

7

**Seventh Annual Report Of  
Radiation Exposures For AEC & AEC  
Contractor Employees**

1974



Energy Research & Development Administration  
Division Of Safety, Standards, & Compliance

Available from:

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

Price:       Printed Copy:   \$ 4.00  
              Microfiche:     \$ 2.25



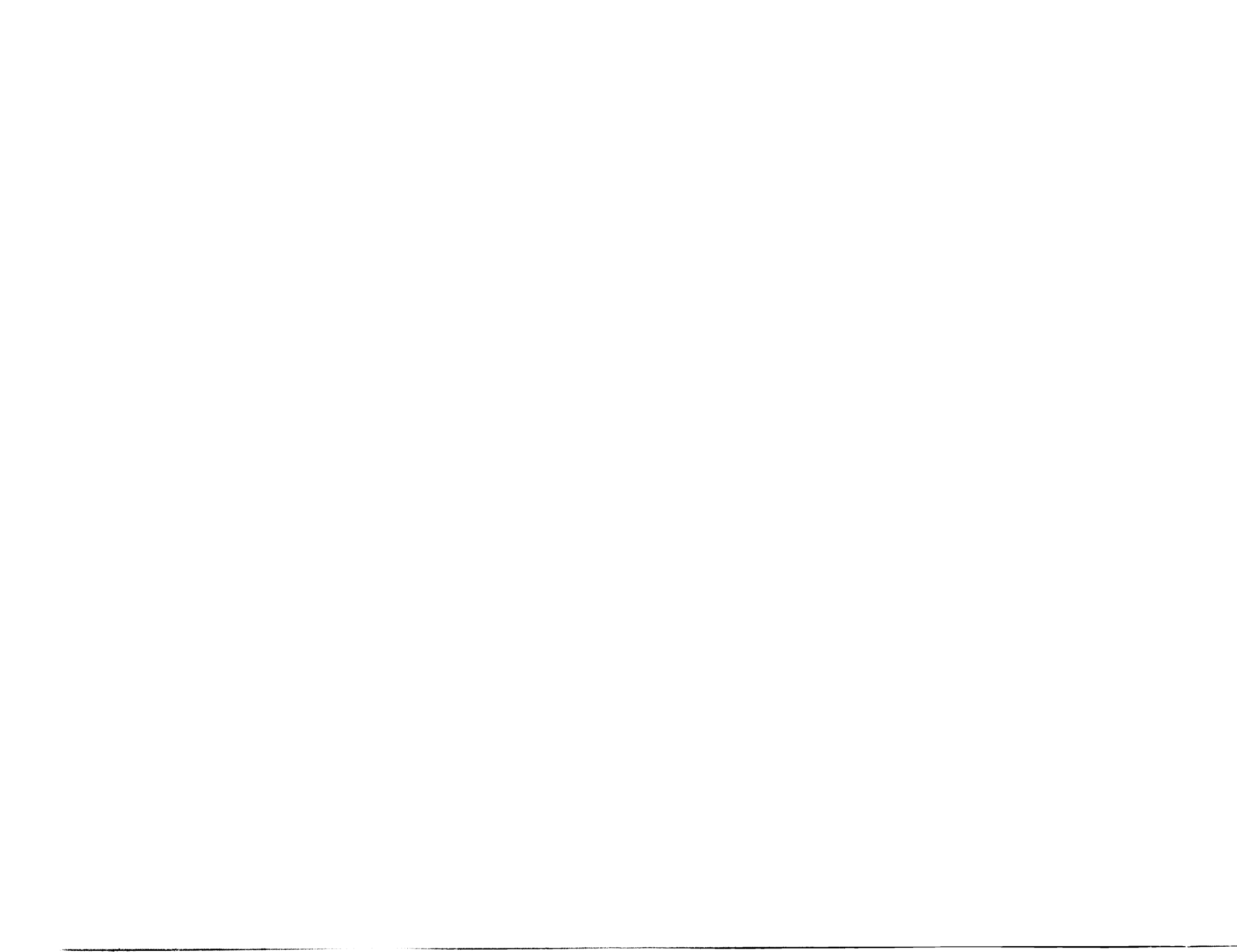
---

# **Seventh Annual Report Of Radiation Exposures For AEC & AEC Contractor Employees**

**197**

---

Energy Research & Development Administration  
Division Of Safety, Standards, & Compliance



## 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. Previous 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 on employees of companies in the private sector licensed by the AEC. These reports may be seen at ERDA Public Documents Room, 20 Massachusetts Ave., NW., Washington, D.C.

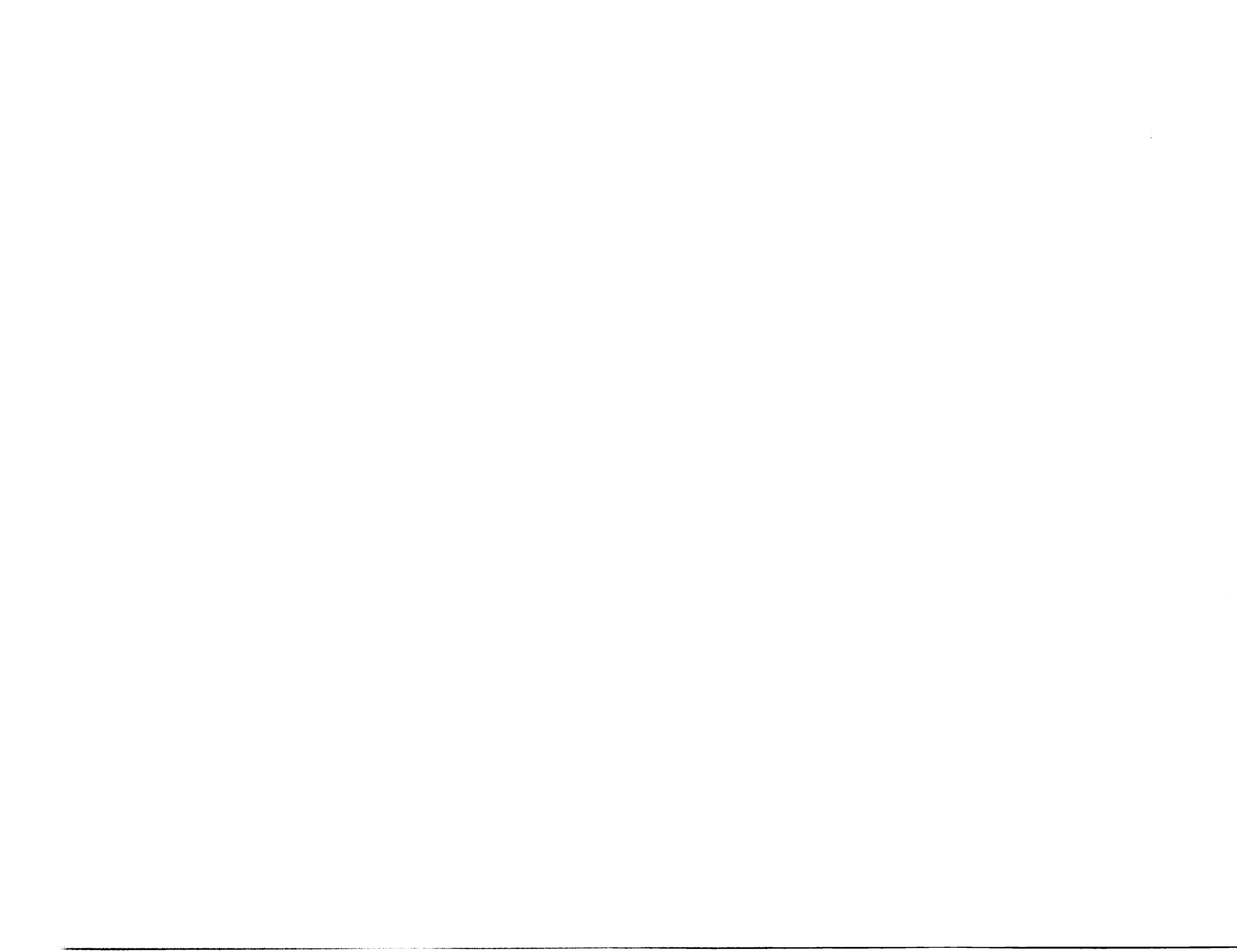
In January 1975, two new agencies, the Energy Research and Development Administration (ERDA) and the U.S. Nuclear Regulatory Commission (NRC) were formed and now share the responsibilities previously held by the AEC. Previous AEC licensees now report to NRC while the contractors report to ERDA. This report contains only the data from 1974 AEC contractors (now ERDA contractors) as required by Manual Chapter 0525.



## WHOLE-BODY RADIATION EXPOSURES

### Introduction

The 1974 whole-body radiation exposure reporting requirements were changed from previous years as a result of a revision of Manual Chapter 0525 on January 7, 1975. Two major changes were prescribed. Improved personnel dosimetry methods now permit more precise measurements of low radiation doses and greater sensitivity. Therefore, instead of asking for the number of employees having between 0-1 rem dose equivalents, this exposure range has been subdivided into six ranges as indicated in the tables. The second major change is the requirement that the contractors now report the whole-body exposures according to type of facility in which the major portion of the dose equivalent was received. These changes permit a better assessment of contractor performance and indicate which facilities are responsible for the largest collective dose equivalent.





## General Trends

Tables 1 and 2 show data for the last 11 years of the Atomic Energy Commission (AEC) and its contractor employees. Table 1 illustrates that as time progresses, the number of personnel receiving large dose equivalents has been reduced. It also shows that fewer employees are being monitored each year. Monitoring is required where the potential exists for the individual to receive a dose or dose commitment in any calendar quarter in excess of 10 percent of the quarterly standards as prescribed in AEC Manual Chapter 0524. However, many contractors badge everyone at a site rather than only those working in radiation areas. Other contractors in their efforts to minimize radiation exposures have, in recent years, highly restricted access to radiation areas and thus reduced the number of people monitored. Therefore, the total number monitored is not necessarily an indicator of the potential for personnel radiation exposure.

As indicated in Table 1, most of the personnel receive an undetectable dose equivalent. Prior to 1974, contractors were asked only to report the number of personnel in the 0-1 rem range making a total man-rem dose equivalent estimate difficult.

The trend in higher ranges of exposures is shown in Table 2. Individuals with dose equivalents of less than 1 rem were excluded and the midpoints of the ranges were used to calculate the man-rem dose equivalents. The percent of the employees with dose equivalents greater than 1 and 2 rem are presented. The corresponding number of employees is given in parenthesis. It is evident that the percentage and number of employees with high dose equivalents as well as the total man-rem dose equivalent is declining as time progresses. In 1974, 45 percent of the total man-rem dose equivalent was distributed to those receiving less than 1 rem. Therefore, Table 2 should be interpreted as the trend for higher ranges of exposures only.

Table 1

## WHOLE-BODY RADIATION EXPOSURE HISTORY FOR AEC AND AEC CONTRACTOR EMPLOYEES

YEAR	NUMBER OF ESTIMATED DOSE EQUIVALENTS IN EACH OF FOLLOWING RANGES (REMS)													TOTAL
	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	MONITORED
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	597	313	88	47	24	6	2			1	137939
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	75485	1683	692	149	40	4								78005

\*Approximately 80 percent of these employees received an undetectable dose equivalent.

\*\*Data for 1966 and 1967 differ from previous reports due to the discovery of an error in the radiation exposure records of one major contractor.

Table 2

## WHOLE-BODY EXPOSURE HISTORY OF AEC AND AEC CONTRACTOR EMPLOYEES

Year	(Percent of employees with dose equivalent greater than)		Total Man rem*	Total Monitored
	1 rem (number)	2 rem (number)		
1964	4.85 (6254)	2.07 (2671)	13411	128965
1965	5.07 (6854)	1.99 (2696)	14818	135214
1966 *	5.35 (7387)	1.98 (2738)	15454	137939
1967 **	6.11 (6622)	2.23 (2415)	13715	108386
1968	4.43 (4780)	1.83 (1981)	9877	107986
1969	4.17 (4293)	1.69 (1739)	8707	102918
1970	4.63 (4476)	1.84 (1778)	9137	96661
1971	3.90 (3675)	1.37 (1295)	5395	94315
1972	3.78 (3383)	1.40 (1253)	6170	89460
1973	3.16 (2906)	1.05 ( 962)	5623	91977
1974	3.26 (2543)	1.13 (882)	4935	78005

\*Individuals with dose equivalent of less than 1 rem have been excluded. In 1974, this represented approximately 45 percent of the total man rem. Therefore, these data reflect only the trend in high ranges of dose equivalents rather than the total collective dose equivalent.

\*\*Data for 1966 and 1967 differ from previous reports due to the discovery of an error in the radiation exposure records of one major contractor.



### **Distribution of Annual Whole-Body Exposures by Facility Type—1974**

Table 3 provides a breakdown of the 1974 whole-body dose equivalents according to facility type. This was the first year that the contractors were asked to submit data of this kind and many were unable to adjust their reporting systems in time to fully comply. They instead reported as a group under the General Research facility type. It was intended that the General Research facility type would include only those that received their radiation exposures from a variety of sources. It is expected that subsequent reports will more truly represent the source of the radiation exposure than does this 1974 report.

Table 4 gives the average annual whole-body dose equivalent for each facility type. As expected, the highest average exposures occur in reactor, fuel processing, and accelerator facilities. However, due to the large number of workers, General Research and Weapons Fabrication and Testing (F&T) produce the highest collective dose equivalent.

Appendix A contains whole body dose equivalent distributions by facility type as reported to each of the 10 operations offices or Naval Reactor offices.

Appendix B contains whole-body dose equivalent distributions for each contractor. These are placed alphabetically under their respective field office or Naval Reactors office. Exposure distributions for each AEC field office or area office are also presented.



TABLE 4

MAN-REMS PER FACILITY TYPE  
1974

FACILITY TYPE	TOTAL NO. INDIVIDUALS MONITORED	NO. INDIVIDUALS WITH MEASURABLE EXPOSURE	TOTAL NO. MAN-REMS	AVERAGE EXPOSURE (REM) PER INDIVIDUAL (BASED ON ALL EXPOSURES)	AVERAGE EXPOSURE (REM) PER INDIVIDUAL (BASED ON MEASURABLE EXPOSURES)
REACTOR	3757	2093	1378	.37	.66
FUEL FAB	1076	1026	291	.27	.28
FUEL PROC	2118	1753	1077	.51	.61
URAN ENRCH	2249	597	93	.04	.16
WEAPON F&T	19026	8731	2244	.12	.26
IRRAD FACL	0				
GEN RESRCH	31612	10910	2526	.08	.23
ACCELERATR	6674	2357	1131	.17	.48
OTHER	9720	7396	1866	.19	.25
VISITORS	45802	2364	305	.01	.13
AEC OFFCS	1773	378	47	.03	.13

### Ratios of Average Exposures

In some instances, it might be desirable to compare exposures associated with the same facility type but at different locations. However, exposure data alone is 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 by far outweigh the efforts of management, radiation workers, and safety personnel in reducing personnel exposures to the levels that exist at similar facilities elsewhere.

Average exposure ratios have been calculated for each facility type under the operations offices and presented in Table 5. The average exposure ratio is defined as the ratio of the average personnel exposure of the subgroup and the average personnel exposure of the group. The numbers within the parentheses of Table 5 are derived by discarding all "less than measurable exposures" while those outside the parentheses are calculated by discarding all exposures less than 0.5 rem. No interpretation of these numbers is possible other than that those numbers less than 1 indicate low average exposures relative to the average for that facility type while those ratios larger than 1 indicate a higher average exposure relative to the average for that facility type.



Table 5

## Average Exposure Ratio

Field Office	1974										AEC Offices
	Reactor	Fuel Fabric	Fuel Process	Uran Enrich	Weapons Fab&Test	Irrad Facil	General Research	Acceler	Other	Visitr	
Albuquerque Operations					1.03(1.44)		1.08(1.35)		.72(.83)	.62(.70)	1.17(1.34)
Chicago Operations	.66(.45)						1.12(1.12)	1.04(1.70)	1.26(1.31)	1.01(1.23)	(.40)
Idaho Operations	.87(.73)		1.12(1.29)								.66(1.23)
Nevada Operations					.75(.62)					(.77)	(.41)
Oak Ridge Operations	(.17)	.72(.68)		1.00(1.00)	.71(.41)		.86(.58)		.67(.24)	.62(.77)	(.47)
Pittsburgh Naval Reactors	.63(.45)						.89(1.23)		.66(1.17)	(.41)	(.89)
Richland Operations	1.42(2.64)	1.46(2.94)					1.00(1.27)		1.02(2.73)	(1.62)	(1.60)
San Francisco Operations	.43(.60)				.53(.78)		1.00(.62)	.66(.29)	.87(.64)	(.48)	(.69)
Schenectady Naval Reactors							.72(.67)		1.12(2.73)	1.13(2.86)	(.72)
Savannah River Operations	.64(.65)	.89(1.05)	.94(.88)		.83(.84)		1.06(1.38)		.90(.83)		(.42)

The average exposure ratio has been defined as the average personnel exposure of the facility subgroup divided by the average personnel exposure of the total facility group. The numbers inside and outside the parenthesis represent the ratios where all measurable exposures and all exposures greater than 500 mrem were considered, respectively.

## INTERNAL EXPOSURES

AEC Manual Chapter 0525 requires AEC contractors to submit a report on personnel with radioactive material deposited in their bodies. A report was required when:

- a. any uptake of radioactive material occurring during the reporting year that independently, or when added to a current burden, is estimated to result in 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 is determined to have been reportable according to the above criteria by reason of more recent dose estimates.

In 1974, 56 workers were determined to have radioactive material deposited in their bodies which produced 50 percent of the annual dose equivalent standard for a critical organ. Many of these had had a previous organ burden but were not reportable according to the Manual Chapter criteria. Additional exposure in 1974 added to their previous organ burden and thus they were reported in 1974. Fourteen of the uranium workers were reported in one or both of the two preceding years but determined to have received an additional uptake during 1974 and were included in the 1974 report.

Table 6 gives a breakdown of these 56 cases where the annual dose commitment exceeded 50 percent of an organ dose standard. The radionuclides are specified as well as the critical organ. The maximum annual dose equivalent limit for the lungs is 15 rem and that for bone is 30 rem as prescribed in AEC Manual Chapter 0524.



## WORKER TERMINATIONS

There were 5356 monitored workers in 1974 who terminated their employment with the AEC or AEC contractors. Table 7 gives the length of employment time distribution. Of particular concern for personnel radiation protection purposes is the large number of workers terminating within 90 days of their employment.

It is possible for certain craft workers to be employed by several AEC contractors or licensees during a short period of time and receive a cumulative dose equivalent which exceeds the radiation exposure standards. A check of the AEC contractor records revealed that no AEC contractor employees could be classified as transient radiation workers. Transient workers are defined as workers who began and terminated their employment with two or more employers within a calendar quarter. Short term employment of AEC contractor employees by AEC licensees is a possibility but it is unlikely that the number of workers is large.

TABLE 7

LENGTH OF EMPLOYMENT FOR  
INDIVIDUALS TERMINATING IN 1974

1-89 DAYS -----	90-180 DAYS -----	180-365 DAYS -----	1-2 YEARS -----	2-4 YEARS -----	4-6 YEARS -----	>6 YEARS -----	TOTAL NO. OF INDIVIDUALS TERMINATING -----	NO. OF TERMINATION REPORTS -----
1169	525	541	449	482	293	1897	5356	5413



**APPENDIX A**

**Operations Office Report**

**Distribution of Annual Whole-Body Exposures  
by Facility Type**

**1974**





























TABLE 11

AEC FIELD OFFICE/AREA OFFICE EMPLOYEE  
 AVERAGE WHOLE BODY EXPOSURES  
 1974

OFFICE	<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	TOTAL MAN-REM
SUBTOTAL	2	1																
SAVANNAH RIVER OPERA 614-00-0000-00	51	1																

**APPENDIX B**

**Operations Office Report**

**Distribution of Annual Whole-Body Exposures  
by Contractor**

**1974**











TABLE 4  
AEC CONTRACTORS  
AVERAGE WHOLE BODY EXPOSURES  
1974

NEVADA OPERATIONS OFFICE

OFFICE	<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	TOTAL MAN-REM
AIR RESOURCES LABORA C06-00-0159-01																		
BIRDWELL DIVISION OF C06-00-0214-01	10	1	1															1
CER GEONUCLEAR C06-00-0215-01																		
DEFENSE NUCLEAR AGEN C06-00-0027-01	43	7	1															4
EG&G, INC. C06-00-0028-01	17	2	4															3
ENVIRONMENTAL PROTEC C06-00-0116-01	4	3																1
FENIX & SCISSON, INC C06-00-0113-01	1																	
HALLIBURTON SERVICES C06-00-0131-01	1																	
HOLMES & NARVER, INC C06-00-0029-01	4																	
NEVADA MISCELLANEOUS C06-00-0157-00	52	22	27	8														22
REYNOLDS ELECTRICAL C06-00-0093-01	93	26	15	3		2												20
SPERRY-SUN WELL SURV C06-00-0150-01																		
U. S. DEPARTMENT OF C06-00-0216-01	2																	
WACKENHUT SERVICES. C06-00-0118-01	3																	
WESTINGHOUSE ELECTRI C06-00-0217-01	3	1	1	1	2	3												8
SUBTOTAL	232	62	49	12	2	5												58







TABLE 8  
AEC CONTRACTORS  
AVERAGE WHOLE BODY EXPOSURES  
1974

SAN FRANCISCO OPERATIONS OFFICE

OFFICE	<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	TOTAL MAN-REM
ATOMICS INTERNATIONAL C11-00-0060-01	69	14	6	2	1	3												15
STANFORD LINEAR ACCE C11-00-0062-01	59	24	11	6		1												17
UNIVERSITY OF CALIFO C11-00-0004-02	796	157	71	20	11	9	3											137
UNIVERSITY OF CALIFO C11-00-0004-03	697	110	52	16	3	13	2											111
UNIVERSITY OF CALIFO C11-00-0004-04	11				1													1
UNIVERSITY OF CALIFO C11-00-0004-05	6	3	4	4	1	2	2	3										24
UNIVERSITY OF CALIFO C11-00-0004-06																		
UNIVERSITY OF CALIFO C11-00-0004-07	6	11	19	7														14
SUBTOTAL	1644	319	163	55	17	28	7	3										318



TABLE 10  
AEC CONTRACTORS  
AVERAGE WHOLE BODY EXPOSURES  
1974

SAVANNAH RIVER OPERATIONS OFFICE

OFFICE	<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	TOTAL MAN-REM
E. I. DU PONT DE NEM C14-00-0063-01	1649	475	407	302	186	297	77	2										1315
E. I. DU PONT DE NEM C14-00-0063-02	245	86	57	24	16	25	4											125
SAVANNAH RIVER ECOLO C14-00-0064-01	14																	1
SUBTOTAL	1908	561	464	326	202	322	81	2										1441





