

Tenth Annual Report of Radiation Exposures for DOE & DOE Contractor Employees

1977

U.S. Department of Energy
Assistant Secretary for Environment
Office of Environmental Compliance and Overview
Operational and Environmental Safety Division
Washington, D.C., 20545

March 1980

Available from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

Price: Printed Copy: \$ 5.25
 Microfiche: \$ 3.00

TABLE OF CONTENTS

	Page
Acknowledgements	ii
Preface	iii
Standards for Radiation Protection	1
Whole Body Radiation Exposures	
a. General Trends	3
b. Distribution of Annual Whole Body Exposures by Facility Type for 1977	9
c. Average Dose Equivalent Ratios	12
Internal Exposures	14
Worker Terminations	16
Whole Body Dose Equivalents Greater than 5 Rem	18
Appendix A - Distribution of Annual Whole Body Exposures for Each DOE Operations Facility Type - 1977	19
Appendix B - Distribution of Annual Whole Body Exposures for Each DOE Operations by Contractor - 1977	31
Appendix C - Distribution of DOE Operations Office Employees' Average Whole Body Exposures - 1977	53

ACKNOWLEDGEMENTS

This report was prepared under a health physics and support contract by the Occupational and Environmental Department of Battelle-Pacific Northwest Laboratories.

We also acknowledge and thank the Union Carbide Corporation, Oak Ridge, Tennessee, and EG&G Idaho, Inc., for their assistance in the preparation of this report.

PREFACE

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 maintained at the Union Carbide Computing Technology Center, Oak Ridge, Tennessee. Annual summaries (WASH-1350-R1 through WASH-1350-R6) were reported for the years 1968-1973 and included data on AEC contractor employees as well as employees of companies in the private sector licensed by the AEC.

In January 1975, the operational functions of the AEC, including the maintenance of records on the occupational radiation exposure of contractor employees, were transferred to the Energy Research and Development Administration (ERDA) and the AEC's regulatory functions, including the reporting of information on the occupational radiation exposure of licenses, were transferred to the Nuclear Regulatory Commission (NRC). Previous AEC licensees then reported to NRC while the contractors reported to ERDA. Radiation exposure data for AEC/ERDA and AEC/ERDA contractor employees for 1974 and 1975 were reported in ERDA 76/119 and ERDA 77-29. The 1976 data for ERDA and ERDA contractor employees were reported in DOE/EV-0011/9.

On October 1, 1977, the Department of Energy (DOE) was formed and assumed the responsibilities of ERDA. This report contains the 1977 radiation exposure data for DOE and DOE contractors.

Previous reports for AEC/ERDA, AEC/ERDA contractor employees may be seen at the DOE Public Documents Room, 1000 Independence Avenue, SW, Washington, D.C. 20585.

*The word "exposure" is herein synonymous with "dose equivalent".

WHOLE BODY RADIATION EXPOSURES

General Trends

Radiation exposure data for AEC/ERDA/DOE and AEC/ERDA/DOE contractor employees* for years 1974-1977 are plotted in Figure 1. This shows that approximately 50% of the total workers monitored do not receive measurable dose equivalents.

Data obtained from DOE reports on occupational exposures for 1964-1977 are presented in Tables 1 and 3. These data were used to generate Table 2 and Figure 2 which show that the percent of individuals monitored who receive dose equivalents greater than 1 rem and greater than 2 rem has declined significantly in the past 14 years. Table 2 presents the collective dose equivalent (man-rem) for DOE and DOE contractor employees for 1974 through 1977. The collective dose equivalents have been estimated by using the midpoint of each dose equivalent range shown in Table 1.

*Henceforth referred to as DOE and DOE contractor employees.

Figure 1. COMPARISON OF NUMBER OF EMPLOYEES, NUMBER OF EMPLOYEES MONITORED, AND NUMBER OF EMPLOYEES MONITORED THAT RECEIVED NO MEASURABLE DOSE EQUIVALENT

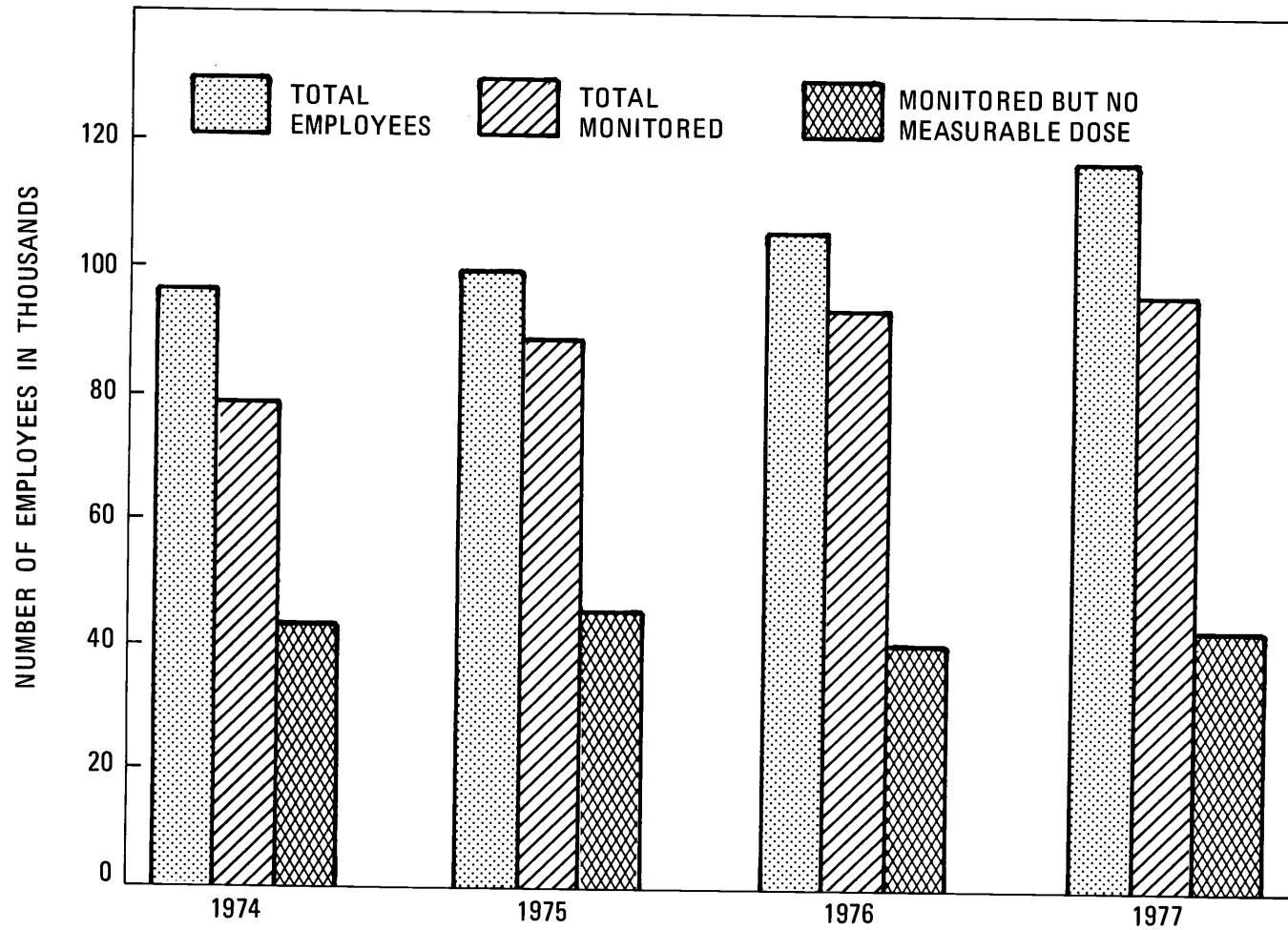


TABLE 1
DISTRIBUTION OF WHOLE BODY RADIATION EXPOSURES FOR
DOE/DOE CONTRACTOR EMPLOYEES - 1964-1977

Year	Dose Equivalent Ranges (rem)												Total Monitored	
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12		>12
1964	122711	3583	1823	575	176	43	20	10	7	6	10	1		128965
1965	128360	4158	1704	515	294	70	32	26	25	22	6	2		135214
1966	131522	3706	1630	593	313	88	47	24	6	2			1	137932
1967	102510	3472	1572	555	168	35	29	23	17	4	1			108386
1968	103206	2799	1408	425	144	3	1							107986
1969	98625	2554	1313	335	86	4					1			102918
1970	92185	2698	1329	279	158	5	4	2		1				96661
1971	90640	2380	888	275	118	8	3				1		2	94315
1972	86077	2130	929	219	95	8	2							89460
1973	89071	1944	727	172	60	2	1							91977
1974	75684	1667	688	149	40	4								78232
1975	85451	1846	753	232	142				1					88425
1976	87969	1679	475	70	6	1								90200
1977	92965	1579	545	103	23			1	2				2	95220

TABLE 2
COLLECTIVE DOSE EQUIVALENT* FOR DOE/DOE CONTRACTOR
EMPLOYEES AND VISITORS BY OPERATIONS OFFICE - 1974-1977

Operations Office	Man-Rem			
	1974	1975	1976	1977
Albuquerque	2405	2324	1437	2300
Chicago	1943	1638	1354	1373
Grand Junction	-----	5	<1	<1
Idaho	686	611	790	929
Nevada	58	55	25	49
Oak Ridge	1178	1284	1351	1300
Pittsburgh Naval Reactors	587	1876	1609	653
Richland	2079	2257	2265	3197
San Francisco	320	283	285	334
Schenectady Naval Reactors	261	1022	203	148
Savannah River	1484	1268	1278	1298
TOTAL	11001	12622	10597	11581

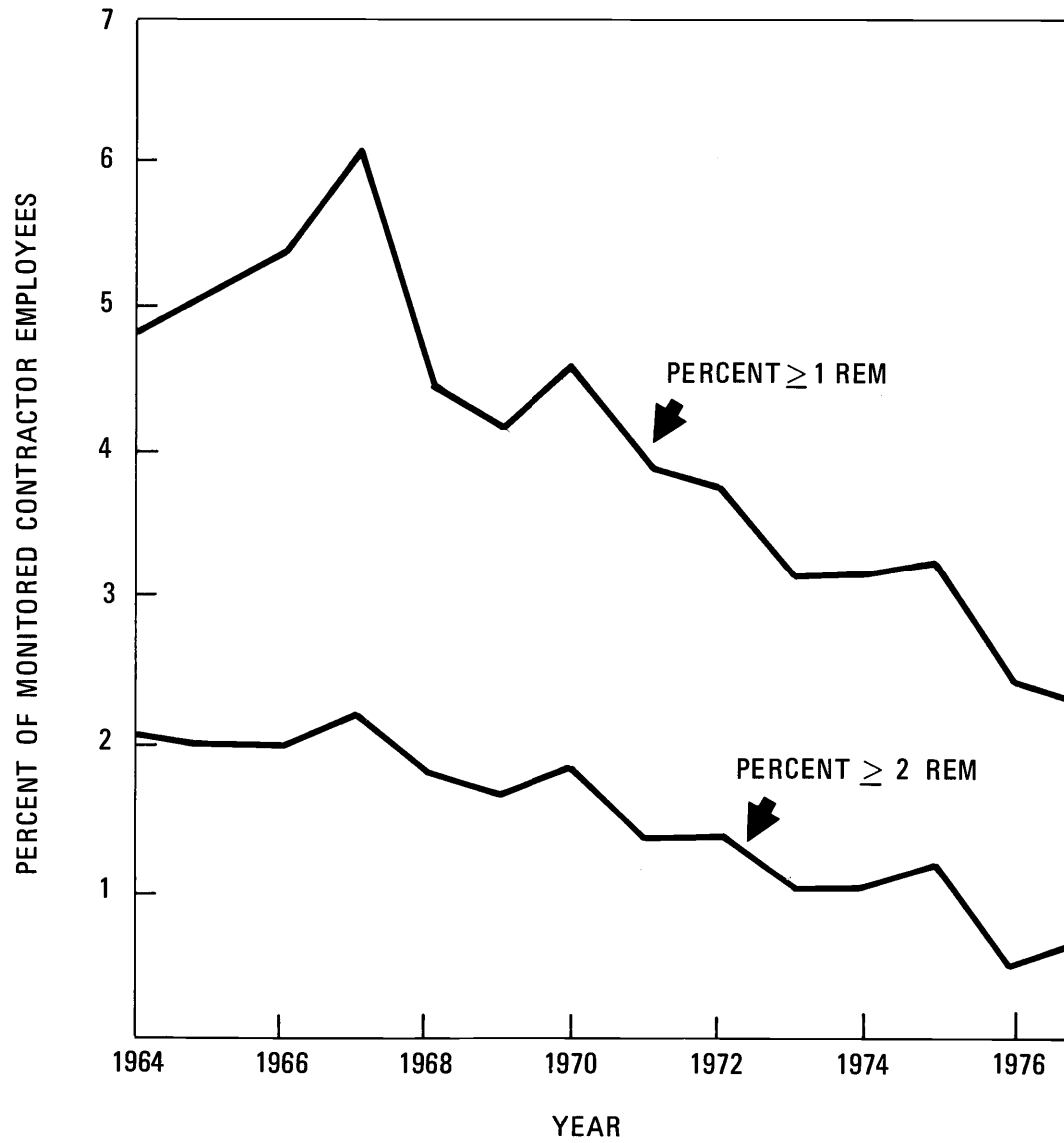
*Throughout this report minor variations in collective dose equivalent values may occur due to computer rounding.

TABLE 3
DISTRIBUTION OF EMPLOYEES WHO RECEIVED ANNUAL WHOLE BODY
DOSE EQUIVALENTS GREATER THAN 1 REM AND GREATER
THAN 2 REM - 1964 - 1977

Year	Number Employees Monitored	Number of Employees With Annual Whole Body Dose Equivalents		Collective Dose Equivalent (man-rem)*
		> 1 rem	>2 rem	
1964	128965	6254	2671	13411
1965	135214	6854	2696	14918
1966	137932	6410	2704	14173
1967	108386	5876	2404	12583
1968	107986	4780	1981	9877
1969	102918	4293	1739	8706
1970	96661	4476	1778	9135
1971	94315	3675	1295	7357
1972	89460	3383	1253	6769
1973	91977	2906	962	5623
1974	78232	2548	881	4944
1975	88425	2974	1128	6111
1976	90200	2231	552	3984
1977	95220	2255	676	4251

*This column reflects the trend in high exposures since individuals with dose equivalents of less than 1 rem have been excluded. The annual collective dose equivalent has been estimated by using the midpoint of each dose equivalent range shown in Table 1.

Figure 2. PERCENT OF EMPLOYEES WITH WHOLE BODY DOSE EQUIVALENTS GREATER THAN 1 AND 2 REM



STANDARDS FOR RADIATION PROTECTION

DOE (ERDA) Manual Chapter 0524, Standards for Radiation Protection, is applicable to DOE and DOE contractor operations not subject to Nuclear Regulatory Commission licensing.

Two basic requirements exist for all DOE operations. The first requirement is that all operations shall be conducted in a manner to assure that radiation exposure to individuals and population

groups is limited to the lowest levels technically and economically practicable. The second requirement is that radiation exposure to individuals or population groups be maintained below prescribed limits. The DOE prescribed limits for occupationally exposed individuals are given in the following table as excerpted from DOE (ERDA) Manual Chapter 0524:

INDIVIDUALS IN CONTROLLED AREAS

RADIATION PROTECTION STANDARDS FOR EXTERNAL AND INTERNAL DOSE EQUIVALENTS

Type of Exposure	Exposure Period	Dose Equivalent (Dose or Dose Commitment* (rem))
Whole body, head and trunk, gonads, lens of the eye**, red bone marrow, active blood forming organs.	Year	5***
	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****	Year	30
	Calendar Quarter	10
Hands**** and feet	Year	75
	Calendar Quarter	25

*To meet the above dose commitment standards, 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 a radionuclide(s) that would commit the individual to an organ dose which exceeds the limits specified in the above table.

**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).

***In special cases with the approval of the Director, Operational and Environmental Safety Division, a worker may exceed 5 rem/year provided his/her average exposure per year since age 18 will not exceed 5 rem/year.

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

DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES BY FACILITY TYPE FOR 1977

Table 4 provides a breakdown of the 1977 whole body dose equivalents according to facility type. Table 5 shows that employees working in reactor, fuel processing, and accelerator facilities continue to receive the highest average exposures. The general research and other facilities accounted for approximately 42 percent of the total dose equivalent.

Appendix A contains whole body exposure distributions by facility type as reported by each of the 11 DOE operations offices or Naval Reactors offices.

Appendix B contains whole body exposure distributions for each contractor. These are placed alphabetically under their respective DOE operations office or Naval Reactors office.

Appendix C contains whole body exposure distributions for each DOE operations office.

TABLE 4
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES FOR DOE/DOE CONTRACTOR EMPLOYEES
AND VISITORS MONITORED - 1977

Facility Type	Total Monitored	< Meas	Dose Equivalent Ranges (rem)																	Total Man-Rem
			< 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	6868	2137	2204	801	666	354	203	289	196	14				2				2	1889	
Fuel Fab	1029	113	501	164	115	52	30	47	7										244	
Fuel Proc	2417	492	652	293	292	200	104	223	118	37	6								1195	
Uran Enrich	11117	2635	8064	317	76	17	6	2											506	
Weapon F&T	16264	7057	7873	766	334	106	64	60	4										875	
Irrad Fac																				
Gen Research	37259	23138	10163	2098	923	366	192	272	77	22	8								2332	
Accelerator	3055	1363	751	312	219	91	74	153	61	24	7								793	
Other	15367	4882	6900	1309	865	456	333	532	82	6	1		1						2511	
Visitors	84003	63181	20273	366	111	47	6	11	8										1190	
DOE Offices	1844	1200	562	69	10	1		1			1								51	
TOTAL	179223	106198	57943	6495	3611	1690	1012	1590	553	103	23		1	2				2	11581	

TABLE 5
COLLECTIVE DOSE EQUIVALENT (MAN-REM) PER FACILITY TYPE
DOE/DOE CONTRACTOR EMPLOYEES AND VISITORS - 1977

Facility Type	Total No. Individuals Monitored	No. Individuals With Measurable Exposure	Total No. Man-rem	Average Dose Equivalent (rem) Per Individual Monitored	Average Dose Equivalent (rem) Per Individual Monitored With Measurable Exposures
Reactor	6868	4731	1889	0.28	0.40
Fuel Fab	1029	916	244	0.24	0.27
Fuel Proc	2417	1925	1195	0.50	0.62
Uran Enrich	11117	8482	506	0.05	0.06
Weapon F&T	16264	9207	875	0.05	0.10
Irrad FacI	0				
Gen Research	37259	14121	2332	0.06	0.17
Accelerator	3055	1692	793	0.26	0.47
Other	15367	10485	2511	0.16	0.24
Visitors	84003	20822	1190	0.01	0.06
DOE Offices	1844	644	51	0.03	0.08
TOTAL	179223	73025	11586	0.07	0.16

AVERAGE DOSE EQUIVALENT RATIOS

It is known that dose equivalent data are inadequate in assessing whether radiation exposures are reduced to as low as practicable. Variables such as facility age and design, along with all the other factors which enter into accomplishing the program objectives may far outweigh the efforts of management, radiation workers, and safety personnel in reducing personnel exposures to the levels that exist at similar facilities elsewhere.

In some instances, it might be desirable to compare average radiation dose equivalents associated with the same facility type but at different locations. Average dose equivalent ratios have been calculated for each facility type under an operations office and are presented in Table 6. The average dose equivalent ratio is defined as the ratio of the average personnel dose equivalent for a facility type within an operations office and the average personnel dose equivalent for the facility type. The numbers in Table 6 are derived by discarding all dose equivalents less than 0.5 rem. By discarding numbers less than 0.5 rem, it is intended to include only those people working in the radiation areas. No interpretation of these numbers is possible other than those numbers less than 1 indicate a low average dose equivalent relative to the average for that facility type while those ratios greater than 1 indicate a higher average dose equivalent.

TABLE 7
DOSE DISTRIBUTIONS FROM INTERNAL BODY DEPOSITIONS

Radionuclide	Critical Organ	Dose Equivalent Ranges (rem)					
		7.5-10	10-15	15-25	25-50	50-100	100-200
Depositions prior to 1977							
U-234, U-235, U-238	Lung	6	2				
U-235	Lung	3					
Pu-238, Pu-239, Pu-240	Bone Liver Kidney	1 1	1	1	1	1	1
Pu-238	Bone Liver		1	1			
Am-241	Bone Liver				1		1
1977 Depositions							
Pu-238	Lung	1		1	1		

*Nineteen persons were reported in 1977 as receiving internal doses that exceeded 50% of the annual dose limit to the critical organ from depositions prior to 1977. Three persons were reported as receiving doses exceeding 50% of the annual limit to the lung from depositions during 1977.

WORKER TERMINATIONS

There were 10354 monitored workers in 1977 who terminated their employment with DOE or DOE contractors. Table 8 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 annual dose equivalent for workers terminating in 1977 was a small fraction of the 5-rem-per-year limit.

TABLE 8
LENGTH OF EMPLOYMENT FOR INDIVIDUALS TERMINATING IN 1977

	1-90 Days	90-180 Days	180-365 Days	1-2 Years	2-4 Years	4-6 Years	>6 Years
Total Number	2659	1664	1120	1009	1217	527	2158
Total Cumulative Dose Equivalent (rem)	1105	306	366	249	1071	556	6086
Average Cumulative Dose Equivalent (rem)	0.42	0.18	0.33	0.25	0.88	1.06	2.82

WHOLE BODY DOSE EQUIVALENTS GREATER THAN 5 REM

Five persons received whole body dose equivalents greater than 5 rem during 1977. Their dose equivalents ranged from 8.0 rem to 17.8 rem. In each instance an investigation was conducted and procedures established to reduce the probability of a similar occurrence.

APPENDIX A

**DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
FOR EACH DOE OPERATIONS OFFICE
BY FACILITY TYPE**

1977

TABLE A-1
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
ALBUQUERQUE OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)																Total Man-Rem
			<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		
Reactor																			
Fuel Fab																			
Fuel Proc																			
Uran Enrich																			
Weapon F&T	7119	1158	4952	555	257	87	58	48	4										628
Irrad FacI																			
Gen Research	7304	4409	2092	383	169	69	52	79	31	12	8								598
Accelerator																			
Other	1816	1154	490	96	41	18	10	7											87
Visitors	23717	5159	18407	109	32	7	1	1	1										961
DOE Offices	807	510	256	36	3			1			1								26
TOTAL	40763	12390	26197	1179	502	181	121	136	36	12	9								2300

TABLE A-2
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
CHICAGO OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem	
			< 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
Reactor	393	137	128	43	31	17	13	21	3									87
Fuel Fab																		
Uran Enrich																		
Weapon F&T																		
Irrad Fac																		
Gen Research	4872	2894	1362	336	128	69	36	36	5	6								337
Accelerator	2846	1329	607	299	211	87	71	151	60	24	7							770
Other	919	675	168	38	23	7	5	3										37
Visitors	9863	8895	683	171	61	34	3	9	7									142
DOE Offices	21	15	5	1														< 1
TOTAL	18914	13945	2953	888	454	214	128	220	75	30	7							1373

TABLE A-3
 DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
 GRAND JUNCTION OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)															Total Man-Rem			
			< 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				
Reactor																					
Fuel Fab																					
Fuel Proc																					
Uran Enrich																					
Weapon F&T																					
Irrad FacI																					
Gen Research																					
Accelerator																					
Other	45	43	1		1															< 1	
Visitors																					
DOE Offices																					
TOTAL	45	43	1		1																< 1

TABLE A-4
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
IDAHO OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)															Total Man-Rem
			<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	
Reactor	2506	1457	539	207	135	61	41	55	10	1								299
Fuel Fab																		
Fuel Proc	873	313	104	65	85	39	37	103	84	37	6							626
Uran Enrich																		
Weapon F&T																		
Irrad FacI																		
Gen Research																		
Accelerator																		
Other																		
Visitors	27079	27079																< 1
DOE Offices	241	169	69	3														4
TOTAL	30699	29018	712	275	220	100	78	158	94	38	6							929

TABLE A-5
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
NEVADA OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)															Total Man-Rem
			<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	
Reactor																		
Fuel Fab																		
Fuel Proc																		
Uran Enrich																		
Weapon F&T	5968	5791	100	37	23	7	3	7										38
Irrad FacI																		
Gen Research																		
Accelerator																		
Other	91	89	1		1													< 1
Visitors	9835	9710	106	13	5	1												10
DOE Offices	238	230	7	1														1
TOTAL	16132	15820	214	51	29	8	3	7										49

TABLE A-6
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
OAK RIDGE OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem
			< 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	
Reactor																	
Fuel Fab	598	41	353	98	66	21	10	8	1								96
Fuel Proc																	
Uran Enrich	11117	2635	8064	317	76	17	6	2									506
Weapon F&T	2932		2736	148	36	9	3										184
Irrad FacI																	
Gen Research	7469	5722	1281	224	116	53	21	35	14	3							296
Accelerator																	
Other	3937	104	3704	115	14												211
Visitors	2482	2408	61	12	1												6
DOE Offices	23	5	18														1
TOTAL	28558	10915	16217	914	309	100	40	45	15	3							1300

TABLE A-7
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
PITTSBURGH NAVAL REACTORS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem	
			<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
Reactor	1548	122	725	277	187	118	64	55										367
Fuel Fab																		
Fuel Proc																		
Uran Enrich																		
Weapon F&T																		
Irrad Faci																		
Gen Research	2311	423	1330	313	162	41	15	22	5									266
Accelerator																		
Other																		
Visitors	548	262	272	14														16
DOE Offices	77	28	41	7	1													4
TOTAL	4484	835	2368	611	350	159	79	77	5									653

TABLE A-8
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
RICHLAND OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem
			<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	
Reactor	568	4	16	53	71	47	39	138	183	13					2	2	827
Fuel Fab	59		2	14	14	11	6	9	3								41
Fuel Proc																	
Uran Enrich																	
Weapon F&T																	
Irrad Faci																	
Gen Research	1664	39	701	503	199	86	42	71	22	1							453
Accelerator																	
Other	3642	124	937	741	606	378	294	485	69	6	1		1				1830
Visitors	649	146	447	36	12	5	2	1									40
DOE Offices	43	5	18	14	6												6
TOTAL	6625	318	2121	1361	908	527	383	704	277	20	1		1	2		2	3197

TABLE A-9
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
SAN FRANCISCO OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)															Total Man-Rem			
			<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				
Reactor	5	3	2																< 1		
Fuel Fab																					
Fuel Proc																					
Uran Enrich																					
Weapon F&T	99	86	9	1	2	1														2	
Irrad FacI																					
Gen Research	11546	9016	2182	227	83	22	7	9												213	
Accelerator	209	34	144	13	8	4	3	2	1											23	
Other	805	475	236	29	29	7	5	11	13											86	
Visitors	8533	8348	176	9																10	
DOE Offices	60	54	6																	< 1	
TOTAL	21257	18016	2755	279	122	34	15	22	14											334	

TABLE A-10
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
SCHENECTADY NAVAL REACTORS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem		
			<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	
Reactor	907	144	566	111	52	21	10	3											94
Fuel Fab																			
Fuel Proc																			
Uran Enrich																			
Weapon F&T																			
Irrad Fac																			
Gen Research	1135	309	774	34	18														51
Accelerator																			
Other																			
Visitors	197	150	47																2
DOE Offices	25	7	18																1
TOTAL	2264	610	1405	145	70	21	10	3											148

TABLE A-11
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
SAVANNAH RIVER OPERATIONS OFFICE - 1977

Facility Type	Total Monitored	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem	
			<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
Reactor	941	270	228	110	190	90	36	17										215
Fuel Fab	372	72	146	52	35	20	14	30	3									107
Fuel Proc	1544	179	548	228	207	161	67	120	34									569
Uran Enrich																		
Weapon F&T	146	22	76	25	16	2		5										23
Irrad Fac																		
Gen Research	951	324	436	78	48	26	19	20										116
Accelerator																		
Other	4112	2218	1363	290	150	46	19	26										260
Visitors	1100	1024	74	2														4
DOE Offices	216	151	59	5		1												4
TOTAL	9382	4260	2930	790	646	346	155	218	37									1298

APPENDIX B
DISTRIBUTION OF ANNUAL WHOLE BODY EXPOSURES
FOR EACH OPERATIONS OFFICE
BY CONTRACTOR

1977

TABLE B-1
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

ALBUQUERQUE OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)																Total Man-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		
Albuquerque Misc. C01-00-0209-00																		
Employees		1785	7	1														91
Visitors																		
Total		1785	7	1														91
Mason & Hanger-Silas C01-01-0001-01																		
Employees	20	211	160	38	6	4	1											62
Visitors	631	56																3
Total	651	267	160	38	6	4	1											64
Dow Chemical, USA C01-07-0007-01																		
Employees		2552	257	162	58	44	39	2										372
Visitors		17402																870
Total		19954	257	162	58	44	39	2										1242
General Electric Co, FL C01-06-0006-01																		
Employees	130	134	25	4														13
Visitors	4																	<1
Total	134	134	25	4														13
General Electric Co, PA C01-08-0006-02																		
Employees		99	10	3	6	4	1											17
Visitors		34	2	1	1	1												4
Totals		133	12	4	7	5	1											21
Inhalation Toxicology C01-08-0009-01																		
Employees	305	43	10	1		2	1											8
Visitors	1069	2																<1
Total	1374	45	10	1		2	1											8

TABLE B-1 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

ALBUQUERQUE OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)														Total Man-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
Jet Propulsion Lab																
C01-00-0210-01																
Employees	46	29	12	4	1	1										7
Visitors																
Total	46	29	12	4	1	1										7
Monsanto Research Co																
C01-03-0002-01																
Employees	858	402	131	54	23	10	8	2								103
Visitors	571	119	5	2												8
Total	1429	521	136	56	23	10	8	2								111
Ross Aviation, Inc.																
C01-00-0212-01																
Employees	19	23														1
Visitors																
Total	19	23														1
Sandia Laboratories, NM																
C01-08-0008-01																
Employees	930	1090	153	46	13	7	9	4	2	2						152
Visitors	1520	729	94	24	6		1	1								70
Total	2450	1819	247	70	19	7	10	5	2	2						222
Sandia Laboratories, CA																
C01-08-0008-02																
Employees	726	202	7													11
Visitors	161	9														<1
Total	887	211	7													12
Teledyne Isotopes																
C01-00-0211-01																
Employees	6	9	9	8	2	2										8
Visitors	5	8	2	3												2
Total	11	17	11	11	2	2										10

TABLE B-1 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

ALBUQUERQUE OPERATIONS OFFICE

Office	< Meas.	<0.10	Dose Equivalent Ranges (rem)														Total Man-Rem
			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 Bendix Corp																	
C01-04-0003-01																	
Employees	280	2		2													1
Visitors																	
Total	280	2		2													1
The ZIA Company																	
C01-05-0005-01																	
Employees	953	196	40	22	9	3	6										42
Visitors																	
Total	953	196	40	22	9	3	6										42
Univ. of California/LASL																	
C01-05-0004-01																	
Employees	2448	757	213	122	56	43	69	27	10	6							427
Visitors	1194	48	6	2													4
Total	3642	805	219	124	56	43	69	27	10	6							431
<hr/>																	
SUBTOTAL	11876	25941	1143	499	181	121	135	36	12	8							2274

TABLE 6
AVERAGE DOSE EQUIVALENT RATIOS FOR 1977*

Operations Office	Type of Facility										
	Reactor	Fuel Fabric	Fuel Process	Uran Enrich	Weapons Fab&Test	Iradi Facil	General Research	Acceler	Other	Visitors	DOE Offices
Albuquerque					1.00		1.22		0.76	0.94	1.36
Chicago	0.86						0.90	1.01	0.77	1.05	
Grand Junction											
Idaho	0.84		1.30								
Nevada					1.08					0.63	
Oak Ridge		0.84		1.00	0.72		1.00				
Pittsburgh Naval Reactors	0.68						0.86				
Richland	1.42	1.06					0.97		1.01	0.81	
San Francisco					0.66		0.74	0.70	1.40		
Schenectady Naval Reactors	0.59										
Savannah River	0.61	1.07	0.76		1.32		0.82		0.81		0.28

*The average dose equivalent ratio is defined as the average personnel dose equivalent for a facility type within an operations office divided by the average personnel dose equivalent for that facility type within DOE and DOE contractors.

INTERNAL EXPOSURES

DOE (ERDA) Manual Chapter 0525 required DOE contractors to submit a report on personnel with an internal body deposition of radioactive materials. A report was required when:

- A. Any uptake of radioactive material occurring 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 standards set forth in Appendix 0524.
- B. Any previously unreported uptake of radioactive material that was determined to have been reportable according to the above criteria by reason of more recent dose equivalent estimates.

The annual dose equivalent unit for the lungs, liver, and thyroid is 15 rem each, while for the bone it is 30 rem.

In 1977, 25 workers were determined to have radioactive material in their bodies which resulted in a dose equivalent to the critical organ in excess of 50 percent of the annual dose equivalent limit. Twenty-two of these workers met this criteria due to an internal body deposition of radioactive materials prior to 1977. Table 7 gives a breakdown of these 25 cases.

TABLE B-2
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

CHICAGO OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)															Total Man-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
Ames Laboratory																	
C03-00-0011-01																	
Employees	43	56	26	13	8	1	5										26
Visitors	647																<1
Total	690	56	26	13	8	1	5										26
Argonne National Lab.																	
C03-00-0012-02																	
Employees	2134	544	220	145	71	52	50	6	4								314
Visitors	6849	170	25	9	10	2											24
Total	8983	714	245	154	81	54	50	6	4								338
Brookhaven National Lab.																	
C03-02-0010-01																	
Employees	205	964	273	125	51	48	122	52	25	6							644
Visitors	78	167	90	37	16	1	9	7									80
Total	283	1131	363	162	67	49	131	59	25	6							724
Chicago Miscellaneous																	
C03-00-0013-00																	
Employees	285	213	54	11	2	1	1										28
Visitors	10																<1
Total	295	213	54	11	2	1	1										28
Fermi National Accel.																	
C03-01-0135-01																	
Employees	1155	362	121	87	42	22	33	10	1	1							200
Visitors	1311	346	56	15	8												38
Total	2466	708	177	102	50	22	33	10	1	1							238

TABLE B-2 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

CHICAGO OPERATIONS OFFICE

Office	< Meas.	< 0.10	Dose Equivalent Ranges (rem)													Total Man-Rem			
			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		
Massachusetts Inst. C03-00-0035-01																			
Employees	130	43	15	10	4	1													12
Visitors																			
Total	130	43	15	10	4	1													12
Princeton University C03-00-0037-01																			
Employees	986	65	3																4
Visitors																			
Total	986	65	3																4
SUBTOTAL	13833	2930	883	452	212	128	220	75	30	7									1369

TABLE B-3
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

GRAND JUNCTION OFFICE

Office	< Meas.	<0.10	Dose Equivalent Ranges (rem)														Total Man-Rem			
			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. C04-00-0001-00																				
Employees	43	1		1																< 1
Visitors																				
Total	43	1		1																< 1
SUBTOTAL	43	1		1																< 1

TABLE B-4
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

IDAHO OPERATIONS OFFICE

Office	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem	
		<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
Allied Chemical Corp.																	
C05-00-0169-01																	
Employees	325	72	56	79	32	30	86	65	29	1							487
Visitors	8280																< 1
Total	8605	72	56	79	32	30	86	65	29	1							487
Arrington Const.																	
C05-00-0070-01																	
Employees	8	9	1	1	2		2										5
Visitors																	
Total	8	9	1	1	2		2										5
Bingham Mechanical																	
C05-00-0082-01																	
Employees	7	6	4	5	4	1	9	6	1								38
Visitors																	
Total	7	6	4	5	4	1	9	6	1								38
C-L Electric Company																	
C05-00-0075-01																	
Employees	1	17	2	1													2
Visitors																	
Total	1	17	2	1													2
Consultants & Design																	
C05-00-0181-01																	
Employees	7	1															< 1
Visitors																	
Total	7	1															< 1

TABLE B-4 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

IDAHO OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)															Total Man-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
EG & G Idaho, Inc. C05-00-0182-01																	
Employees	1143	372	154	93	48	34	47	9									233
Visitors	17959																
Total	19102	372	154	93	48	34	47	9									233
Idaho Miscellaneous C05-00-0078-00																	
Employees	155	112	36	26	12	9	10	12	5	5							122
Visitors																	
Total	155	112	36	26	12	9	10	12	5	5							122
Jones - Boecon C05-00-0183-01																	
Employees	25	3															<1
Visitors																	
Total	25	3															<1
Lehigh Design Co. C05-00-0071-01																	
Employees	42	13	2														1
Visitors																	
Total	42	13	2														1
Morrison-Knudsen C05-00-0134-01																	
Employees	56	28	15	13	2	4	3	2	3								34
Visitors																	
Total	56	28	15	13	2	4	3	2	3								34

TABLE B-4 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

IDAHO OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)																Total Man-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			
Ormond Construction																			
C05-00-0069-01																			
Employees	1	4	2	1			1											2	
Visitors																			
Total	1	4	2	1			1											2	
Waters Asbestos																			
C05-00-0156-01																			
Employees		6		1															1
Visitors																			
Total		6		1															1
SUBTOTAL	28009	643	272	220	100	78	158	94	38	6									925

TABLE B-5
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

NEVADA OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)																Total Man-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	
Defense Nuclear Agency																	
C06-00-0027-01																	
Employees	93	1		1													<1
Visitors	1638	28	3														2
Total	1731	29	3	1													2
EG&G, Inc.																	
C06-00-0028-01																	
Employees	785	35	2	1		1											3
Visitors	282																<1
Total	1067	35	2	1		1											3
Air Resources Lab.																	
C06-00-0159-01																	
Employees	39																<1
Visitors	11																<1
Total	50																<1
Eberline Instrument																	
C06-00-0218-01																	
Employees	48	3															<1
Visitors																	<1
Total	48	3															<1
EPA/NERC																	
C06-00-0116-01																	
Employees	227	1															<1
Visitors	60																<1
Total	287	1															<1
Fenix & Scisson, Inc.																	
C06-00-0113-01																	
Employees	235	3	2	1													1
Visitors	400																<1
Total	635	3	2	1													1

TABLE B-5 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

NEVADA OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)																Total Man-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	
Holmes & Narver, Inc.																	
C06-00-0029-01																	
Employees	297	3	1														<1
Visitors	176																<1
Total	473	3	1														<1
Nevada Miscellaneous																	
C06-00-0157-00																	
Employees	349	2	1														<1
Visitors	269																<1
Total	618	2	1														<1
Reynolds Electrical																	
C06-00-0093-01																	
Employees	3497	43	29	20	7	1	2										23
Visitors	3283																<1
Total	6780	43	29	20	7	1	2										23
Department of Interior																	
C06-00-0216-01																	
Employees	59	9															<1
Visitors	44																<1
Total	103	9															<1
Wackenhut Services																	
C06-00-0118-01																	
Employees	230																<1
Visitors	27																<1
Total	257																<1

TABLE B-5 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

NEVADA OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)															Total Man-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
Westinghouse Elec. C06-00-0217-01																	
Employees	21	1	2	1		1	5										9
Visitors	47																<1
Total	68	1	2	1		1	5										9
SUBTOTAL	12117	129	40	24	7	3	7										40

TABLE B-6
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

OAK RIDGE OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)															Total Man-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
Comparative Animal																	
C08-00-0044-01																	
Employees	106	11															1
Visitors	16																< 1
Total	122	11															1
Goodyear Atomic Corp.																	
C08-04-0049-01																	
Employees	484	356	98	43	10	6	2										66
Visitors																	
Total	484	356	98	43	10	6	2										66
National Lead Co.																	
C08-01-0047-01																	
Employees	41	353	98	66	21	10	8	1									96
Visitors																	
Total	41	353	98	66	21	10	8	1									96
Oak Ridge Associated																	
C08-00-0128-01																	
Employees	371	124	19	3													11
Visitors																	
Total	371	124	19	3													11
Puerto Rico Nuclear																	
C08-05-0046-02																	
Employees	171	60	6	4	3	1											8
Visitors	1316	32	10														3
Total	1487	92	16	4	3	1											12
RMI Company																	
C08-00-0043-01																	
Employees	26	36															2
Visitors																	
Total	26	36															2

TABLE B-6 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

OAK RIDGE OPERATIONS OFFICE

Office	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem
		<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	
Rust Engineering Co.																
C08-00-0045-01																
Employees		1449	57	7												85
Visitors																
Total		1449	57	7												85
Union Carbide Corp./ORGDP																
C08-00-0042-01																
Employees		7396	101	17	1											394
Visitors																
Total		7396	101	17	1											394
Union Carbide Corp./Y-12																
C08-00-0042-02																
Employees		5430	214	42	11	3	1									336
Visitors																
Total		5430	214	42	11	3	1									336
Union Carbide Corp./ORNL																
C08-00-0042-03																
Employees	5152	611	191	110	48	20	34	14	3							249
Visitors	1076	29	2	1												2
Total	6228	640	193	111	48	20	34	14	3							251
Union Carbide Corp.																
C08-00-0042-04																
Employees	2151	312	118	16	6											46
Visitors																
Total	2151	312	118	16	6											46
<hr/>																
SUBTOTAL	10910	16199	914	309	100	40	45	15	3							1299

TABLE B-7
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

PITTSBURGH NAVAL REACTORS OFFICE

Office	< Meas.	Dose Equivalent Ranges (rem)															Total Man-Rem
		<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.																	
C09-02-0051-01																	
Employees		107	115	68	60	43	35										179
Visitors		171	4														9
Total		278	119	68	60	43	35										188
Westinghouse Elec./BAPL																	
C09-00-0050-02																	
Employees	436	1527	367	196	84	32	39	5									366
Visitors	153	44	6														3
Total	589	1571	373	196	84	32	39	5									369
Westinghouse Elec./NRF																	
C09-01-0050-01																	
Employees	109	421	108	85	15	4	3										89
Visitors	109	57	4														4
Total	218	478	112	85	15	4	3										93
SUBTOTAL		807	2327	604	349	159	79	77	5								649

TABLE B-8
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

RICHLAND OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)																Total Man-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	
Automation Ind.																	
C10-00-0205-01																	
Employees	2	26	29	11	3	1											13
Visitors		3															<1
Total	2	29	29	11	3	1											13
Battelle Memorial Inst.																	
C10-00-0013-02																	
Employees	5	471	285	105	43	20	28	16	1								243
Visitors	16	40	3	2													3
Total	21	511	288	107	43	20	28	16	1								246
BCS Richland Inc.																	
C10-00-0056-01																	
Employees		1	1	1													1
Visitors																	
Total		1	1	1													1
Hanford Engineering																	
C10-00-0142-01																	
Employees	34	230	218	94	43	22	43	6									211
Visitors	18	51	2														3
Total	52	281	220	94	43	22	43	6									213
Hanford Environmental																	
C10-00-0057-01																	
Employees		1	1														<1
Visitors																	
Total		1	1														<1

TABLE B-8 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

RICHLAND OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)														Total Man-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
J. A. Jones Const.																	
C10-00-0058-01																	
Employees	100	562	260	238	209	202	339	44									1089
Visitors	1	5	3	2	3	1	1										6
Total	101	567	263	240	212	203	340	44									1095
Rockwell Hanford																	
C10-00-0220-01																	
Employees	22	347	450	356	166	91	146	25	6	1			1				727
Visitors	83	287	22	4	1	1											21
Total	105	634	472	360	167	92	146	25	6	1			1				748
United Nuclear Ind.																	
C10-00-0055-01																	
Employees	4	18	67	85	58	45	147	186	13					2		2	868
Visitors	6	13	3	4	1												3
Total	10	31	70	89	59	45	147	186	13					2		2	871
SUBTOTAL																	
	291	2055	1344	902	527	383	704	277	20	1			1	2		2	3188

TABLE B-9
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

SAN FRANCISCO OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)															Total Man-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
Atomics International																	
C11-00-0060-01																	
Employees	475	236	29	29	7	5	11	13									86
Visitors	426	104	2														6
Total	901	340	31	29	7	5	11	13									91
Stanford Linear Accel.																	
C11-00-0062-01																	
Employees	34	144	12	8	4	2											17
Visitors																	
Total	34	144	12	8	4	2											17
University of Calif./LBL																	
C11-00-0004-02																	
Employees	2441	1273	120	36	3	2	1										103
Visitors																	
Total	2441	1273	120	36	3	2	1										103
University of Calif./LLL																	
C11-00-0004-03																	
Employees	6369	879	100	45	15	5	7										103
Visitors	7870	64	7														4
Total	14239	943	107	45	15	5	7										107
University of Calif./CF																	
C11-00-0004-04																	
Employees	120	20	3	1	1												3
Visitors																	
Total	120	20	3	1	1												3

TABLE B-9 (continued)
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

SAN FRANCISCO OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)																Total Man-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	
University of Calif./LNM																	
C11-00-0004-05																	
Employees	77	9	5	1	3	1	3	1									11
Visitors	52	8															<1
Total	129	17	5	1	3	1	3	1									12
University of Calif./MC																	
C11-00-0004-06																	
Employees	9	1															<1
Visitors																	<1
Total	9	1															<1
University of Calif./NTS																	
C11-00-0004-07																	
Employees	89	11	1	2	1												2
Visitors																	
Total	89	11	1	2	1												2
<hr/>																	
SUBTOTAL	17962	2749	279	122	34	15	22	14									334

TABLE B-10
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

SCHENECTADY NAVAL REACTORS OFFICE

Office	Dose Equivalent Ranges (rem)															Total Man-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
General Electric Co. C13-00-0006-06																	
Employees	453	1340	145	70	21	10	3										145
Visitors	150	47															2
Total	603	1387	145	70	21	10	3										147
SUBTOTAL	603	1387	145	70	21	10	3										147

TABLE B-11
DOE CONTRACTORS
AVERAGE WHOLE BODY EXPOSURES - 1977

SAVANNAH RIVER OPERATIONS OFFICE

Office	Dose Equivalent Ranges (rem)																Total Man-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	
E. I. Du Pont/SRP-OPNS																	
C14-00-0063-01																	
Employees	2074	2151	605	542	308	147	205	37									1138
Visitors	1024	74	2														4
Total	3098	2225	607	542	308	147	205	37									1142
E. I. Du Pont/SRP-CON																	
C14-00-0063-02																	
Employees	955	628	175	104	37	8	13										151
Visitors																	
Total	955	628	175	104	37	8	13										151
Savannah River Ecol.																	
C14-00-0064-01																	
Employees	56	18	3														1
Visitors																	
Total	56	18	3														1
SUBTOTAL	4109	2871	785	646	345	155	218	37									1294

APPENDIX C

**DISTRIBUTION OF DOE OPERATION OFFICE EMPLOYEES'
AVERAGE WHOLE BODY EXPOSURES**

1977

TABLE C-1
DOE OPERATIONS OFFICE EMPLOYEES'
AVERAGE WHOLE BODY EXPOSURES - 1977

Office	Dose Equivalent Ranges (rem)															Total Man-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
Administration G00-00-0000-00	26	65	2														4
SUBTOTAL	26	65	2														4
Albuquerque Operations G01-00-0000-00	159	132	9														8
Amarillo Area Office G01-01-0000-00	1	17	14														3
Dayton Area Office G01-03-0000-00	6	11	4	1													2
Kansas City Area Office G01-04-0000-00	14																<1
Los Alamos Area Office G01-05-0000-00	331	23	5	2			1			1							9
Rocky Flats Area Office G01-07-0000-00		72	3														4
Sandia Area Office G01-08-0000-00	1	1	1														<1
The Bendix Corporation G01-00-0000-00	2																<1
SUBTOTAL	514	256	36	3			1			1							26

TABLE C-1 (continued)

DOE OPERATIONS OFFICE EMPLOYEES'
AVERAGE WHOLE BODY EXPOSURES - 1977

Office	Dose Equivalent Ranges (rem)																Total Man-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	
Chicago Operations G03-00-0000-00	15	5	1														< 1
Health and Safety Lab. G03-04-0000-00	31	4		1	1												1
New Brunswick Lab. G03-03-0000-00	66	14	4	1	1												2
SUBTOTAL	112	23	5	2	2												4
Idaho Operations G05-00-0000-00	1009	69	3														4
SUBTOTAL	1009	69	3														4
Nevada Operations G06-00-0000-00	3703	85	11	5	1												9
SUBTOTAL	3703	85	11	5	1												9
Oak Ridge Operations G08-00-0000-00	4	17															1
Cincinnati Area Office G08-01-0000-00		1															< 1
Paducah Area Office G08-02-0000-00	1																< 1
SUBTOTAL	5	18															1

TABLE C-1 (continued)
DOE OPERATIONS OFFICE EMPLOYEES'
AVERAGE WHOLE BODY EXPOSURES - 1977

Office	< Meas.	Dose Equivalent Ranges (rem)														Total Man-Rem	
		<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
Pittsburgh Naval Reactors G09-00-0000-00	28	34	7														3
Pittsburgh Naval Reactors G09-01-0000-00		6															< 1
Shippingport Branch G09-02-0000-00		1		1													< 1
SUBTOTAL	28	41	7	1													4
Richland Operations G10-00-0000-00	27	66	17	6													9
SUBTOTAL	27	66	17	6													9
San Francisco Operations G11-00-0000-00	54	6															< 1
SUBTOTAL	54	6															< 1
Schenectady Naval Reactors G13-00-0000-00	6	16															1
Schenectady Naval Reactors G13-01-0000-00	1	2															< 1
SUBTOTAL	7	18															1

TABLE C-1 (continued)
DOE OPERATIONS OFFICE EMPLOYEES'
AVERAGE WHOLE BODY EXPOSURES - 1977

Office	Dose Equivalent Ranges (rem)														Total Man-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
Savannah River Operations G14-00-0000-00	151	59	5		1												4
SUBTOTAL	151	59	5		1												4
Morgantown Energy Tech. G15-00-0000-00	2	5															< 1
SUBTOTAL	2	5															< 1

*U.S. GOVERNMENT PRINTING OFFICE : 1980 O-310-912/206

