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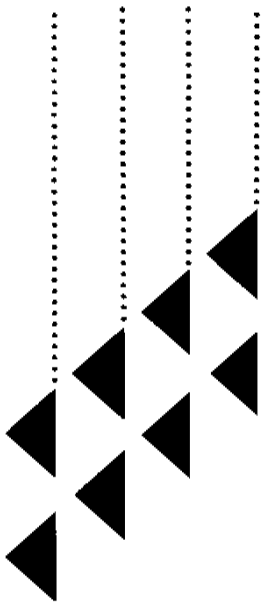
1996 Report on Occupational Radiation Exposures in Canada



Canada

1996 Report on Occupational Radiation Exposures in Canada

Environmental Health Directorate
Health Protection Branch

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Our mission is to help the people of Canada
maintain and improve their health.
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Abstract

This document was prepared by Dr. W.N. Sont and Dr. J.P. Ashmore of the Occupational Radiation Hazards Division, Radiation Protection Bureau. Acknowledgements are extended to Mr. B. Davies for his assistance.

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Introduction

This series of reports provides statistics on occupational radiation exposures of monitored workers in Canada. Previous issues of the report can be obtained from the authors [1-5].

The information is based on the data in the National Dose Registry (NDR) maintained by the Radiation Protection Bureau of Health Canada[6]. The Registry is a centralized record-keeping system containing dose information on all monitored workers in Canada. It includes records from the National Dosimetry Services (NDS), as well as data submitted by nuclear power generating stations, Atomic Energy of Canada Ltd., uranium mines, and private dosimeter processing companies. About 80 percent of the records are from the NDS.

Information for input into the NDR is received in a number of different physical forms. Data from the NDS are fed directly from the dosimeter reading stations into a computer, where they are processed, reported and entered into the NDR files. Most other dose records are submitted to the Registry in computer readable form.

The report provides data on the two consecutive years prior to the year in which the data are extracted from the database. The data for the second (i.e. more recent) year will be close to stable at the time of data extraction. Some changes may still occur, for which the most frequent causes are: (1) a high dose to a dosimeter is judged to be non-personal after investigation; (2) a job category of a worker is updated; or (3) dosimeters or data are returned late. The report therefore contains preliminary data on the second year, and more complete data on the first year.

For a description and a guide to interpretation of the data, the reader is referred to the next section "General Comments". The section "Comments specific to this report" has been included to address situations that do not reoccur from year to year.

General Comments

The statistics include doses as they exist in the database at the time they are extracted for analysis, which in the case of this report is 17 July 1996. All NDS doses are assigned to the year in which the dosimeter was issued, even though some of the dosimeters may actually have been worn during part of the subsequent year. As the statistics are determined in the same manner each year, the annual dose figures are based on a 12-month period, though not necessarily the strict calendar year.

Dose records submitted by outside organizations such as nuclear power generating stations, uranium mines, and commercial processors are included to the extent that they have been received. The doses are representative of the calendar year only if the fourth quarter records have been received by the time of analysis. When statistics are based on partial data, the fact is indicated in the section "Comments specific to this report".

All doses are in International System (SI) units and presented to the nearest hundredth of a millisievert (1 mSv = 100 mrem). For the external whole body doses recorded by the NDS there is a minimum reporting level of 0.2 mSv. Organizations submitting their own doses may have lower reporting levels.

The words "dose" and "exposure" are used interchangeably in this report. Doses of different types of radiation are expressed in mSv and added to give the dose stated in the report. The following dose types may be included:

- External whole body gamma
- External whole body high energy beta
- External whole body X-ray
- External whole body neutron
- Internal whole body tritium, as determined by uri-na-lysis
- Radon progeny exposures, converted from WLM values (see below).

All types of exposure are given in one total. In Tables 3 and 4, the percentage contribution of radon progeny and tritium components are indicated for occupations related to mining and nuclear power generation, respectively. Skin doses and extremity doses are not included in the report but are recorded in the database.

In the NDR database, radon progeny exposures are expressed in Working Level Months (WLM), which are in most cases calculated by the mines on the basis of area monitoring.[7] In the report the radon progeny exposures are converted to dose equivalents (in mSv). The value used in this report is given in the specific comments section.

Job category designations are based on a standard list provided by the Registry and are updated when the Registry is notified. The job category is selected by the organization from a standard list maintained by the NDR. The NDR keeps the most recent job category that an organization submits for a worker in a given year. However, a worker can have records under more than one job category for the same year, if monitoring has been by more than one organization. Some organizations have their own job classification schemes, and translate them into the Registry's standardized list prior to submission of the records.

In this report, the data are tabulated as follows:

1995: Preliminary analysis

Table 1:
Table 1 gives the annual dose distributions by job category.

1994: Final analysis

Table 2:
In Table 2, statistics are broken down by job category and province or territory.

Table 3:
Table 3 contains dose distributions broken down by age and sex. In these tables job categories have been grouped into "job sectors".

Table 4:
Table 4 contains various dose statistics broken down by job category. The table also shows the parameters of the lognormal or hybrid lognormal distribution for positive doses, as produced by maximum likelihood estimation. From that information, it is possible to calculate estimates and confidence intervals of statistics of the distribution. For a more detailed discussion the reader is referred to the Appendix.

Table 4 also includes an accumulated dose distribution over the 5 year period 1990-1994 for the workers under the given job category.

Finally, Table 4 contains a histogram that shows the trend in average annual doses over the period 1985-1994.

It should be noted that in the tables, a worker is counted more than once if he(she) works in more than one job category, in more than one province, or in more than one job sector in the same year. For this reason the totals in Tables 2-4 may slightly differ.

Comments specific to this report

1. The report has changed substantially from previous reports in this series. The report now covers two separate years, as is discussed in the introduction.

2. The dose intervals in Tables 1 and 4 have been changed to reflect current trends in regulatory control.

3. The NDR has been reviewing its job classification table. New job classes have been introduced, and the wording of some of the existing job classes has been updated.

4. The reporting of ninth deciles in previous reports has been discontinued. Estimates of ninth deciles and other statistics may be calculated through the parameters of the lognormal or hybrid lognormal distribution which have been supplied, as discussed in the general comments section. The Appendix gives a brief description of the underlying statistics. The software necessary to calculate estimates and confidence intervals for dose statistics is available from the authors. Other dose distributions are being investigated for potential improvements in the estimation.

5. Table 2 now includes, besides the doses, the number of workers in each province under each job category.

6. Table 3, which includes dose statistics broken down by job sector, age, and sex, has been added as a new table. See the general comments section for notes regarding the interpretation of these tables.

7. The conversion factor currently used to convert Radon progeny exposures is 10 mSv per WLM. This is based on the annual dose limits recommended by the ICRP[8] which are 50 mSv for external whole body doses and 4.8 WLM for Radon progeny exposures.

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Table 1
Breakdown of annual doses by job category for all of Canada

Job Category	Distribution of workers over dose intervals							Number of Workers	Avg. Dose (mSv)	Avg. of Positive Doses
	0 mSv	>0-1 mSv	>1-2 mSv	>2-5 mSv	>5-20 mSv	>20-50 mSv	>50 mSv			
Administration:										
Administrator	233	166	7	1	0	0	0	407	0.21	0.50
Office staff	3083	748	32	6	0	0	0	3869	0.10	0.49
Safety officer	65	26	0	0	0	0	0	91	0.12	0.43
Industry and Research:										
Industrial radiographer	918	308	133	236	291	50	0	1936	2.75	5.23
Instructor (non-medical)	125	14	0	0	0	0	0	139	0.04	0.43
Instrument technician	1145	349	42	26	22	5	0	1589	0.38	1.37
Laboratory technician (industrial)	2609	591	76	48	10	0	0	3334	0.17	0.78
Nuclear fuel processor	35	46	25	32	40	0	0	178	2.62	3.27
Scientist engineer (field)	536	477	44	29	14	0	0	1100	0.45	0.87
Scientist/engineer (laboratory)	3405	649	31	12	2	0	0	4099	0.08	0.46
Well logger	487	230	58	42	15	0	0	832	0.51	1.24
Medicine:										
Chiropractor	873	60	4	3	1	0	0	941	0.05	0.65
Dental assistant	5739	58	1	2	1	0	0	5801	0.01	0.56
Dental hygienist	6232	55	0	1	2	0	0	6290	0.01	0.83
Dental therapist/nurse	18	0	0	0	0	0	0	18	0.00	0.00
Dentist	6094	94	5	3	1	0	0	6197	0.01	0.48
Gynaecologist	24	1	0	0	0	0	0	25	0.01	0.20
Laboratory technician (medical)	2776	277	8	2	3	0	0	3066	0.04	0.43
Medical physicist	185	21	2	2	0	0	0	210	0.08	0.64
Medical radiation technologist	9650	1156	57	27	2	1	0	10893	0.06	0.49
Nuclear medicine technologist	413	348	228	212	20	0	0	1221	1.08	1.64

Table 1 (cont'd)
Breakdown of annual doses by job category for all of Canada

Job Category	Distribution of workers over dose intervals							Number of Workers	Avg. Dose (mSv)	Avg. of Positive Doses
	0 mSv	>0-1 mSv	>1-2 mSv	>2-5 mSv	>5-20 mSv	>20-50 mSv	>50 mSv			
Medicine (cont'd)										
Nurse	4061	439	15	9	0	0	0	4524	0.04	0.42
Physician	1550	237	21	14	3	0	0	1825	0.10	0.67
Radiation therapist	569	188	18	9	4	0	0	788	0.19	0.67
Radiologist (diagnostic)	1374	206	10	6	5	0	0	1601	0.09	0.61
Radiologist (therapeutic)	127	14	1	1	0	0	0	143	0.06	0.54
Veterinarian	2810	316	10	5	1	0	0	3142	0.04	0.40
Veterinary technician	11	1	0	0	0	0	0	12	0.02	0.20
Ward aide/orderly	1571	136	12	8	1	0	0	1728	0.05	0.57
Nuclear Power:										
Reactor – administration	3162	471	71	84	65	0	0	3853	0.26	1.44
Reactor – chemical and radiation control	113	119	60	37	59	0	0	388	2.20	3.11
Reactor – construction	498	233	95	154	46	16	0	1342	3.79	6.03
Reactor – control technicians	42	15	12	23	11	0	0	103	1.99	3.35
Reactor – electrical maintenance	277	262	145	193	147	0	0	1024	1.90	2.61
Reactor – fuel handling	11	23	12	18	96	0	0	160	6.93	7.44
Reactor – general maintenance	507	298	77	158	123	6	0	1169	1.66	2.93
Reactor – health physics	56	16	5	7	9	0	0	93	1.31	3.30
Reactor – industrial radiographer	8	3	2	1	8	1	0	23	4.66	7.14
Reactor – mechanical maintenance	273	224	109	296	540	3	0	1445	3.99	4.91
Reactor – operations	441	484	212	377	174	0	0	1688	1.72	2.32
Reactor – scientific/professional	929	208	55	89	169	2	0	1452	1.46	4.04
Reactor – training	38	7	2	2	2	0	0	51	0.67	2.65
Reactor – visitor	25	1	0	0	2	2	0	30	2.39	14.32

Table 1 (cont'd)
Breakdown of annual doses by job category for all of Canada

Job Category	Distribution of workers over dose intervals							Number of Workers	Avg. Dose (mSv)	Avg. of Positive Doses
	0 mSv	>0-1 mSv	>1-2 mSv	>2-5 mSv	>5-20 mSv	>20-50 mSv	>50 mSv			
Mining:										
Uranium mine mill maintenance	22	45	42	62	10	0	0	181	1.92	2.18
Uranium mine mill workers	21	32	52	94	16	0	0	215	2.33	2.59
Uranium mine nurses	2	3	0	0	0	0	0	5	0.16	0.27
Uranium mine office staff	10	57	30	4	2	0	0	103	0.93	1.03
Uranium mine support workers	3	9	23	27	68	4	0	134	7.81	7.99
Uranium mine surface maintenance	41	78	49	16	10	0	0	194	1.28	1.62
Uranium mine surface miner	11	48	65	27	1	0	0	152	1.26	1.35
Uranium mine surface personnel	10	31	7	2	0	0	0	50	0.59	0.73
Uranium mine surface support workers	82	85	54	20	2	0	0	243	0.78	1.18
Uranium mine underground maintenance	3	22	11	31	45	0	0	112	5.11	5.25
Uranium mine underground miner	5	34	22	57	211	50	0	379	10.86	11.01
Uranium mine underground personnel	183	74	17	30	25	0	0	329	1.08	2.43
Uranium mine visitors	112	149	26	6	0	0	0	293	0.40	0.65
Miscellaneous/Unknown:										
Miscellaneous/unknown	32545	5234	618	484	408	15	1	39305	0.23	1.31

Table 2
Number of workers (top) and average whole body dose in mSv (bottom) by job category and province/territory

Job Sector and Category	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	N.W.T.	Yukon	Canada
Administration													
Administrator	4	0	4	1	18	252	5	0	12	6	0	0	302
	0.05	0.00	0.00	0.00	0.20	0.39	0.00	0.00	0.09	0.07	0.00	0.00	0.34
Office staff	30	7	77	54	583	2432	178	50	163	231	5	5	3815
	0.01	0.00	0.01	0.02	0.10	0.18	0.03	0.02	0.04	0.01	0.00	0.00	0.13
Safety officer	1	0	13	6	5	25	18	2	4	9	0	0	83
	0.00	0.00	0.02	0.13	0.06	0.24	0.01	0.00	1.33	0.00	0.00	0.00	0.16
Overall	**35**	**7**	**94**	**61**	**606**	**2709**	**201**	**52**	**179**	**246**	**5**	**5**	**4200**
	0.01	**0.00**	**0.01**	**0.03**	**0.10**	**0.20**	**0.03**	**0.02**	**0.07**	**0.01**	**0.00**	**0.00**	**0.15**
Industry and Research													
Industrial radiographer	50	0	92	104	404	626	36	137	674	200	0	0	2323
	2.27	0.00	1.65	1.99	1.95	2.49	0.55	2.94	6.58	3.03	0.00	0.00	3.56
Instructor	3	0	9	2	7	64	4	3	18	24	1	0	135
	0.13	0.00	0.00	0.15	0.03	0.23	0.45	0.00	0.18	0.04	0.00	0.00	0.16
Instrument technician	62	0	71	52	345	687	43	29	165	65	0	0	1519
	0.10	0.00	0.05	0.10	0.11	0.44	0.07	0.11	0.90	0.51	0.00	0.00	0.36
Lab. technician (industrial)	57	10	113	36	752	1720	189	237	735	342	0	0	4191
	0.05	0.17	0.14	0.08	0.89	0.22	0.05	0.06	0.09	0.50	0.00	0.00	0.32
Nuclear fuel processor	0	0	0	0	1	169	2	0	3	8	0	0	183
	0.00	0.00	0.00	0.00	0.00	2.93	0.00	0.00	0.00	0.00	0.00	0.00	2.70
Scientist/engineer (field)	7	0	27	17	98	633	15	69	150	102	4	0	1122
	0.31	0.00	0.26	0.22	0.21	0.78	0.06	0.35	0.31	0.26	0.13	0.00	0.56
Scientist/engineer(lab.)	112	1	124	14	1080	1719	97	189	246	769	0	0	4351
	0.04	0.50	0.11	0.04	0.06	0.14	0.04	0.08	0.21	0.06	0.00	0.00	0.10
Well logger	1	0	7	0	4	10	1	39	958	21	2	0	1043
	0.00	0.00	0.10	0.00	0.00	0.87	0.00	0.58	0.89	0.28	0.50	0.00	0.85
Overall	**292**	**11**	**443**	**225**	**2691**	**5628**	**387**	**703**	**2949**	**1531**	**7**	**0**	**14867**
	0.44	**0.20**	**0.43**	**0.97**	**0.59**	**0.62**	**0.10**	**0.69**	**1.90**	**0.58**	**0.21**	**0.00**	**0.85**

Table 2 (cont'd)
Number of workers (top) and average whole body dose in mSv (bottom) by job category and province/territory

Job Sector and Category	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	N.W.T.	Yukon	Canada
Medicine													
Chiropractor	0	0	3	2	282	350	50	14	178	42	0	0	921
	0.00	0.00	0.00	0.10	0.03	0.05	0.04	0.00	0.03	0.09	0.00	0.00	0.04
Dental assistant	12	4	63	22	214	688	69	44	60	67	8	1	1252
	0.00	0.00	0.02	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.09	0.00	0.01
Dental hygienist	52	27	179	101	1881	2632	489	242	295	450	13	13	6374
	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Dentist	80	14	148	82	1697	2651	476	111	177	292	9	4	5741
	0.00	0.00	0.01	0.12	0.00	0.02	0.00	0.00	0.01	0.01	0.02	0.02	0.01
Gynaecologist	1	0	3	0	6	12	7	0	0	2	0	0	31
	0.00	0.00	0.00	0.00	0.03	0.06	0.03	0.00	0.00	0.35	0.00	0.00	0.06
Laboratory technician (medical)	39	7	145	10	856	1641	184	122	316	292	0	2	3614
	0.04	0.13	0.05	0.28	0.09	0.06	0.02	0.04	0.06	0.08	0.00	0.10	0.07
Medical physicist	3	0	11	9	65	105	5	12	14	38	0	0	262
	0.00	0.00	0.16	0.00	0.08	0.07	0.00	0.23	0.04	0.05	0.00	0.00	0.08
Medical radiation technologist	277	68	377	321	2445	4397	485	545	1255	1300	22	7	11499
	0.08	0.10	0.12	0.08	0.10	0.08	0.07	0.06	0.09	0.09	0.02	0.10	0.09
Nuclear medicine technologist	18	3	48	25	377	595	73	24	114	164	0	1	1442
	2.28	1.97	0.98	1.30	1.76	1.21	0.81	1.58	0.76	0.91	0.00	0.00	1.28
Nurse	227	22	180	126	1027	2646	161	98	157	303	84	61	5092
	0.04	0.03	0.13	0.07	0.06	0.06	0.03	0.04	0.10	0.07	0.00	0.02	0.06
Physician	47	6	80	27	637	879	47	48	160	195	9	3	2138
	0.27	0.05	0.46	0.20	0.13	0.13	0.05	0.61	0.13	0.13	0.04	0.00	0.15
Radiation therapist	11	0	34	32	186	480	48	53	60	125	0	0	1029
	3.00	0.00	0.23	0.22	0.60	0.23	0.23	0.18	0.09	0.30	0.00	0.00	0.33
Radiologist (diagnostic)	41	5	74	47	505	743	67	40	130	203	3	0	1858
	0.13	0.00	0.22	0.25	0.11	0.13	0.07	0.08	0.07	0.19	0.00	0.00	0.13
Radiologist (therapeutic)	3	0	10	12	40	63	19	4	14	17	0	0	182
	0.00	0.00	1.92	0.30	0.22	0.13	0.05	0.08	0.11	0.04	0.00	0.00	0.24

Table 2
Number of workers (top) and average whole body dose in mSv (bottom) by job category and province/territory

Job Sector and Category	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	N.W.T.	Yukon	Canada
Medicine (cont'd)													
Veterinarian	26	21	93	31	427	842	131	123	413	383	0	2	2492
	0.04	0.10	0.10	0.11	0.03	0.08	0.03	0.04	0.06	0.07	0.00	0.35	0.06
Veterinary technician	0	0	0	0	2	5	0	1	2	3	0	0	13
	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Ward aide/orderly	47	12	18	61	1145	363	33	41	36	113	6	2	1877
	0.04	0.15	0.03	0.05	0.07	0.08	0.00	0.05	0.02	0.04	0.00	0.00	0.06
Overall	**884**	**189**	**1466**	**908**	**11792**	**19092**	**2344**	**1522**	**3381**	**3989**	**154**	**96**	**45817**
	0.15	**0.10**	**0.15**	**0.13**	**0.12**	**0.10**	**0.05**	**0.09**	**0.09**	**0.11**	**0.11**	**0.03**	**0.10**
Nuclear Power													
Reactor – administration	0	0	0	150	362	3329	0	0	0	0	0	0	3841
	0.00	0.00	0.00	0.10	0.06	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.17
Reactor – chemical and radiation control	0	0	0	26	41	334	0	0	0	0	0	0	401
	0.00	0.00	0.00	0.89	1.45	2.19	0.00	0.00	0.00	0.00	0.00	0.00	2.03
Reactor – construction	0	0	0	46	62	1258	0	0	0	0	0	0	1366
	0.00	0.00	0.00	0.01	0.02	3.02	0.00	0.00	0.00	0.00	0.00	0.00	2.78
Reactor – control technicians	0	0	0	0	115	1	0	0	0	0	0	0	116
	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
Reactor – electrical maintenance	0	0	0	75	38	922	0	0	0	0	0	0	1035
	0.00	0.00	0.00	0.76	0.17	1.51	0.00	0.00	0.00	0.00	0.00	0.00	1.40
Reactor – fuel handling	0	0	0	44	11	101	0	0	0	0	0	0	156
	0.00	0.00	0.00	3.53	1.38	8.22	0.00	0.00	0.00	0.00	0.00	0.00	6.41
Reactor – general maintenance	0	0	0	154	62	894	0	0	0	0	0	0	1110
	0.00	0.00	0.00	0.74	0.61	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.93
Reactor – health physics	0	0	0	30	10	56	0	0	0	0	0	0	96
	0.00	0.00	0.00	1.01	0.16	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.41
Reactor – industrial radiographer	0	0	0	0	0	23	0	0	0	0	0	0	23
	0.00	0.00	0.00	0.00	0.00	2.53	0.00	0.00	0.00	0.00	0.00	0.00	2.53
Reactor – mechanical maintenance	0	0	8	93	79	1092	0	0	0	0	0	0	1264
	0.00	0.00	0.00	2.68	1.55	3.48	0.00	0.00	0.00	0.00	0.00	0.00	3.30
Reactor – operations	0	0	0	85	110	1549	0	0	0	0	0	0	1744
	0.00	0.00	0.00	0.99	0.99	1.87	0.00	0.00	0.00	0.00	0.00	0.00	1.77

Table 2 (cont'd)
Number of workers (top) and average whole body dose in mSv (bottom) by job category and province/territory

Job Sector and Category	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	N.W.T.	Yukon	Canada
Nuclear Power (cont'd)													
Reactor – scientific/professional	0	0	0	298	139	957	0	0	0	0	0	0	1394
	0.00	0.00	0.00	0.50	0.13	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.63
Reactor – training	0	0	0	29	21	15	0	0	0	0	0	0	65
	0.00	0.00	0.00	0.20	0.37	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.22
Reactor – visitor	0	0	0	0	2	47	0	0	0	0	0	0	49
	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.16
Overall	**0**	**0**	**0**	**1030**	**1052**	**10578**	**0**	**0**	**0**	**0**	**0**	**0**	**12660**
	0.00	**0.00**	**0.00**	**0.86**	**0.42**	**1.49**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.35**
Mining													
Uranium mine mill maintenance	0	0	0	0	0	9	0	162	0	0	0	0	171
	0.00	0.00	0.00	0.00	0.00	0.08	0.00	2.26	0.00	0.00	0.00	0.00	2.15
Uranium mine mill workers	0	0	0	0	0	34	0	166	0	0	0	0	200
	0.00	0.00	0.00	0.00	0.00	0.76	0.00	2.89	0.00	0.00	0.00	0.00	2.53
Uranium mine nurses	0	0	0	0	0	0	0	2	0	0	0	0	2
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.10
Uranium mine office staff	0	0	0	0	0	22	0	68	0	0	0	0	90
	0.00	0.00	0.00	0.00	0.00	0.96	0.00	0.80	0.00	0.00	0.00	0.00	0.84
Uranium mine support workers	0	0	0	0	0	90	0	75	0	0	0	0	165
	0.00	0.00	0.00	0.00	0.00	9.45	0.00	6.92	0.00	0.00	0.00	0.00	8.31
Uranium mine surface maintenance	0	0	0	0	0	63	0	141	0	0	0	0	204
	0.00	0.00	0.00	0.00	0.00	1.95	0.00	1.21	0.00	0.00	0.00	0.00	1.44
Uranium mine surface miner	0	0	0	0	0	0	0	115	0	0	0	0	115
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.09	0.00	0.00	0.00	0.00	2.09
Uranium mine surface personnel	0	0	0	0	0	0	0	60	0	0	0	0	60
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.80
Uranium mine surface support workers	0	0	0	0	0	70	0	212	0	0	0	0	282
	0.00	0.00	0.00	0.00	0.00	0.20	0.00	1.30	0.00	0.00	0.00	000	1.04
Uranium mine underground maintenance	0	0	0	0	0	75	0	21	0	0	0	0	96
	0.00	0.00	0.00	0.00	0.00	6.84	0.00	5.21	0.00	0.00	0.00	0.00	6.49

Table 2 (cont'd)
Number of workers (top) and average whole body dose in mSv (bottom) by job category and province/territory

Job Sector and Category	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	N.W.T.	Yukon	Canada
Mining (cont'd)													
Uranium mine underground miner	0	0	0	0	0	155	0	197	0	0	0	0	352
	0.00	0.00	0.00	0.00	0.00	17.23	0.00	8.76	0.00	0.00	0.00	0.00	12.49
Uranium mine underground personnel	0	0	0	0	0	194	0	194	0	0	0	0	388
	0.00	0.00	0.00	0.00	0.00	0.92	0.00	1.41	0.00	0.00	0.00	0.00	1.17
Uranium mine visitors	0	0	0	0	0	0	0	115	0	0	0	0	115
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.31
Overall	**0**	**0**	**0**	**0**	**0**	**712**	**0**	**1528**	**0**	**0**	**0**	**0**	**2240**
	0.00	**0.00**	**0.00**	**0.00**	**0.00**	**5.18**	**0.00**	**2.82**	**0.00**	**0.00**	**0.00**	**0.00**	**3.89**

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Table 3
Dose distribution broken down by job sector, age and sex

			Sex			
Job Sector	Age	Statistic	Male	Female	Unknown	Overall
Administration	Below 25	Number of Workers	8	286	0	294
		Average dose (mSv)	0.18	0.04	0.00	0.04
	25-34	Number of Workers	102	1071	3	1176
		Average dose (mSv)	0.71	0.06	0.00	0.12
	35-44	Number of Workers	223	1159	8	1390
		Average dose (mSv)	0.46	0.10	0.00	0.16
	45-54	Number of Workers	293	682	2	977
		Average dose (mSv)	0.42	0.12	0.00	0.21
	55-up	Number of Workers	90	201	5	296
		Average dose (mSv)	0.34	0.07	0.00	0.15
	Unknown	Number of Workers	18	30	0	48
		Average dose (mSv)	0.43	0.11	0.00	0.23
	Overall	**Number of Workers**	**734**	**3429**	**18**	**4181**
		Average dose (mSv)	**0.46**	**0.08**	**0.00**	**0.15**
Industry and Research	Below 25	Number of Workers	770	397	3	1170
		Average dose (mSv)	2.62	0.08	0.77	1.75
	25-34	Number of Workers	3524	1485	17	5026
		Average dose (mSv)	1.38	0.11	0.38	1.00
	35-44	Number of Workers	3889	945	14	4848
		Average dose (mSv)	0.98	0.11	0.05	0.80
	45-54	Number of Workers	2121	392	4	2517
		Average dose (mSv)	0.57	0.13	0.05	0.50
	55-up	Number of Workers	747	93	15	855
		Average dose (mSv)	0.47	0.18	0.37	0.44
	Unknown	Number of Workers	149	13	1	163
		Average dose (mSv)	0.31	0.06	0.00	0.28
	Overall	**Number of Workers**	**11200**	**3325**	**54**	**14579**
		Average dose (mSv)	**1.10**	**0.11**	**0.28**	**0.87**
Medicine	Below 25	Number of Workers	410	3035	5	3450
		Average dose (mSv)	0.31	0.09	0.16	0.12
	25-34	Number of Workers	3548	11248	26	14822
		Average dose (mSv)	0.17	0.10	0.01	0.12
	35-44	Number of Workers	4834	9942	26	14802
		Average dose (mSv)	0.13	0.09	0.08	0.10
	45-54	Number of Workers	3780	4915	21	8716
		Average dose (mSv)	0.10	0.08	0.06	0.09
	55-up	Number of Workers	2081	1091	37	3209
		Average dose (mSv)	0.10	0.08	0.05	0.10
	Unknown	Number of Workers	241	227	2	470
		Average dose (mSv)	0.14	0.12	0.00	0.13
	Overall	**Number of Workers**	**14894**	**30458**	**117**	**45469**
		Average dose (mSv)	**0.13**	**0.09**	**0.05**	**0.11**

Table 3 (cont'd)
Dose distribution broken down by job sector, age and sex

			Sex			
Job Sector	Age	Statistic	Male	Female	Unknown	Overall
Nuclear Power	Below 25	Number of Workers	228	71	0	299
		Average dose (mSv)	1.40	0.42	0.00	1.17
		% tritium	25.6	40.4	0.0	26.9
	25-34	Number of Workers	2630	549	1	3180
		Average dose (mSv)	2.00	0.41	0.00	1.72
		% tritium	25.5	30.0	0.0	25.7
	35-44	Number of Workers	4498	608	2	5108
		Average dose (mSv)	1.55	0.38	0.00	1.41
		% tritium	22.6	24.0	0.0	22.7
	45-54	Number of Workers	2884	225	0	3109
		Average dose (mSv)	1.06	0.27	0.00	1.00
		% tritium	19.1	16.9	0.0	19.0
	55-up	Number of Workers	568	16	1	585
		Average dose (mSv)	1.25	0.03	0.00	1.22
		% tritium	13.3	29.6	0.0	13.4
	Unknown	Number of Workers	143	5	0	148
		Average dose (mSv)	1.07	0.00	0.00	1.03
		% tritium	17.1	0.0	0.0	17.1
	Overall	**Number of Workers**	**10951**	**1474**	**4**	**12429**
		Average dose (mSv)	**1.50**	**0.37**	**0.00**	**1.37**
		% tritium	**22.5**	**26.6**	**0.0**	**22.6**
Mining	Below 25	Number of Workers	91	22	0	113
		Average dose (mSv)	2.10	0.40	0.00	1.77
		% radon daughters	63.6	77.3	0.0	64.2
	25-34	Number of Workers	443	55	0	498
		Average dose (mSv)	3.54	1.23	0.00	3.28
		% radon progeny	64.2	65.4	0.0	64.3
	35-44	Number of Workers	770	43	0	813
		Average dose (mSv)	5.22	0.56	0.00	4.97
		% radon progeny	72.8	70.5	0.0	72.8
	45-54	Number of Workers	497	19	0	516
		Average dose (mSv)	4.43	0.65	0.00	4.29
		% radon progeny	73.2	71.0	0.0	73.2
	55-up	Number of Workers	193	7	3	203
		Average dose (mSv)	2.30	0.26	0.40	2.20
		% radon progeny	72.7	77.8	8.3	72.6
	Unknown	Number of Workers	43	2	0	45
		Average dose (mSv)	3.43	0.00	0.00	3.28
		% radon progeny	81.9	0.0	0.0	81.9
	Overall	**Number of Workers**	**2037**	**148**	**3**	**2188**
		Average dose (mSv)	**4.21**	**0.78**	**0.40**	**3.97**
		% radon progeny	**71.3**	**68.2**	**8.3**	**71.2**