	159	180	43	9	10	2		1									30
Total	1,038	698	159	97	57	26	47	11	4								269
Chicago Misc.																	
Employees	352	184	29	10	6	4	2	4	7	3							76
Visitors	270	16	3														1
Total	622	200	32	10	6	4	2	4	7	3							77
Fermi National Lab.																	
Employees	1,405	392	59	39	15	6	4										65
Visitors	1,894	211	62	14	5												30
Total	3,299	603	121	53	20	6	4										95
Massachusetts Inst. of Tech.																	
Employees	242	108	15	13	2	1											15
Visitors	1,509	8															
Total	1,751	116	15	13	2	1											15

TABLE B.2 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
CHICAGO FIELD ORGANIZATION
1983

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	813	846	18	6													48
Visitors																	
Total	813	846	18	6													48
TOTAL CHICAGO	12,560	2,864	468	255	111	45	61	19	11	3							620

TABLE B.3
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
ENERGY TECHNOLOGY CENTERS
1983

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	
EG&G WASC, Inc.																	
Employees	5		1														
Visitors																	
Total	5		1														
TOTAL ENERGY TECHNOLOGY CENTERS	5		1														

TABLE B.4
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
IDAHO FIELD ORGANIZATION
1983

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	
American Protective Service																	
Employees	50	74															4
Visitors																	
Total	50	74															4
Bendix Field Eng.																	
Employees	98	10	2		1												1
Visitors																	
Total	98	10	2		1												1
Biggers Const.																	
Employees	1	6			1												1
Visitors																	
Total	1	6			1												1
Bingham Mechanical																	
Employees	2	6	5	5	1												4
Visitors																	
Total	2	6	5	5	1												4
CL Electric Company																	
Employees		1															
Visitors																	
Total		1															
EG & G Idaho, Inc.																	
Employees	1,252	320	122	73	35	15	9										113
Visitors	20,779																
Total	22,031	320	122	73	35	15	9										113

TABLE B.4 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
IDAHO FIELD ORGANIZATION
1983

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	
Exxon Nuclear Co.																	
Employees	834	212	109	94	41	18	8										118
Visitors	9,830																
Total	10,664	212	109	94	41	18	8										118
Idaho Miscellaneous																	
Employees	215	123	26	11	6	2	1										22
Visitors																	
Total	215	123	26	11	6	2	1										22
Lehigh Design Co., Inc																	
Employees	7	2															
Visitors																	
Total	7	2															
Morrison-Knudsen																	
Employees	55	68	19	12	6	1	5										23
Visitors																	
Total	55	68	19	12	6	1	5										23
Ormond Construction																	
Employees	2	8	4	5	2	3	4										13
Visitors																	
Total	2	8	4	5	2	3	4										13
Waters Asbestos																	
Employees		2	1	2		1											2
Visitors																	
Total		2	1	2		1											2

TABLE B.4 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
IDAHO FIELD ORGANIZATION
1983

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	
West Valley Nuclear																	
Employees	151	59	21	28	18	18	3										49
Visitors																	
Total	151	59	21	28	18	18	3										49
TOTAL IDAHO	33,276	891	309	230	111	58	30										350

TABLE B.5
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
NEVADA FIELD ORGANIZATION
1983

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	
Air Resources Lab.																	
Employees	55																
Visitors	4																
Total	59																
CER Geonuclear																	
Employees	3																
Visitors																	
Total	3																
Defense Nuclear Agency																	
Employees	973	4	2														1
Visitors	3,996	9	1														1
Total	4,969	13	3														2
EG&G, Inc.																	
Employees	1,368	11	1	1	1												2
Visitors	164	4	1														
Total	1,532	15	2	1	1												2
Environmental Protec.																	
Employees	106	2		1													
Visitors																	
Total	106	2		1													
Fenix & Scisson, Inc.																	
Employees	260	20	6	1													2
Visitors	134																
Total	394	20	6	1													2

TABLE B.5 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
NEVADA FIELD ORGANIZATION
1983

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
Halliburton Services.																	
Employees	70																
Visitors	270																
Total	340																
Holmes & Narver, Inc.																	
Employees	569	4	1														
Visitors	232																
Total	801	4	1														
Nevada Misc.																	
Employees	549	1															
Visitors	365																
Total	914	1															
Reynolds Electrical																	
Employees	6,041	65	22	9	1												11
Visitors	4,318																
Total	10,359	65	22	9	1												11
U.S. Department of Interior																	
Employees	180	1															
Visitors	8																
Total	188	1															
Wackenhut Services																	
Employees	267	5	3														1
Visitors	55																
Total	322	5	3														1

TABLE B.5 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
NEVADA FIELD ORGANIZATION
1983

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	58	1															
Visitors	51																
Total	109	1															
TOTAL NEVADA	20,096	127	37	12	2												18

TABLE B.6
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
OAK RIDGE FIELD ORGANIZATION
1983

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
Goodyear Atomic Corp.																	
Employees	280	256	33	3	1												20
Visitors																	
Total	280	256	33	3	1												20
National Lead of Ohio																	
Employees	5	54	91	131	26	2	1										87
Visitors																	
Total	5	54	91	131	26	2	1										87
Oak Ridge Assoc. Univ.																	
Employees	107	83	3	1	3	1											8
Visitors																	
Total	107	83	3	1	3	1											8
Puerto Rico Nuclear Ctr.																	
Employees	64	3															
Visitors																	
Total	64	3															
RMI Company																	
Employees	32	39	32	15													13
Visitors																	
Total	32	39	32	15													13
Rust Engineering Co.																	
Employees	808	35	34	10													11
Visitors																	
Total	808	35	34	10													11

TABLE B.6 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
OAK RIDGE FIELD ORGANIZATION
1983

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/ORGDP																	
Employees	470	54	12	1													5
Visitors																	
Total	470	54	12	1													5
Union Carbide/Y-12																	
Employees	94	116	110	38	9	1											46
Visitors																	
Total	94	116	110	38	9	1											46
Union Carbide/ORNL																	
Employees	29	31	35	86	55	24	35	4									158
Visitors	479	30	15	8	3	3											12
Total	508	61	50	94	58	27	35	4									170
Union Carbide/Paducah																	
Employees	16	7	16	6													5
Visitors																	
Total	16	7	16	6													5
Woven Structures, Inc.																	
Employees	6	13	1	5	1	2											5
Visitors																	
Total	6	13	1	5	1	2											5
TOTAL OAK RIDGE	2,390	721	382	304	98	33	36	4									370

TABLE B.7
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
PITTSBURGH NAVAL REACTOR FIELD ORGANIZATION
1983

Contractor	Dose-Equivalent Ranges (rem)																Total
	< 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	Person-rem
Duquesne Light Co.																	
Employees	5	228	66	70													49
Visitors	36	55															3
Total	41	283	66	70													52
Westinghouse Electric/BAPL																	
Employees	192	838	36	19	9	10	6										79
Visitors	158	36															2
Total	350	874	36	19	9	10	6										81
Westinghouse Electric/NRF																	
Employees	93	572	169	61	3		1										84
Visitors	56	6															
Total	149	578	169	61	3		1										84
Westinghouse Plant Appa.																	
Employees	117	23															1
Visitors																	
Total	117	23															1
TOTAL PITTSBURGH	657	1,758	271	150	12	10	7										218

TABLE B.8
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
RICHLAND FIELD ORGANIZATION
1983

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
Pacific Northwest Laboratory																	
Employees	502	403	75	47	26	21	38	6	2								165
Visitors	241	16															1
Total	743	419	75	47	26	21	38	6	2								166
BCS Richland Inc.																	
Employees	5	10	1	3													2
Visitors																	
Total	5	10	1	3													2
Hanford Eng. Dev. Lab.																	
Employees	476	352	64	41	13	4	8										68
Visitors	169	18															1
Total	645	370	64	41	13	4	8										69
Hanford Environ. Health Found.																	
Employees	11	9															
Visitors	3																
Total	14	9															
J. A. Jones Const. Co.																	
Employees	510	370	92	156	77	61	101	22									401
Visitors	27	3															
Total	537	373	92	156	77	61	101	22									401
Kaiser Engineers-Hanford																	
Employees	219	132	8	9	3		1										15
Visitors	11	1															
Total	230	133	8	9	3		1										15

TABLE B.8 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
RICHLAND FIELD ORGANIZATION
1983

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	1,426	1,420	370	204	97	48	78	11									459
Visitors	839	86		1													5
Total	2,265	1,506	370	205	97	48	78	11									464
United Nuclear Ind. Inc.																	
Employees	601	579	397	343	176	145	292	169	2								1,331
Visitors	287	43	9		3	1											6
Total	888	622	406	343	179	146	292	169	2								1,337
TOTAL RICHLAND	5,327	3,442	1,016	804	395	280	518	208	4								2,454

TABLE B.9
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SAN FRANCISCO FIELD ORGANIZATION
1983

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	308	249	8	5	4	5	13	8	2	17							146
Visitors	313	25															1
Total	621	274	8	5	4	5	13	8	2	17							147
Stanford Linear Accel. Ctr.																	
Employees	157	28	5	3													3
Visitors																	
Total	157	28	5	3													3
University of California/LBL																	
Employees	810	441	20	1													26
Visitors																	
Total	810	441	20	1													26
University of California/LLNL																	
Employees	8,098	562	62	24	13	4	6	1									71
Visitors	9,857	136	11	1													9
Total	17,955	698	73	25	13	4	6	1									80
University of California/LEHR																	
Employees	58	46															2
Visitors																	
Total	58	46															2

TABLE B.9 (Continued)
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SAN FRANCISCO FIELD ORGANIZATION
1983

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
University of California/LNM																	
Employees	56	3	1	1	1	1	2										5
Visitors																	
Total	56	3	1	1	1	1	2										5
University of California/MC																	
Employees	30																
Visitors																	
Total	30																
University of California/NTS																	
Employees	105	6	3	4													2
Visitors	1,288	8		1													1
Total	1,393	14	3	5													3
TOTAL SAN FRANCISCO	21,080	1,504	110	40	18	10	21	9	2	17							266

TABLE B.10
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SAVANNAH RIVER FIELD ORGANIZATION
1983

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.																	
Employees	3,179	3,016	700	575	294	132	147										1,009
Visitors	6,975	27	10	2													4
Total	10,154	3,043	710	577	294	132	147										1,013
E. I. Du Pont/SRP-Const.																	
Employees	1,329	1,518	474	208	33	9	6	1									277
Visitors																	
Total	1,329	1,518	474	208	33	9	6	1									277
Savannah River Ecol. Lab.																	
Employees	47	21	1														1
Visitors																	
Total	47	21	1														1
Southern Bell Tel.																	
Employees	25	14															1
Visitors																	
Total	25	14															1
U. S. Forest Service																	
Employees	21	1															
Visitors																	
Total	21	1															
TOTAL SAVANNAH RIVER	11,576	4,597	1,185	785	327	141	153	1									1,292

TABLE B.11
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES BY CONTRACTOR
SCHENECTADY NAVAL REACTOR FIELD ORGANIZATION
1983

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	
General Electric Company																	
Employees	831	1,369	142	95	33	10	38										215
Visitors																	
Total	831	1,369	142	95	33	10	38										215
General Electric/MAO																	
Employees	21	17	1														1
Visitors																	
Total	21	17	1														1
TOTAL SCHENECTADY	852	1,386	143	95	33	10	38										216

APPENDIX C

DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES FOR DOE GOVERNMENT EMPLOYEES AND VISITORS BY DOE FIELD ORGANIZATION, 1983

TABLE C.1
DISTRIBUTION OF ANNUAL WHOLE-BODY EXPOSURES FOR DOE GOVERNMENT EMPLOYEES AND VISITORS BY DOE FIELD ORGANIZATION
1983

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	244	170	1														9
Amarillo Area Office	38	1															
Dayton Area Office		27															1
Kansas City Area Office	22																
Los Alamos Area Office	84	45	4	1													3
Pinellas Area Office	5	7															
Rocky Flats Area Office		55	6	3													5
UMTRA Project Office	7																
TOTAL	400	305	11	4													18
Chicago Operations	22	2															
Environmental Meas. Lab.	33	3															
New Brunswick Lab.	59	7	3	2													2
TOTAL	114	12	3	2													2
Energy Tech. Centers																	
Morgantown	7																
TOTAL	7																

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)																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 Operations	111	53	2														3
West Valley Nuclear	2	1															
TOTAL	113	54	2														3
Nevada Operations	7,351	44	9	6													6
TOTAL	7,351	44	9	6													6
Oak Ridge Operations	1																
TOTAL	1																
Pittsburgh Naval Reactors	11	40	2														2
TOTAL	11	40	2														2
Richland Operations	375	50	3														3
TOTAL	375	50	3														3