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2005 Report on Occupational Radiation Exposures in Canada

Canada

2005 Report on Occupational Radiation Exposures in Canada

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Abstract

The report provides statistics on occupational radiation exposures for use by regulatory authorities, organizations and private individuals. Out of a total of 142 767 monitored workers, 10 annual doses exceeded the regulatory limit of 50 mSv in 2004. Out of 60 specified job categories, 42 had a smaller annual average in 2004 than in 2003, 9 had a higher average, and 9 had the same average rounded to 0.01 mSv. Typically, the changes in average dose were small.

Acknowledgments

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Introduction

This series of reports provides statistics on occupational radiation exposures of monitored workers in Canada. The statistics are intended to assist regulatory authorities, organizations, and private individuals in comparing incurred occupational radiation exposures with national or provincial/territorial averages and trends in similar occupations. This report, as well as previous issues, can be found on the NDR's web site[1] and downloaded, or obtained from the authors.

The information is based on the data in the National Dose Registry (NDR) maintained by the Radiation Protection Bureau of Health Canada[1]. The Registry is a centralized record-keeping system containing dose information on all monitored workers in Canada. It includes data submitted by nuclear power generating stations, Atomic Energy of Canada Ltd., uranium mines, and dosimeter processing companies.

Information for input into the NDR is received either via a direct link or by mail 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 complete 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 (Table 1), and more complete data on the first year (Tables 2-4).

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 recur 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 September 13, 2005. 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 various organizations have set recording thresholds from 0 to 0.2 mSv.

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 effective 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 urinalysis.
- 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[2]. In the report the radon progeny exposures are converted to equivalent doses (in mSv). The value used in this report is 5 mSv/WLM, in accordance with the radiation protection regulations[3] under the *Nuclear Safety and Control Act*.

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 who has been monitored by more than one organization, can have records under more than one job category for the same year. Some organizations have their own job classifications 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:

2004: Preliminary analysis

Table 1:

Table 1 gives the annual dose distributions by job category.

2003: Final Analysis

Table 2:

Table 2 contains dose statistics by job category and province or territory.

Table 3:

Table 3 contains dose statistics by age and sex. In this table job categories have been grouped into "job sectors".

Table 4:

Table 4 contains various dose statistics by job category. The table also shows the parameters of the statistical distribution applied to the doses, as determined 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 1999-2003 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 1994-2003.

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 on job sector in the same year. For this reason the totals in Tables 2-4 may slightly differ.

Comments specific to this report

We have included in Tables 1 and 2 now the statistics for the miscellaneous/unknown job categories and for all job categories combined.

References

1. The National Dose Registry's web site is found at http://www.hc-sc.gc.ca/ndr

2. ICRP publication 65, "Protection against Radon-222 at home and at work.", Annals of the ICRP 23(2), p.4 (1993).

3. Regulations of the *Nuclear Safety and Control Act*, Canada Gazette, June 21, 2000, part 2. For more information see the web site of the CNSC:

   http://www.cnsc-ccsn.gc.ca

4. Kumazawa, S. and Numakunai, T. "A new theoretical analysis of occupational dose distributions indicating the effect of dose limits.", Health Physics 41(3) pp. 465-475 (1981).

2004 Preliminary Analysis

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	430	199	2	6	1	0	0	638	0.15	0.45
Office staff	3252	532	15	3	3	0	1	3806	0.10	0.66
Safety officer	350	122	4	4	0	0	0	480	0.11	0.41
Industry and Research										
Aircrew	7	7	1	1	0	0	0	16	0.46	0.81
Ground transportation	33	37	8	4	1	0	0	83	0.58	0.96
Industrial radiographer	1164	456	237	382	455	42	2	2738	2.73	4.74
Instructor (non-medical)	222	21	1	0	1	0	0	245	0.07	0.71
Instrument technician	1578	540	38	33	5	2	0	2196	0.19	0.69
Laboratory technician (industrial)	2339	830	77	87	17	1	0	3351	0.23	0.77
Nuclear fuel processor	192	319	88	102	54	0	0	755	1.27	1.71
Scientist/Engineer (field)	743	561	29	13	5	0	0	1351	0.25	0.56
Scientist/Engineer (laboratory)	4596	930	21	5	4	0	0	5556	0.05	0.30
Security	166	18	0	0	0	0	0	184	0.02	0.24
Tradesmen	155	80	3	1	0	0	0	239	0.11	0.32
Well logger	1330	806	155	76	7	0	0	2374	0.35	0.80
Medicine										
Chiropractor	1019	78	4	2	0	0	0	1103	0.03	0.42
Dental assistant	13346	615	6	4	1	1	0	13973	0.01	0.26
Dental hygienist	9114	394	1	2	1	0	0	9512	0.01	0.22
Dental therapist/nurse	123	25	0	0	0	0	0	148	0.04	0.26
Dentist	7572	384	3	5	1	1	0	7966	0.02	0.33
Gynaecologist	9	1	0	0	0	0	0	10	0.02	0.15
Laboratory technician (medical)	3240	953	48	26	2	0	0	4269	0.09	0.39
Medical physicist	348	78	2	2	0	0	0	430	0.06	0.31
Medical radiation technologist	10152	3033	143	97	10	2	0	13437	0.10	0.43
Nuclear medicine technologist	353	462	368	520	69	0	5	1777	1.97	2.46
Nurse	4909	1375	58	31	9	0	0	6382	0.10	0.42
Physician	1888	703	77	32	15	0	1	2716	0.23	0.77
Radiation therapist	1275	500	6	10	1	1	0	1793	0.11	0.37

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			
Radiologist (diagnostic)	1638	495	32	20	12	1	0	2198	0.19	0.73
Radiologist (therapeutic)	229	48	5	3	0	0	0	285	0.10	0.52
Veterinarian	3002	445	12	2	0	0	0	3461	0.04	0.30
Veterinary technician	2819	368	14	2	0	0	0	3203	0.04	0.29
Ward aid/orderly	1060	178	9	7	1	0	0	1255	0.08	0.49
Nuclear Power										
Reactor - administration	3396	394	68	69	21	0	0	3948	0.15	1.05
Reactor - chemical and radiation control	164	186	65	60	93	0	0	568	2.10	2.96
Reactor - construction	685	302	65	130	86	0	0	1268	1.01	2.20
Reactor - control technician	86	61	6	1	0	0	0	154	0.16	0.35
Reactor - electrical maintenance	679	426	130	124	31	0	0	1390	0.67	1.32
Reactor - fuel handling	28	44	11	12	18	0	0	113	1.98	2.64
Reactor - general maintenance	887	306	59	78	84	0	0	1414	0.75	2.01
Reactor - health physics	43	16	8	4	0	0	0	71	0.43	1.09
Reactor - industrial radiographer	11	14	12	26	9	0	0	72	2.25	2.65
Reactor - mechanical maintenance	509	396	172	226	148	0	0	1451	1.56	2.41
Reactor - operations	949	760	261	236	112	0	0	2318	1.02	1.73
Reactor - scientific/professional	1803	431	101	108	61	0	0	2504	0.42	1.51
Reactor - training	49	10	1	1	1	0	0	62	0.26	1.25
Reactor - visitor	4012	1091	375	513	314	0	0	6305	0.81	2.23
Uranium Mining										
Uranium mine mill maintenance	65	140	68	35	0	0	0	308	0.84	1.07
Uranium mine mill worker	41	79	65	79	9	0	0	273	1.58	1.86
Uranium mine nurse	5	9	0	0	0	0	0	14	0.18	0.27
Uranium mine office staff	88	130	4	0	0	0	0	222	0.16	0.26
Uranium mine support worker	39	109	32	42	8	0	0	230	1.20	1.44
Uranium mine surface maintenance	85	176	34	6	0	0	0	301	0.42	0.58
Uranium mine surface miner	10	21	2	1	0	0	0	34	0.46	0.66
Uranium mine surface personnel	107	101	12	10	0	0	0	230	0.34	0.64
Uranium mine surface support worker	307	230	13	3	0	0	0	553	0.14	0.32
Uranium mine underground maintenance	11	82	25	24	0	0	0	142	0.98	1.07
Uranium mine underground miner	12	49	35	45	65	0	0	206	3.61	3.83
Uranium mine underground personnel	16	35	18	24	1	0	0	94	1.29	1.56

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			
Uranium mine visitor	7	3	0	0	0	0	0	10	0.06	0.18
Miscellaneous/Unknown										
Miscellaneous/unknown	20054	4647	320	215	132	6	1	25375	0.15	0.72
TOTAL	108706	25259	3335	3480	1918	59	10	142767	0.30	1.24

2003 Final Analysis

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	9	0	6	9	55	387	19	11	88	42	1	0	627
	0.17	0.00	0.00	0.22	0.02	0.16	0.00	0.00	0.08	0.08	0.00	0.00	0.13
Office staff	46	10	82	53	671	1932	238	100	474	314	11	2	3933
	0.05	0.06	0.03	0.05	0.01	0.08	0.02	0.01	0.05	0.04	0.01	0.00	0.05
Safety officer	2	1	6	5	31	178	12	7	38	14	0	0	294
	0.00	0.32	0.00	0.12	0.09	0.13	0.00	0.09	0.33	1.39	0.00	0.00	0.20
OVERALL	**57**	**11**	**94**	**67**	**757**	**2497**	**269**	**118**	**600**	**370**	**12**	**2**	**4854**
	0.07	**0.09**	**0.03**	**0.08**	**0.02**	**0.09**	**0.01**	**0.02**	**0.07**	**0.09**	**0.01**	**0.00**	**0.07**
Industry and Research													
Aircrew	0	0	0	0	0	11	0	0	0	0	0	0	11
	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.63
Ground transportation	0	0	0	0	13	56	0	4	4	5	0	0	82
	0.00	0.00	0.00	0.00	0.98	0.81	0.00	0.00	0.08	0.10	0.00	0.00	0.72
Industrial radiographer	72	0	82	100	336	598	30	176	1151	230	1	3	2779
	0.28	0.00	0.86	1.19	1.30	1.15	0.42	1.91	4.64	2.02	0.10	0.03	2.70
Instructor (non-medical)	8	2	9	8	31	71	11	21	35	19	1	0	216
	0.09	0.42	0.30	0.12	0.26	0.07	0.03	0.01	0.56	0.00	0.00	0.00	0.18
Instrument technician	88	0	178	113	465	983	43	61	277	77	0	0	2285
	0.18	0.00	0.15	0.24	0.13	0.26	0.02	0.12	0.69	0.26	0.00	0.00	0.26
Laboratory technician (industrial)	50	12	68	64	857	1588	214	313	305	162	0	0	3633
	0.22	0.08	0.09	0.39	0.09	0.44	0.01	0.07	0.11	0.38	0.00	0.00	0.26
Nuclear fuel processor	1	0	0	0	0	715	0	0	22	0	0	0	738
	0.70	0.00	0.00	0.00	0.00	1.48	0.00	0.00	0.31	0.00	0.00	0.00	1.45
Scientist/Engineer (field)	28	0	28	22	54	787	15	93	127	93	14	0	1261
	0.26	0.00	0.06	0.19	0.04	0.41	1.28	0.05	0.41	0.15	0.06	0.00	0.34
Scientist/Engineer (laboratory)	82	2	151	17	2125	2104	116	97	933	403	0	0	6030
	0.02	0.16	0.06	0.20	0.03	0.08	0.02	0.03	0.08	0.04	0.00	0.00	0.06
Security	1	0	2	11	0	92	0	0	14	10	0	0	130
	0.73	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.02
Tradesmen	1	0	0	3	13	142	0	8	21	4	0	0	192
	0.00	0.00	0.00	2.05	0.00	0.14	0.00	0.48	0.14	0.10	0.00	0.00	0.17
Well logger	0	0	0	4	1	13	0	13	1906	9	0	0	1946
	0.00	0.00	0.00	0.03	0.00	0.15	0.00	0.03	0.44	0.08	0.00	0.00	0.43
OVERALL	**331**	**16**	**518**	**342**	**3895**	**7160**	**429**	**786**	**4795**	**1012**	**16**	**3**	**19303**
	0.17	**0.13**	**0.22**	**0.54**	**0.17**	**0.46**	**0.09**	**0.48**	**1.37**	**0.57**	**0.06**	**0.03**	**0.61**
Medicine													
Chiropractor	1	0	3	3	577	273	80	8	130	19	0	0	1094
	0.00	0.00	0.05	0.04	0.02	0.03	0.02	0.01	0.05	0.14	0.00	0.00	0.03

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
Dental assistant	150	34	297	175	2884	5569	832	358	2299	782	27	1	13408
	0.05	0.08	0.02	0.03	0.02	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01
Dental hygienist	53	18	198	118	3062	3927	491	150	936	330	5	2	9290
	0.03	0.10	0.02	0.02	0.01	0.01	0.00	0.02	0.01	0.02	0.00	0.10	0.01
Dental therapist/nurse	0	0	0	0	11	21	29	42	15	1	11	7	137
	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.05	0.00	0.02	0.43	0.04
Dentist	111	10	153	96	2973	2812	528	106	773	268	16	0	7846
	0.06	0.15	0.01	0.03	0.03	0.01	0.01	0.02	0.03	0.02	0.00	0.00	0.02
Gynaecologist	1	0	1	0	2	1	3	0	1	1	1	0	11
	0.00	0.00	0.14	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Laboratory technician (medical)	35	2	103	9	1268	2256	130	67	293	208	2	2	4375
	0.04	0.18	0.03	0.07	0.12	0.13	0.01	0.04	0.21	0.06	0.00	0.00	0.12
Medical physicist	8	4	12	6	101	167	21	10	21	64	0	0	414
	0.04	0.14	0.11	0.16	0.06	0.10	0.14	0.00	0.28	0.03	0.00	0.00	0.09
Medical radiation technologist	328	47	212	390	3189	4797	685	724	1612	1476	35	11	13506
	0.17	0.14	0.16	0.12	0.10	0.13	0.05	0.06	0.18	0.09	0.02	0.10	0.12
Nuclear medicine technologist	21	6	51	41	525	640	65	27	158	192	0	0	1726
	1.49	1.19	1.99	1.39	2.03	1.69	1.29	2.03	1.82	0.84	0.00	0.00	1.70
Nurse	200	6	126	184	1276	2816	349	110	433	474	119	84	6177
	0.14	0.02	0.11	0.12	0.05	0.14	0.02	0.13	0.23	0.07	0.00	0.05	0.11
Physician	42	4	56	39	779	1112	112	37	207	207	2	3	2600
	0.31	0.00	0.06	0.12	0.26	0.21	0.17	0.33	0.44	0.19	0.00	0.00	0.24
Radiation therapist	16	9	41	45	331	830	48	71	155	276	0	0	1822
	0.81	0.11	0.55	0.21	0.19	0.54	0.31	0.13	0.12	0.06	0.00	0.00	0.34
Radiologist (diagnostic)	53	5	30	50	534	836	72	62	257	239	7	0	2145
	0.34	0.02	0.29	0.13	0.17	0.24	0.05	0.03	0.43	0.19	0.03	0.00	0.23
Radiologist (therapeutic)	1	0	5	9	75	120	10	6	18	26	0	0	270
	0.25	0.00	0.11	0.06	0.13	0.20	0.00	0.00	0.05	0.01	0.00	0.00	0.13
Veterinarian	44	55	156	74	841	830	185	173	677	545	0	9	3589
	0.05	0.27	0.05	0.15	0.02	0.07	0.02	0.04	0.03	0.05	0.00	0.00	0.05
Veterinary technician	42	10	89	53	603	694	142	88	501	518	0	6	2746
	0.03	0.05	0.02	0.05	0.02	0.09	0.01	0.02	0.03	0.04	0.00	0.02	0.04
Ward aid/orderly	14	8	15	33	745	314	77	19	64	82	8	9	1388
	0.02	0.03	0.03	0.05	0.07	0.11	0.00	0.14	0.21	0.06	0.04	0.00	0.08
OVERALL	**1120**	**218**	**1548**	**1325**	**19776**	**28015**	**3859**	**2058**	**8550**	**5708**	**233**	**134**	**72544**
	0.16	**0.17**	**0.14**	**0.13**	**0.12**	**0.13**	**0.05**	**0.08**	**0.13**	**0.09**	**0.01**	**0.06**	**0.12**
Nuclear Power													
Reactor - administration	0	0	0	326	484	3571	0	0	0	0	0	0	4381
	0.00	0.00	0.00	0.16	0.14	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.21
Reactor - chemical and radiation control	0	0	0	23	26	472	0	0	0	0	0	0	521
	0.00	0.00	0.00	1.02	1.35	2.04	0.00	0.00	0.00	0.00	0.00	0.00	1.96

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
Reactor - construction	0	0	0	0	64	1798	0	0	0	0	0	0	1862
	0.00	0.00	0.00	0.00	0.72	1.21	0.00	0.00	0.00	0.00	0.00	0.00	1.20
Reactor - control technician	0	0	0	0	185	0	0	0	0	0	0	0	185
	0.00	0.00	0.00	0.00	2.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.19
Reactor - electrical maintenance	0	0	0	81	41	1288	0	0	0	0	0	0	1410
	0.00	0.00	0.00	0.41	1.80	1.12	0.00	0.00	0.00	0.00	0.00	0.00	1.10
Reactor - fuel handling	0	0	0	111	16	0	0	0	0	0	0	0	127
	0.00	0.00	0.00	3.40	2.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.34
Reactor - general maintenance	0	0	0	160	82	1152	0	0	0	0	0	0	1394
	0.00	0.00	0.00	0.74	3.51	1.01	0.00	0.00	0.00	0.00	0.00	0.00	1.12
Reactor - health physics	0	0	0	26	20	8	0	0	0	0	0	0	54
	0.00	0.00	0.00	1.60	0.08	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.84
Reactor - industrial radiographer	0	0	0	50	8	36	0	0	0	0	0	0	94
	0.00	0.00	0.00	2.53	6.79	2.26	0.00	0.00	0.00	0.00	0.00	0.00	2.79
Reactor - mechanical maintenance	0	0	0	119	184	1330	0	0	0	0	0	0	1633
	0.00	0.00	0.00	1.18	6.54	1.84	0.00	0.00	0.00	0.00	0.00	0.00	2.32
Reactor - operations	0	0	0	128	111	2073	0	0	0	0	0	0	2312
	0.00	0.00	0.00	0.38	1.54	1.16	0.00	0.00	0.00	0.00	0.00	0.00	1.14
Reactor - scientific/professional	0	0	0	300	238	1992	0	0	0	0	0	0	2530
	0.00	0.00	0.00	0.34	1.29	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.55
Reactor - training	0	0	0	37	22	1	0	0	0	0	0	0	60
	0.00	0.00	0.00	0.71	0.44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61
Reactor - visitor	0	0	0	0	1017	5617	0	0	0	0	0	0	6634
	0.00	0.00	0.00	0.00	0.30	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.53
OVERALL	**0**	**0**	**0**	**1361**	**2498**	**19338**	**0**	**0**	**0**	**0**	**0**	**0**	**23197**
	0.00	**0.00**	**0.00**	**0.80**	**1.21**	**0.81**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.85**
Uranium Mining													
Uranium mine mill maintenance	0	0	0	0	0	0	0	209	0	0	0	0	209
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.00	0.00	0.00	0.00	1.03
Uranium mine mill worker	0	0	0	0	0	0	0	260	0	0	0	0	260
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00	0.00	0.00	0.00	1.35
Uranium mine nurse	0	0	0	0	0	0	0	13	0	0	0	0	13
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.21
Uranium mine office staff	0	0	0	0	0	0	0	145	0	0	0	0	145
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.14
Uranium mine support worker	0	0	0	0	0	0	0	143	0	0	0	0	143
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.66	0.00	0.00	0.00	0.00	1.66
Uranium mine surface maintenance	0	0	0	0	0	0	0	230	0	0	0	0	230
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.47
Uranium mine surface miner	0	0	0	0	0	0	0	42	0	0	0	0	42
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.19	0.00	0.00	0.00	0.00	1.19

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
Uranium mine surface personnel	0	0	0	0	0	11	0	170	0	0	0	0	181
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.48
Uranium mine surface support worker	0	0	0	0	0	0	0	367	0	0	0	0	367
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.16
Uranium mine underground	0	0	0	0	0	0	0	158	0	0	0	0	158
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.98
Uranium mine underground miner	0	0	0	0	0	0	0	274	0	0	0	0	274
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.62	0.00	0.00	0.00	0.00	2.62
Uranium mine underground personnel	0	0	0	0	0	3	0	97	0	0	0	0	100
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06	0.00	0.00	0.00	0.00	1.03
Uranium mine visitor	0	0	0	0	0	1	0	120	0	0	0	0	121
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.14
OVERALL	**0**	**0**	**0**	**0**	**0**	**15**	**0**	**2228**	**0**	**0**	**0**	**0**	**2243**
	0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.95**	**0.00**	**0.00**	**0.00**	**0.00**	**0.95**
Miscellaneous/Unknown													
Miscellaneous/unknown	239	67	473	288	8019	9841	880	768	2934	2090	45	4	25649
	0.15	0.19	0.15	0.27	0.06	0.19	0.04	0.06	0.23	0.61	0.01	0.06	0.18
OVERALL	**239**	**67**	**473**	**288**	**8019**	**9841**	**880**	**768**	**2934**	**2090**	**45**	**4**	**25649**
	0.15	**0.19**	**0.15**	**0.27**	**0.06**	**0.19**	**0.04**	**0.06**	**0.23**	**0.61**	**0.01**	**0.06**	**0.18**
TOTAL	1728	311	2589	332	34054	64687	5332	5702	16342	8937	305	143	143457
	0.16	0.17	0.15	0.4	0.19	0.38	0.05	0.48	0.51	0.27	0.01	0.06	0.33

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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	30	300	0	330
		Average dose (mSv)	0.09	0.02	0.00	0.03
	25-34	Number of Workers	125	913	0	1038
		Average dose (mSv)	0.12	0.04	0.00	0.05
	35-44	Number of Workers	285	1174	0	1459
		Average dose (mSv)	0.25	0.05	0.00	0.09
	45-54	Number of Workers	302	1153	0	1455
		Average dose (mSv)	0.23	0.04	0.00	0.08
	55 up	Number of Workers	144	411	0	555
		Average dose (mSv)	0.15	0.03	0.00	0.06
	Unknown	Number of Workers	0	1	0	1
		Average dose (mSv)	0.00	0.00	0.00	0.00
	Overall	**Number of Workers**	**886**	**3952**	**0**	**4838**
		Average dose (mSv)	**0.20**	**0.04**	**0.00**	**0.07**
Industry and Research	Below 25	Number of Workers	1223	550	0	1773
		Average dose (mSv)	1.68	0.25	0.00	1.23
	25-34	Number of Workers	3939	1809	0	5748
		Average dose (mSv)	0.96	0.09	0.00	0.69
	35-44	Number of Workers	4155	1276	0	5431
		Average dose (mSv)	0.64	0.15	0.00	0.53
	45-54	Number of Workers	3482	853	0	4335
		Average dose (mSv)	0.60	0.18	0.00	0.52
	55 up	Number of Workers	1561	230	0	1791
		Average dose (mSv)	0.35	0.16	0.00	0.33
	Unknown	Number of Workers	7	1	0	8
		Average dose (mSv)	0.17	0.00	0.00	0.15
	Overall	**Number of Workers**	**14367**	**4719**	**0**	**19086**
		Average dose (mSv)	**0.78**	**0.15**	**0.00**	**0.62**
Medicine	Below 25	Number of Workers	493	5664	0	6157
		Average dose (mSv)	0.25	0.06	0.00	0.07
	25-34	Number of Workers	3408	17065	0	20473
		Average dose (mSv)	0.18	0.08	0.00	0.10
	35-44	Number of Workers	5221	16160	0	21381
		Average dose (mSv)	0.25	0.12	0.00	0.15
	45-54	Number of Workers	5141	11241	0	16382
		Average dose (mSv)	0.13	0.12	0.00	0.12
	55 up	Number of Workers	3705	3372	0	7077
		Average dose (mSv)	0.11	0.10	0.00	0.11
	Unknown	Number of Workers	5	8	0	13
		Average dose (mSv)	0.06	0.00	0.00	0.02
	Overall	**Number of Workers**	**17973**	**53510**	**0**	**71483**
		Average dose (mSv)	**0.17**	**0.10**	**0.00**	**0.12**

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	1069	272	0	1341
		Average dose (mSv)	0.79	0.19	0.00	0.67
		%tritium	12.83	29.08	0.00	13.77
	25-34	Number of Workers	2875	526	0	3401
		Average dose (mSv)	1.20	0.30	0.00	1.06
		%tritium	18.04	28.17	0.00	18.48
	35-44	Number of Workers	5867	919	0	6786
		Average dose (mSv)	1.12	0.35	0.00	1.02
		%tritium	18.57	21.84	0.00	18.72
	45-54	Number of Workers	6831	689	0	7520
		Average dose (mSv)	0.97	0.20	0.00	0.90
		%tritium	15.54	25.14	0.00	15.74
	55 up	Number of Workers	3297	130	0	3427
		Average dose (mSv)	0.48	0.10	0.00	0.47
		%tritium	14.42	30.97	0.00	14.55
	Unknown	Number of Workers	1	1	2	4
		Average dose (mSv)	0.00	0.00	0.00	0.02
		%tritium	0.00	0.00	100.00	100.00
	Overall	**Number of Workers**	**19940**	**2537**	**2**	**22479**
		Average dose (mSv)	**0.96**	**0.27**	**0.05**	**0.88**
		%tritium	**16.82**	**24.70**	**100.00**	**17.09**
Uranium Mining	Below 25	Number of Workers	104	32	0	136
		Average dose (mSv)	0.47	0.25	0.00	0.42
		% radon progeny	63.73	45.57	0.00	61.22
	25-34	Number of Workers	469	58	0	527
		Average dose (mSv)	1.11	0.35	0.00	1.03
		% radon progeny	55.44	65.43	0.00	55.82
	35-44	Number of Workers	646	60	0	706
		Average dose (mSv)	1.28	0.34	0.00	1.20
		% radon progeny	55.38	70.44	0.00	55.75
	45-54	Number of Workers	502	31	0	533
		Average dose (mSv)	0.97	0.32	0.00	0.94
		% radon progeny	54.60	79.80	0.00	55.10
	55 up	Number of Workers	214	9	0	223
		Average dose (mSv)	0.84	0.12	0.00	0.81
		% radon progeny	61.90	100.00	0.00	62.13
	Overall	**Number of Workers**	**1935**	**190**	**0**	**2125**
		Average dose (mSv)	**1.07**	**0.31**	**0.00**	**1.00**
		% radon progeny	**55.98**	**67.54**	**0.00**	**56.30**

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

			Sex			
Job Sector	Age	Statistic	Male	Female	Unknown	Overall
Miscellaneous/ Unknown	Below 25	Number of Workers	90	95	0	185
		Average dose (mSv)	0.14	0.09	0.00	0.11
	25-34	Number of Workers	191	190	0	381
		Average dose (mSv)	0.10	0.11	0.00	0.11
	35-44	Number of Workers	155	111	0	266
		Average dose (mSv)	0.18	0.10	0.00	0.15
	45-54	Number of Workers	109	61	0	170
		Average dose (mSv)	0.08	0.05	0.00	0.07
	55 up	Number of Workers	52	27	0	79
		Average dose (mSv)	0.02	0.08	0.00	0.04
	Unknown	Number of Workers	2	1	3	6
		Average dose (mSv)	0.00	0.00	0.00	0.00
	Overall	**Number of Workers**	**599**	**485**	**3**	**1087**
		Average dose (mSv)	**0.12**	**0.09**	**0.00**	**0.11**
TOTAL						
	Below 25	Number of Workers	2981	6878	0	9859
		Average dose (mSv)	1.03	0.08	0.00	0.37
		% radon progeny	1.02	0.65	0.00	0.97
		% tritium	3.84	2.89	0.00	3.69
	25-34	Number of Workers	10876	20452	0	31328
		Average dose (mSv)	0.77	0.09	0.00	0.33
		% radon progeny	3.44	0.73	0.00	2.96
		% tritium	7.51	2.77	0.00	6.67
	35-44	Number of Workers	16174	19614	0	35788
		Average dose (mSv)	0.71	0.13	0.00	0.39
		% radon progeny	3.98	0.57	0.00	3.37
		% tritium	10.68	2.98	0.00	9.31
	45-54	Number of Workers	16218	13993	0	30211
		Average dose (mSv)	0.61	0.12	0.00	0.39
		% radon progeny	2.68	0.47	0.00	2.36
		% tritium	10.44	2.07	0.00	9.22
	55 up	Number of Workers	8916	4172	0	13088
		Average dose (mSv)	0.31	0.10	0.00	0.24
		% radon progeny	4.00	0.27	0.00	3.52
		% tritium	8.44	0.94	0.00	7.47
	Unknown	Number of Workers	15	12	5	32
		Average dose (mSv)	0.10	0.00	0.02	0.05
		% radon progeny	0.00	0.00	0.00	0.00
		% tritium	0.00	0.00	100.00	5.70
	Overall	**Number of Workers**	**55180**	**65121**	**5**	**120306**
		Average dose (mSv)	**0.65**	**0.11**	**0.02**	**0.35**
		% radon progeny	**3.24**	**0.58**	**0.00**	**2.80**
		% tritium	**9.10**	**2.58**	**100.00**	**8.04**

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Table 4
Dose Statistics by job category
Administrator

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	408	0.00	0.00
>0-1	213	71.04	0.33
>1-2	6	7.35	1.23
>2-5	0	0.00	0.00
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	627	78.39	0.13
			Five year period 1999 - 2003
0	681	0.00	0.00
>0-5	373	386.48	1.04
>5-25	3	36.61	12.20
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	1057	423.09	0.40

Parameters of the distribution in 2003:

A: 0.2065
B: 1.8506
C: 0
D: 0.6061
Sample size: 627

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

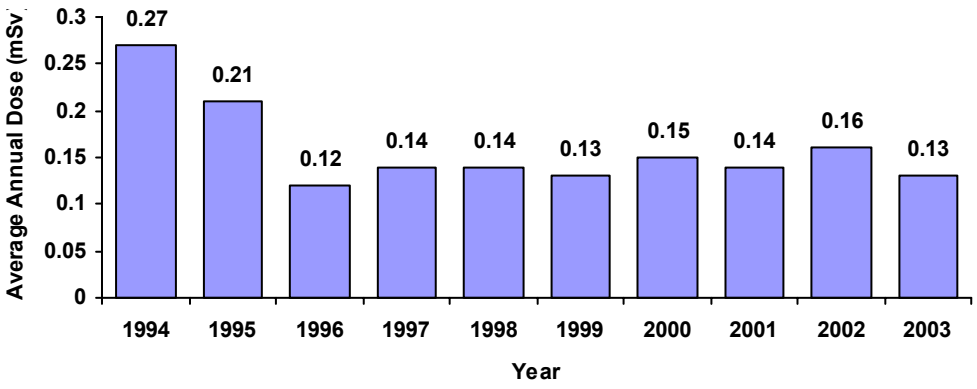


Table 4 (Cont'd)

Office staff

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	3312	0.00	0.00
>0-1	597	164.84	0.28
>1-2	17	22.91	1.35
>2-5	3	7.90	2.63
>5-20	1	13.60	13.60
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	3930	209.25	0.05
			Five year period 1999 - 2003
0	5555	0.00	0.00
>0-5	1164	896.49	0.77
>5-25	19	159.63	8.40
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	6738	1056.12	0.16

Parameters of the distribution in 2003:

A: 0.7053
B: 0
C: 0
D: 2.4514
Sample size: 3930

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

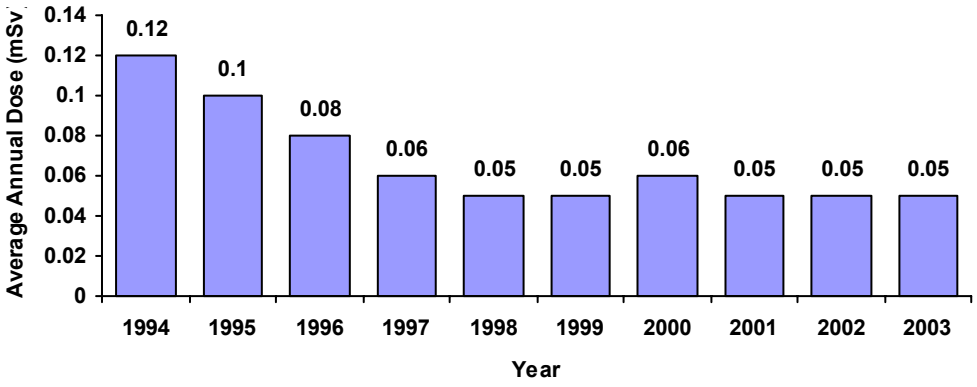


Table 4 (Cont'd)

Safety officer

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	203	0.00	0.00
>0-1	79	23.80	0.30
>1-2	5	6.28	1.26
>2-5	5	16.00	3.20
>5-20	2	13.04	6.52
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	294	59.12	0.20
			Five year period 1999 - 2003
0	223	0.00	0.00
>0-5	136	94.90	0.70
>5-25	10	107.67	10.77
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	369	202.57	0.55

Parameters of the distribution in 2003:

A: 0.2479
B: 0.0917
C: 0.1035
D: 1.7089
Sample size: 294

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

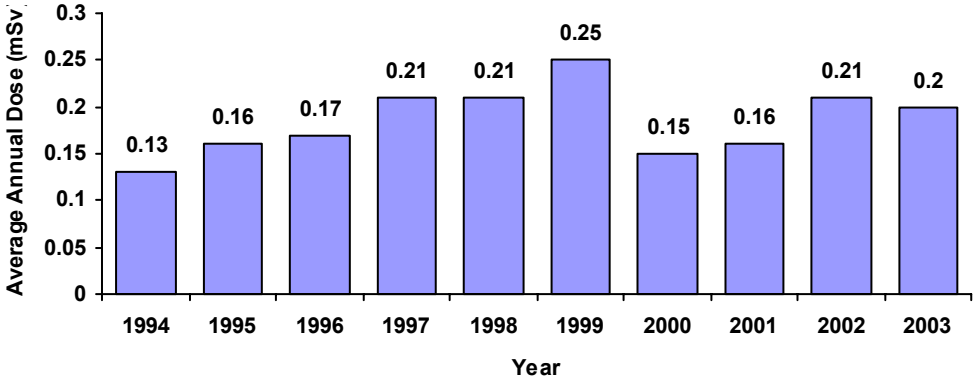


Table 4 (Cont'd)

Aircrew

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	3	0.00	0.00
>0-1	5	1.32	0.26
>1-2	3	5.62	1.87
>2-5	0	0.00	0.00
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	11	6.94	0.63
			Five year period 1999 - 2003
0	5	0.00	0.00
>0-5	11	9.66	0.88
>5-25	3	19.18	6.39
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	19	28.84	1.52

Parameters of the distribution in 2003:

A: 0
B: 0.5915
C: 0.1004
D: 0.2714
Sample size: 11

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

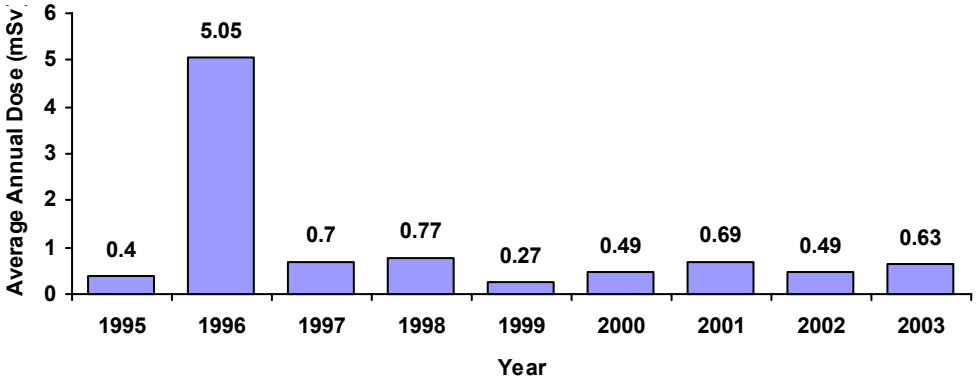


Table 4 (Cont'd)

Ground transportation

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	30	0.00	0.00
>0-1	35	12.49	0.36
>1-2	8	10.59	1.32
>2-5	6	19.01	3.17
>5-20	3	17.10	5.70
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	82	59.19	0.72
			Five year period 1999 - 2003
0	128	0.00	0.00
>0-5	100	106.22	1.06
>5-25	12	89.60	7.47
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	240	195.82	0.82

Parameters of the distribution in 2003:

A: 0.3338
B: 0.1584
C: 0.0398
D: 0.6880
Sample size: 82

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

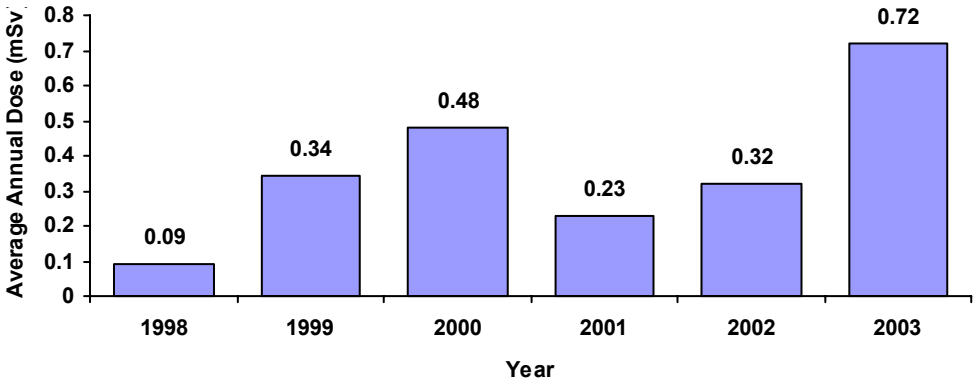


Table 4 (Cont'd)

Industrial radiographer

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1155	0.00	0.00
>0-1	514	207.47	0.40
>1-2	185	274.32	1.48
>2-5	342	1163.36	3.40
>5-20	466	4576.55	9.82
>20-50	47	1206.02	25.66
>50	1	67.71	67.71
Total	2710	7495.43	2.77
			Five year period 1999 - 2003
0	1798	0.00	0.00
>0-5	1393	1965.58	1.41
>5-25	932	12269.57	13.16
>25-100	494	21915.50	44.36
>100	12	2078.64	173.22
Total	4629	38229.29	8.26

Parameters of the distribution in 2003:

A: 0.1818
B: 0.0652
C: 0
D: 0.2426
Sample size: 2710

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

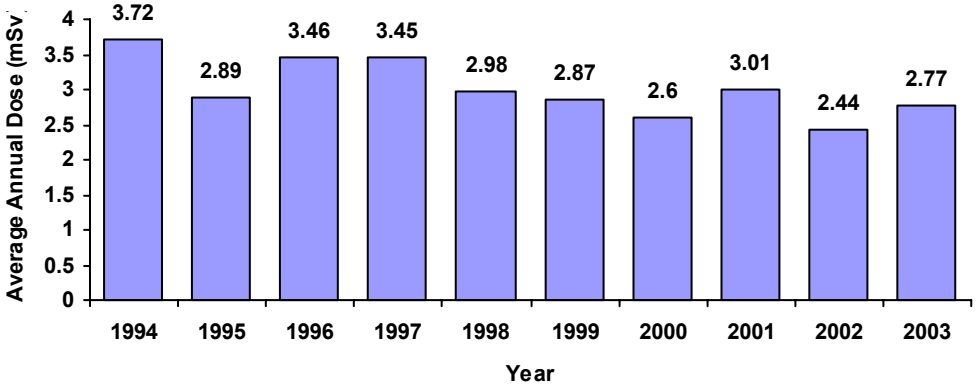


Table 4 (Cont'd)

Instructor (non-medical)

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	173	0.00	0.00
>0-1	38	8.45	0.22
>1-2	1	1.18	1.18
>2-5	3	10.13	3.38
>5-20	1	18.70	18.70
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	216	38.46	0.18
			Five year period 1999 - 2003
0	279	0.00	0.00
>0-5	68	36.62	0.54
>5-25	1	6.33	6.33
>25-100	1	48.62	48.62
>100	0	0.00	0.00
Total	349	91.57	0.26

Parameters of the distribution in 2003:

A: 0.0944
B: 0.0336
C: 0.1267
D: 2.0951
Sample size: 216

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

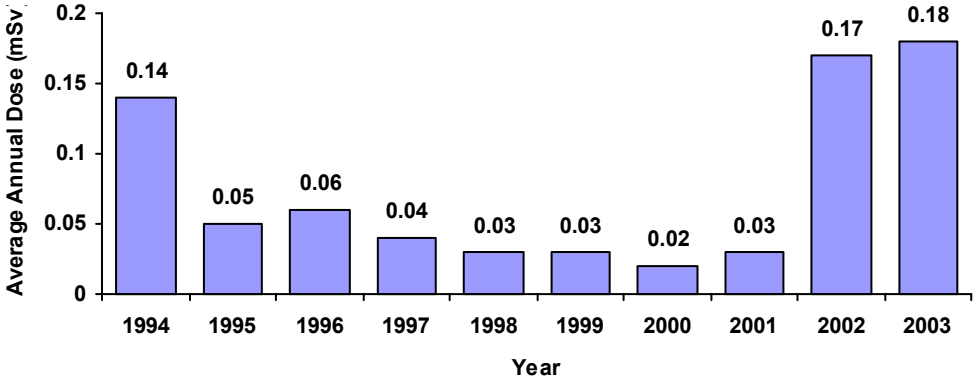


Table 4 (Cont'd)

Instrument technician

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1530	0.00	0.00
>0-1	605	183.22	0.30
>1-2	45	64.09	1.42
>2-5	29	90.74	3.13
>5-20	17	144.35	8.49
>20-50	0	0.00	0.00
>50	1	117.20	117.20
Total	2227	599.60	0.27
			Five year period 1999 - 2003
0	2347	0.00	0.00
>0-5	1244	1002.37	0.81
>5-25	72	733.85	10.19
>25-100	14	724.20	51.73
>100	2	243.74	121.87
Total	3679	2704.16	0.74

Parameters of the distribution in 2003:

A: 0.4526
B: 0
C: 0.0362
D: 1.7345
Sample size: 2227

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

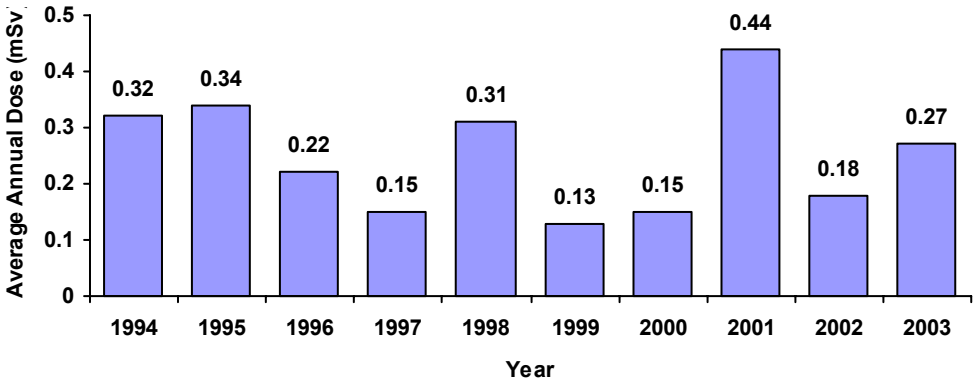


Table 4 (Cont'd)

Laboratory technician (industrial)

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	2505	0.00	0.00
>0-1	923	267.74	0.29
>1-2	66	92.82	1.41
>2-5	99	308.51	3.12
>5-20	31	248.58	8.02
>20-50	1	24.50	24.50
>50	0	0.00	0.00
Total	3625	942.15	0.26
			Five year period 1999 - 2003
0	4882	0.00	0.00
>0-5	1933	1491.27	0.77
>5-25	176	1934.14	10.99
>25-100	14	560.66	40.05
>100	1	154.94	154.94
Total	7006	4141.01	0.59

Parameters of the distribution in 2003:

A: 0.2413
B: 0.0702
C: 0.0790
D: 1.5907
Sample size: 3625

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

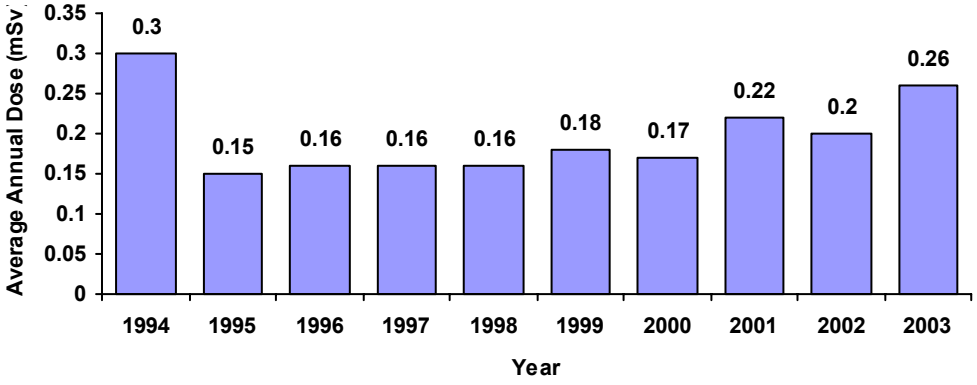


Table 4 (Cont'd)

Nuclear fuel processor

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	116	0.00	0.00
>0-1	347	148.75	0.43
>1-2	108	160.31	1.48
>2-5	110	352.20	3.20
>5-20	56	405.75	7.25
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	737	1067.01	1.45
			Five year period 1999 - 2003
0	79	0.00	0.00
>0-5	479	826.27	1.72
>5-25	254	2847.14	11.21
>25-100	28	920.41	32.87
>100	0	0.00	0.00
Total	840	4593.82	5.47

Parameters of the distribution in 2003:

A: 0.3144
B: 0.1421
C: 0.1007
D: 0.2650
Sample size: 737

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

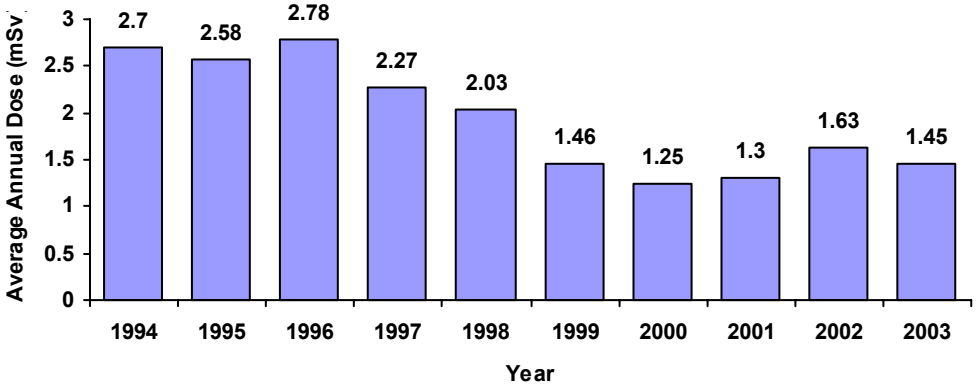


Table 4 (Cont'd)

Scientist/Engineer (field)

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	597	0.00	0.00
>0-1	566	179.67	0.32
>1-2	44	59.22	1.35
>2-5	23	72.93	3.17
>5-20	8	88.58	11.07
>20-50	1	24.99	24.99
>50	0	0.00	0.00
Total	1239	425.39	0.34
			Five year period 1999 - 2003
0	1032	0.00	0.00
>0-5	1137	1244.03	1.09
>5-25	60	580.91	9.68
>25-100	4	129.33	32.33
>100	0	0.00	0.00
Total	2233	1954.27	0.88

Parameters of the distribution in 2003:

A: 0.6145
B: 0
C: 0.0347
D: 1.5253
Sample size: 1239

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

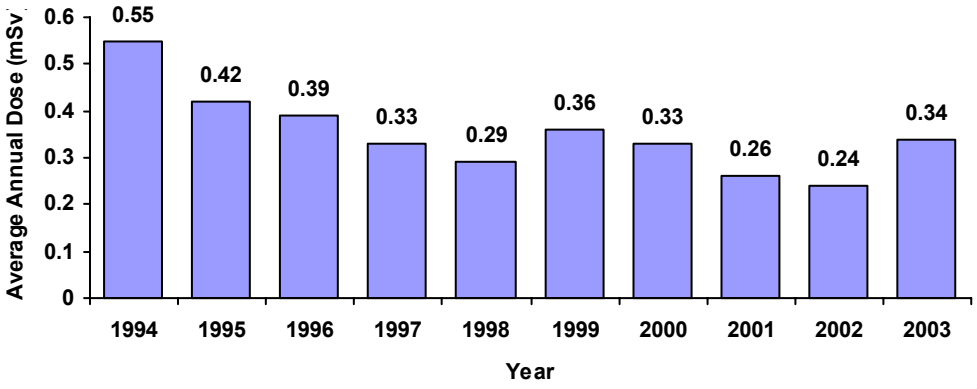


Table 4 (Cont'd)

Scientist/Engineer (laboratory)

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	4934	0.00	0.00
>0-1	1031	244.24	0.24
>1-2	48	66.42	1.38
>2-5	8	25.84	3.23
>5-20	2	16.66	8.33
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	6023	353.16	0.06
			Five year period 1999 - 2003
0	7650	0.00	0.00
>0-5	2835	1420.63	0.50
>5-25	23	189.78	8.25
>25-100	6	379.18	63.20
>100	1	153.67	153.67
Total	10515	2143.26	0.20

Parameters of the distribution in 2003:

A: 0.3981
B: 0.0732
C: 0.0937
D: 2.3947
Sample size: 6023

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

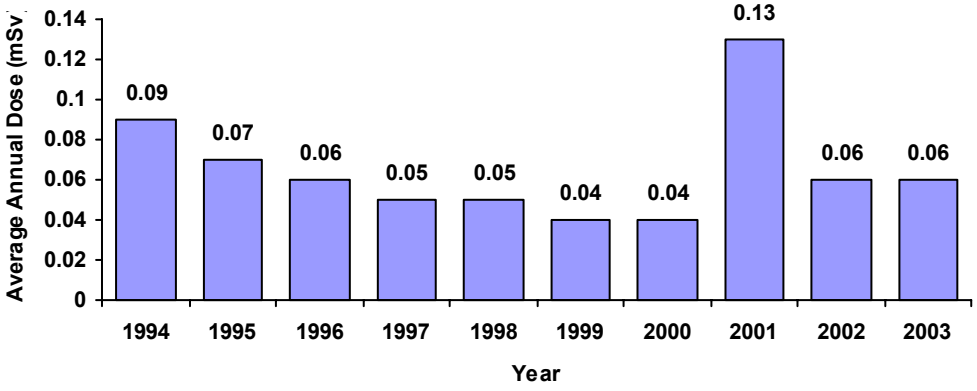


Table 4 (Cont'd)

Security

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	117	0.00	0.00
>0-1	13	2.74	0.21
>1-2	0	0.00	0.00
>2-5	0	0.00	0.00
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	130	2.74	0.02
			Five year period 1999 - 2003
0	118	0.00	0.00
>0-5	13	3.43	0.26
>5-25	0	0.00	0.00
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	131	3.43	0.03

Parameters of the distribution in 2003:

A: 0
B: 1.6768
C: 0.0000
D: 1.5410
Sample size: 130

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

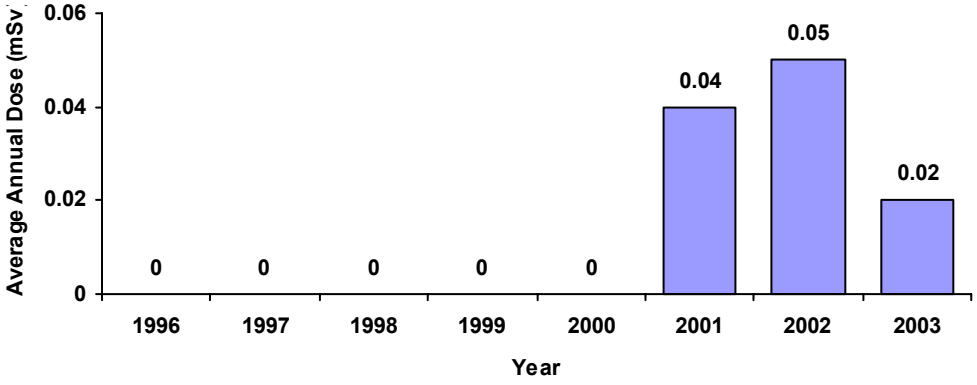


Table 4 (Cont'd)

Tradesmen

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	119	0.00	0.00
>0-1	67	19.34	0.29
>1-2	4	5.70	1.42
>2-5	1	2.20	2.20
>5-20	1	5.54	5.54
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	192	32.78	0.17
			Five year period 1999 - 2003
0	133	0.00	0.00
>0-5	106	95.63	0.90
>5-25	5	28.04	5.61
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	244	123.67	0.51

Parameters of the distribution in 2003:

A: 0.2301
B: 0.1206
C: 0.2095
D: 1.9589
Sample size: 192

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

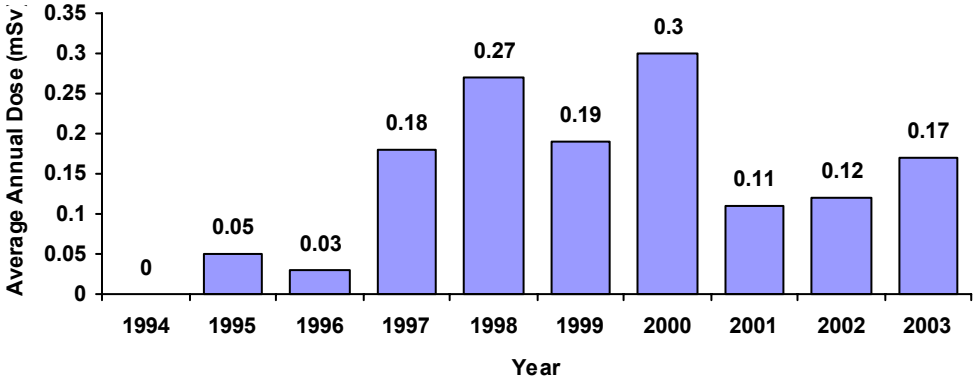


Table 4 (Cont'd)

Well logger

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1048	0.00	0.00
>0-1	672	291.31	0.43
>1-2	138	191.47	1.39
>2-5	67	200.14	2.99
>5-20	20	151.42	7.57
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	1945	834.34	0.43
			Five year period 1999 - 2003
0	1166	0.00	0.00
>0-5	1597	1782.39	1.12
>5-25	136	1243.37	9.14
>25-100	9	331.47	36.83
>100	0	0.00	0.00
Total	2908	3357.23	1.15

Parameters of the distribution in 2003:

A: 0.5056
B: 0.0948
C: 0
D: 1.0561
Sample size: 1945

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

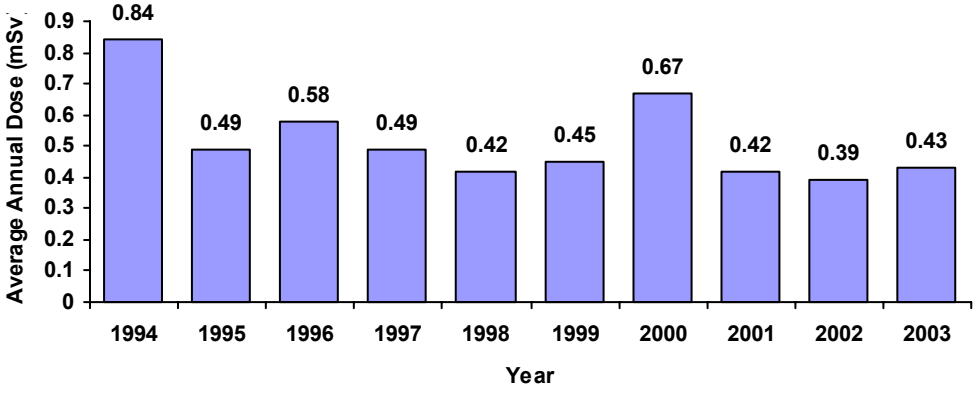


Table 4 (Cont'd)

Chiropractor

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1004	0.00	0.00
>0-1	84	22.42	0.27
>1-2	5	8.03	1.61
>2-5	1	2.31	2.31
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	1094	32.76	0.03
			Five year period 1999 - 2003
0	1238	0.00	0.00
>0-5	188	105.26	0.56
>5-25	6	47.28	7.88
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	1432	152.54	0.11

Parameters of the distribution in 2003:

A: 0.2374
B: 0.3634
C: 0.0293
D: 2.1745
Sample size: 1094

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

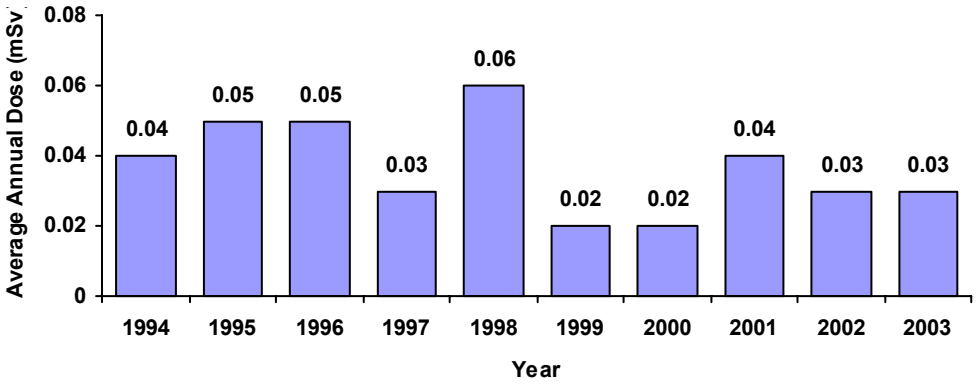


Table 4 (Cont'd)

Dental assistant

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	12738	0.00	0.00
>0-1	640	122.66	0.19
>1-2	3	4.57	1.52
>2-5	1	3.19	3.19
>5-20	0	0.00	0.00
>20-50	1	23.38	23.38
>50	0	0.00	0.00
Total	13383	153.80	0.01
			Five year period 1999 - 2003
0	18654	0.00	0.00
>0-5	1274	399.84	0.31
>5-25	4	59.08	14.77
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	19932	458.92	0.02

Parameters of the distribution in 2003:

A: 0.5073
B: 0
C: 0.0524
D: 3.2410
Sample size: 13383

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

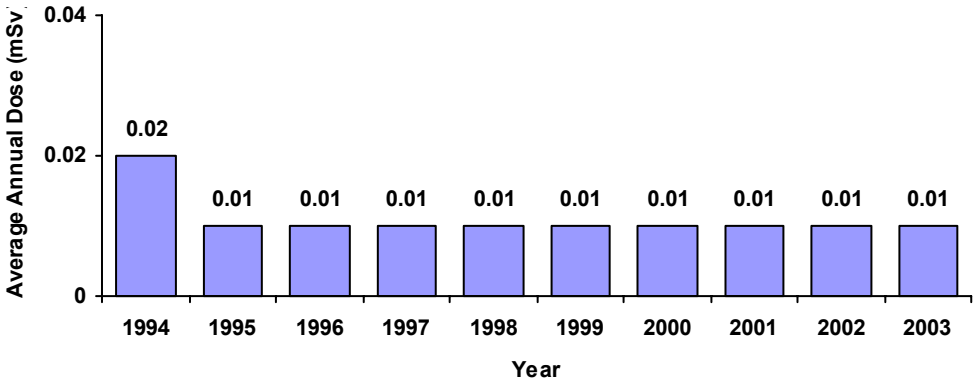


Table 4 (Cont'd)

Dental hygienist

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	8802	0.00	0.00
>0-1	456	88.56	0.19
>1-2	5	6.35	1.27
>2-5	2	6.31	3.16
>5-20	2	15.00	7.50
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	9267	116.22	0.01
			Five year period 1999 - 2003
0	11234	0.00	0.00
>0-5	926	293.64	0.32
>5-25	5	37.60	7.52
>25-100	0	0.00	0.00
>100	1	102.50	102.50
Total	12166	433.74	0.04

Parameters of the distribution in 2003:

A: 0.4139
B: 0
C: 0.0518
D: 3.0766
Sample size: 9267

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

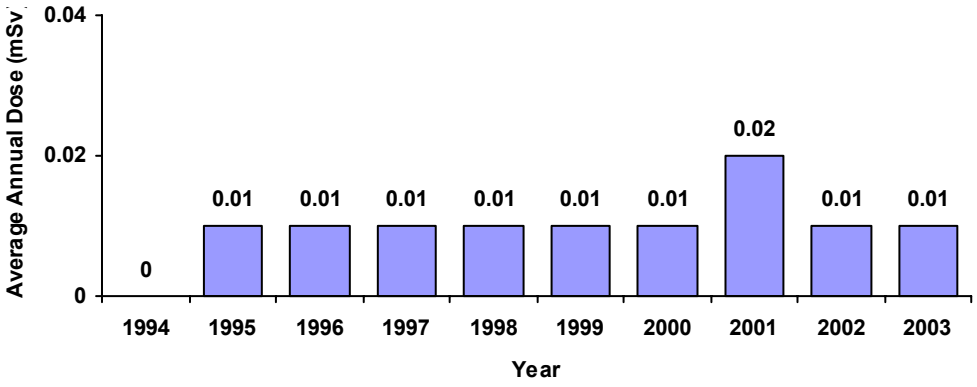


Table 4 (Cont'd)

Dental therapist/nurse

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	114	0.00	0.00
>0-1	23	5.50	0.24
>1-2	0	0.00	0.00
>2-5	0	0.00	0.00
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	137	5.50	0.04
			Five year period 1999 - 2003
0	159	0.00	0.00
>0-5	31	13.91	0.45
>5-25	0	0.00	0.00
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	190	13.91	0.07

Parameters of the distribution in 2003:

A: 0
B: 2.8453
C: 0.0350
D: 0.9347
Sample size: 137

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

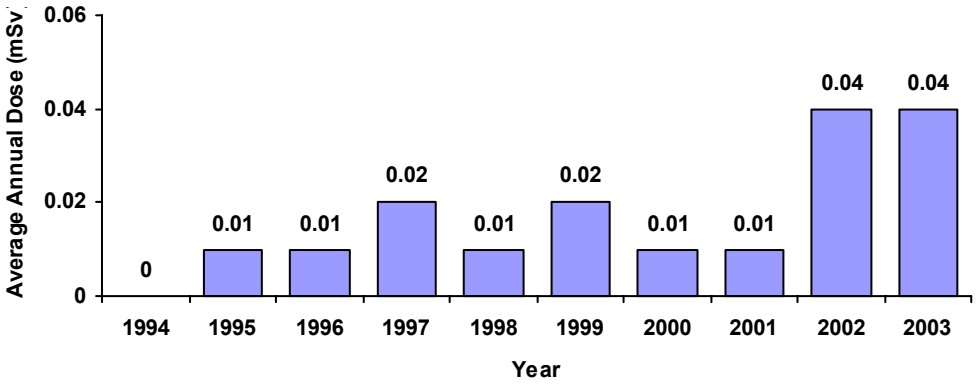


Table 4 (Cont'd)

Dentist

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	7307	0.00	0.00
>0-1	502	95.21	0.19
>1-2	5	7.66	1.53
>2-5	3	8.94	2.98
>5-20	1	9.03	9.03
>20-50	2	59.87	29.94
>50	0	0.00	0.00
Total	7820	180.71	0.02
			Five year period 1999 - 2003
0	8645	0.00	0.00
>0-5	999	365.37	0.37
>5-25	3	39.52	13.17
>25-100	3	86.41	28.80
>100	1	207.00	207.00
Total	9651	698.30	0.07

Parameters of the distribution in 2003:

A: 0.2409
B: 0.0026
C: 0.1190
D: 3.0075
Sample size: 7820

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

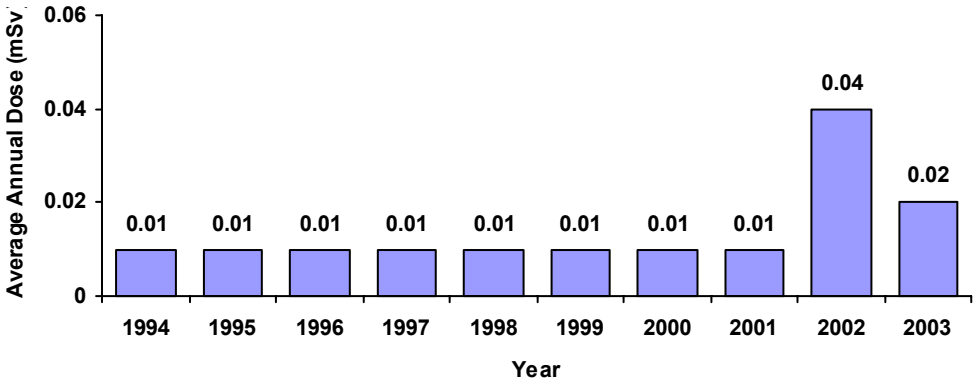


Table 4 (Cont'd)

Gynaecologist

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	9	0.00	0.00
>0-1	2	0.37	0.18
>1-2	0	0.00	0.00
>2-5	0	0.00	0.00
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	11	0.37	0.03
			Five year period 1999 - 2003
0	17	0.00	0.00
>0-5	4	1.18	0.30
>5-25	0	0.00	0.00
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	21	1.18	0.06

Parameters of the distribution in 2003:

A: N/A
B: N/A
C: N/A
D: N/A
Sample size: N/A

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

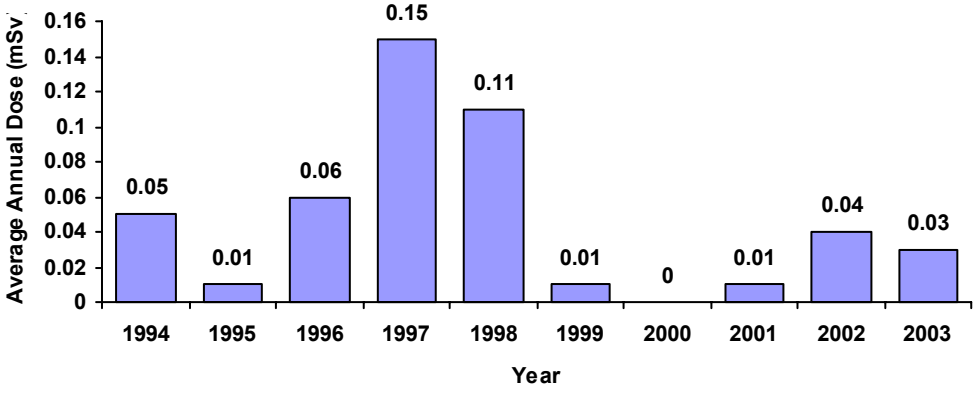


Table 4 (Cont'd)

Laboratory technician (medical)

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	3328	0.00	0.00
>0-1	921	229.78	0.25
>1-2	73	104.02	1.42
>2-5	44	133.73	3.04
>5-20	7	59.97	8.57
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	4373	527.50	0.12
			Five year period 1999 - 2003
0	4947	0.00	0.00
>0-5	1907	1100.84	0.58
>5-25	60	567.74	9.46
>25-100	2	53.23	26.62
>100	1	197.30	197.30
Total	6917	1919.11	0.28

Parameters of the distribution in 2003:

A: 0.1675
B: 0.1370
C: 0.1110
D: 1.8967
Sample size: 4373

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

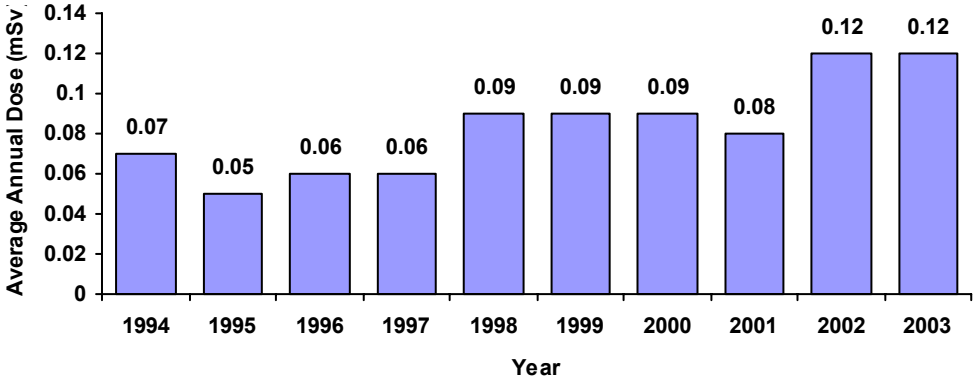


Table 4 (Cont'd)

Medical physicist

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	291	0.00	0.00
>0-1	115	26.89	0.23
>1-2	2	3.10	1.55
>2-5	3	7.00	2.33
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	411	36.99	0.09
			Five year period 1999 - 2003
0	344	0.00	0.00
>0-5	187	104.54	0.56
>5-25	2	18.73	9.36
>25-100	1	50.70	50.70
>100	0	0.00	0.00
Total	534	173.97	0.33

Parameters of the distribution in 2003:

A: 0
B: 0.2963
C: 0.2530
D: 2.1901
Sample size: 411

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

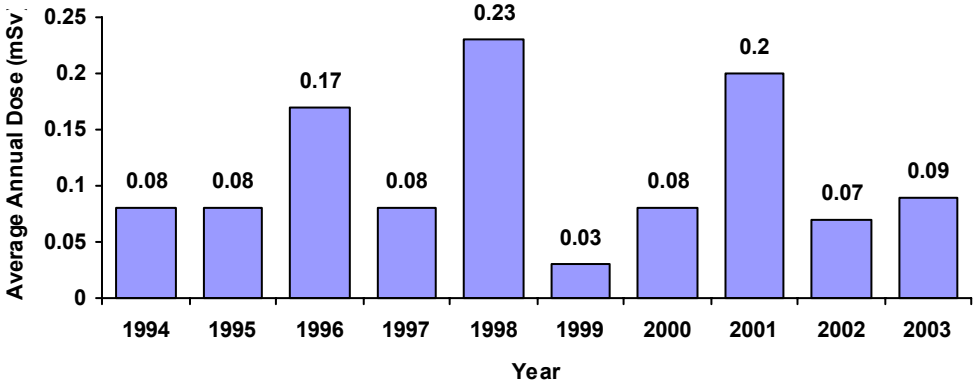


Table 4 (Cont'd)

Medical radiation technologist

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	9809	0.00	0.00
>0-1	3321	881.16	0.27
>1-2	181	254.93	1.41
>2-5	93	281.99	3.03
>5-20	9	68.00	7.56
>20-50	2	50.21	25.10
>50	1	50.94	50.94
Total	13416	1587.23	0.12
			Five year period 1999 - 2003
0	9584	0.00	0.00
>0-5	6246	3944.14	0.63
>5-25	170	1549.42	9.11
>25-100	6	200.73	33.46
>100	0	0.00	0.00
Total	16006	5694.29	0.36

Parameters of the distribution in 2003:

A: 0.5463
B: 0.0004
C: 0.0263
D: 2.05190
Sample size: 13416

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

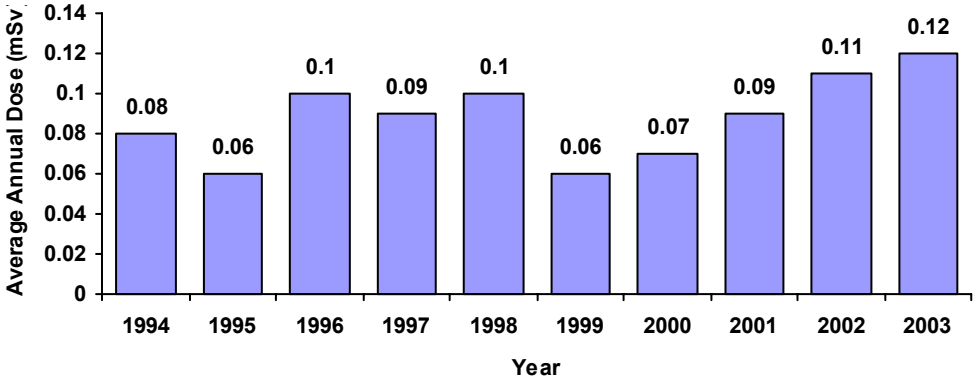


Table 4 (Cont'd)

Nuclear medicine technologist

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	319	0.00	0.00
>0-1	460	237.96	0.52
>1-2	345	523.32	1.52
>2-5	500	1576.00	3.15
>5-20	87	571.42	6.57
>20-50	1	23.73	23.73
>50	0	0.00	0.00
Total	1712	2932.43	1.71
			Five year period 1999 - 2003
0	430	0.00	0.00
>0-5	795	1545.58	1.94
>5-25	871	9634.50	11.06
>25-100	39	1201.01	30.80
>100	0	0.00	0.00
Total	2135	12381.09	5.80

Parameters of the distribution in 2003:

A: 0.2650
B: 0.2938
C: 0.0000
D: -0.3815
Sample size: 1712

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

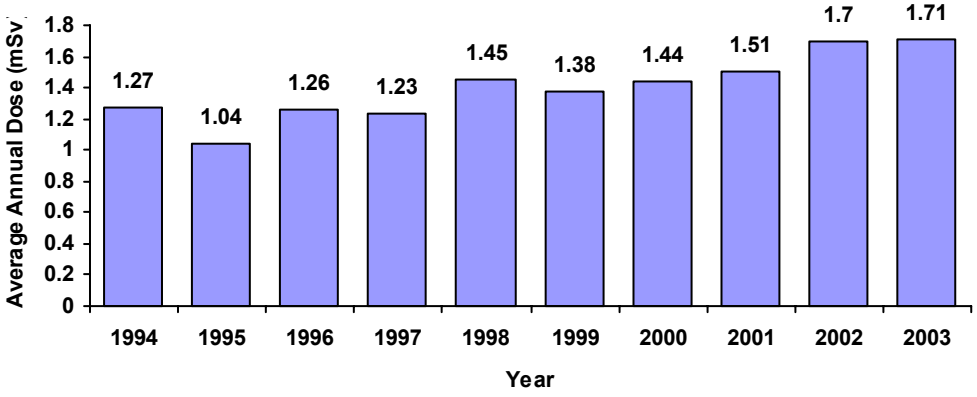


Table 4 (Cont'd)

Nurse

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	4485	0.00	0.00
>0-1	1573	459.20	0.29
>1-2	81	114.21	1.41
>2-5	28	78.42	2.80
>5-20	6	36.57	6.10
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	6173	688.40	0.11
			Five year period 1999 - 2003
0	5912	0.00	0.00
>0-5	2973	2312.00	0.78
>5-25	56	455.54	8.13
>25-100	2	74.30	37.15
>100	0	0.00	0.00
Total	8943	2841.84	0.32

Parameters of the distribution in 2003:

A: 0.6472
B: 0.0339
C: 0.0096
D: 2.0209
Sample size: 6173

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

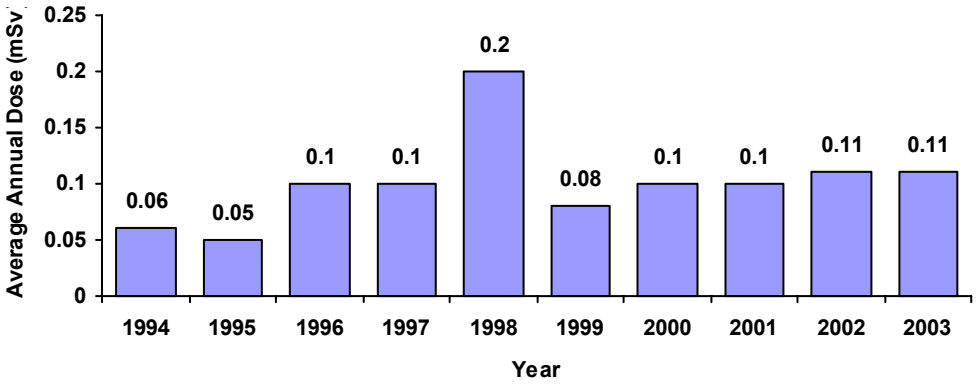


Table 4 (Cont'd)

Physician

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1670	0.00	0.00
>0-1	783	257.86	0.33
>1-2	90	127.14	1.41
>2-5	30	94.90	3.16
>5-20	11	131.44	11.95
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	2584	611.34	0.24
			Five year period 1999 - 2003
0	1875	0.00	0.00
>0-5	1413	1276.59	0.90
>5-25	93	860.60	9.25
>25-100	4	114.33	28.58
>100	0	0.00	0.00
Total	3385	2251.52	0.67

Parameters of the distribution in 2003:

A: 0.5644
B: 0.0077
C: 0
D: 1.6077
Sample size: 2584

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

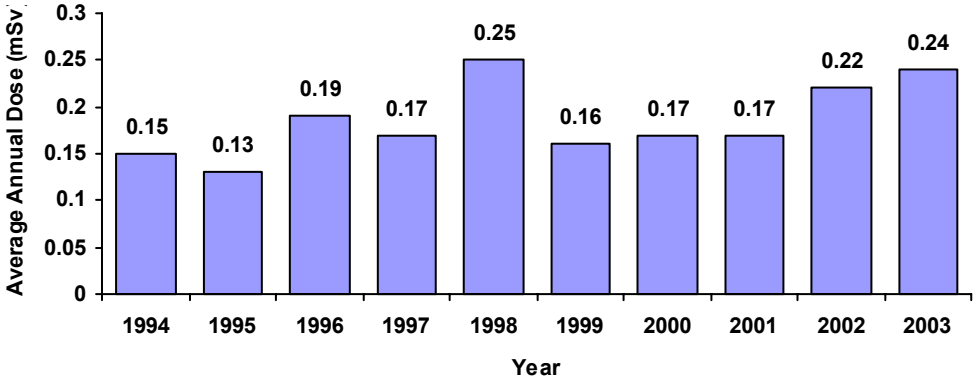


Table 4 (Cont'd)

Radiation therapist

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1138	0.00	0.00
>0-1	622	161.08	0.26
>1-2	23	30.59	1.33
>2-5	14	43.67	3.12
>5-20	4	42.55	10.64
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	1801	277.89	0.15
			Five year period 1999 - 2003
0	981	0.00	0.00
>0-5	1119	760.35	0.68
>5-25	23	241.85	10.52
>25-100	2	77.70	38.85
>100	1	103.25	103.25
Total	2126	1183.15	0.56

Parameters of the distribution in 2003:

A: 0.4651
B: 0
C: 0.1239
D: 2.1543
Sample size: 1801

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

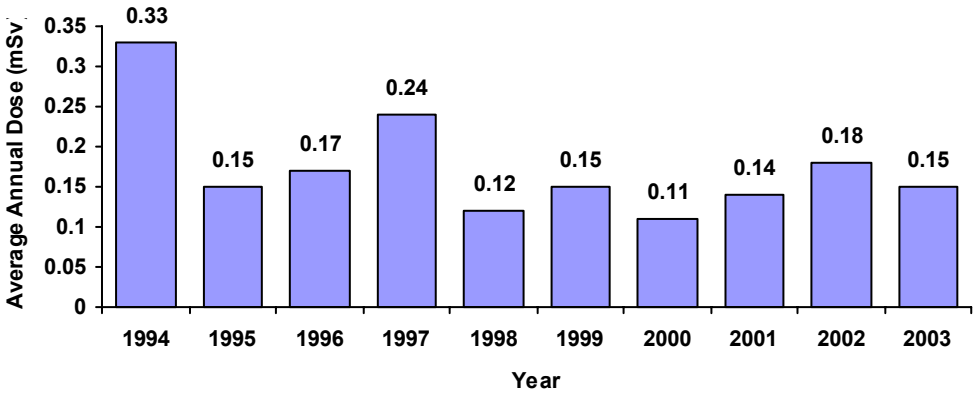


Table 4 (Cont'd)

Radiologist (diagnostic)

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1483	0.00	0.00
>0-1	565	157.70	0.28
>1-2	42	63.08	1.50
>2-5	21	61.31	2.92
>5-20	10	75.60	7.56
>20-50	4	130.81	32.70
>50	0	0.00	0.00
Total	2125	488.50	0.23
			Five year period 1999 - 2003
0	1442	0.00	0.00
>0-5	1084	881.05	0.81
>5-25	55	524.53	9.54
>25-100	11	394.91	35.90
>100	0	0.00	0.00
Total	2592	1800.49	0.69

Parameters of the distribution in 2003:

A: 0.3812
B: 0.0040
C: 0.0677
D: 1.8458
Sample size: 2125

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

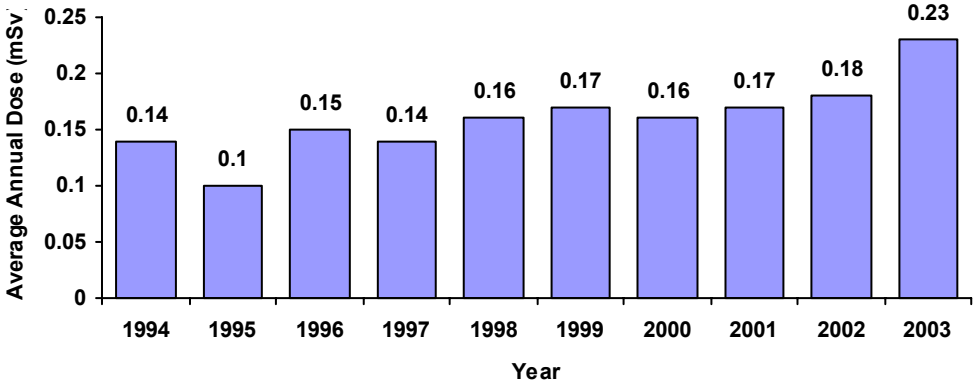


Table 4 (Cont'd)

Radiologist (therapeutic)

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	207	0.00	0.00
>0-1	57	14.22	0.25
>1-2	2	3.85	1.92
>2-5	2	6.62	3.31
>5-20	2	11.16	5.58
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	270	35.85	0.13
			Five year period 1999 - 2003
0	219	0.00	0.00
>0-5	129	81.24	0.63
>5-25	5	41.77	8.35
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	353	123.01	0.35

Parameters of the distribution in 2003:

A: 0.0479
B: 0.1414
C: 0.1270
D: 1.8832
Sample size: 270

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

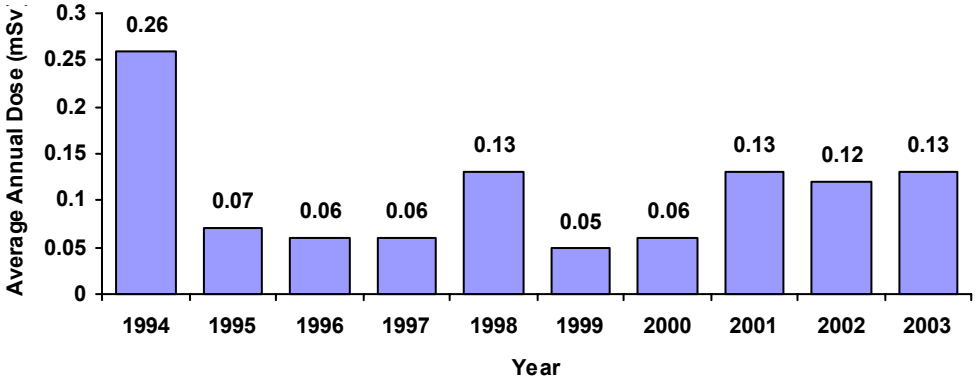


Table 4 (Cont'd)

Veterinarian

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	3004	0.00	0.00
>0-1	552	146.36	0.27
>1-2	18	22.08	1.23
>2-5	1	2.70	2.70
>5-20	1	5.12	5.12
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	3576	176.26	0.05
			Five year period 1999 - 2003
0	4338	0.00	0.00
>0-5	1212	591.14	0.49
>5-25	11	89.50	8.14
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	5561	680.64	0.12

Parameters of the distribution in 2003:

A: 0.4474
B: 0.3848
C: 0.0000
D: 2.0648
Sample size: 3576

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

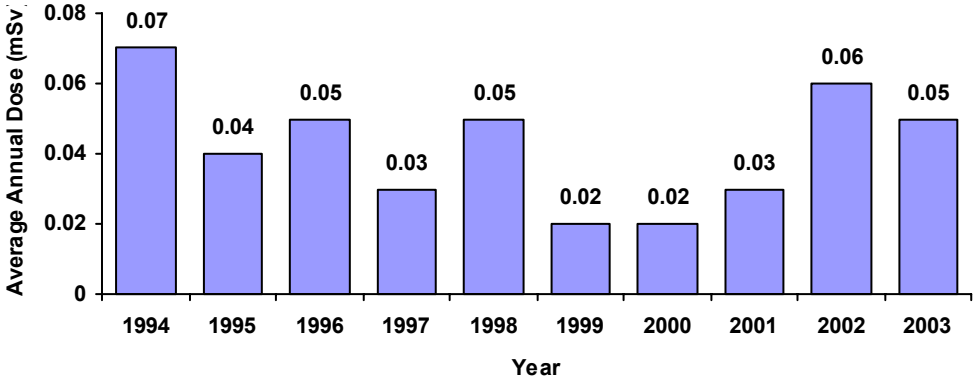


Table 4 (Cont'd)

Veterinary technician

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	2342	0.00	0.00
>0-1	386	88.52	0.23
>1-2	6	7.29	1.22
>2-5	0	0.00	0.00
>5-20	2	19.40	9.70
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	2736	115.21	0.04
			Five year period 1999 - 2003
0	3523	0.00	0.00
>0-5	712	318.66	0.45
>5-25	2	19.40	9.70
>25-100	0	0.00	0.00
>100	0	0.00	0.00
Total	4237	338.06	0.08

Parameters of the distribution in 2003:

A: 0.6335
B: 0
C: 0.0053
D: 2.6156
Sample size: 2736

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

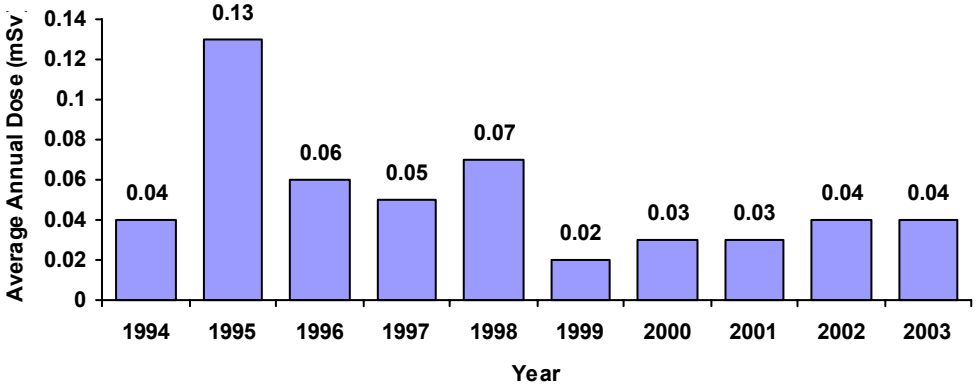


Table 4 (Cont'd)

Ward aid/orderly

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose
			Year 2003
0	1127	0.00	0.00
>0-1	237	59.11	0.25
>1-2	14	19.86	1.42
>2-5	10	34.00	3.40
>5-20	0	0.00	0.00
>20-50	0	0.00	0.00
>50	0	0.00	0.00
Total	1388	112.97	0.08
			Five year period 1999 - 2003
0	1927	0.00	0.00
>0-5	518	357.23	0.69
>5-25	16	132.34	8.27
>25-100	1	59.40	59.40
>100	0	0.00	0.00
Total	2462	548.97	0.22

Parameters of the distribution in 2003:

A: 0
B: 0.2430
C: 0.1658
D: 2.0242
Sample size: 1388

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

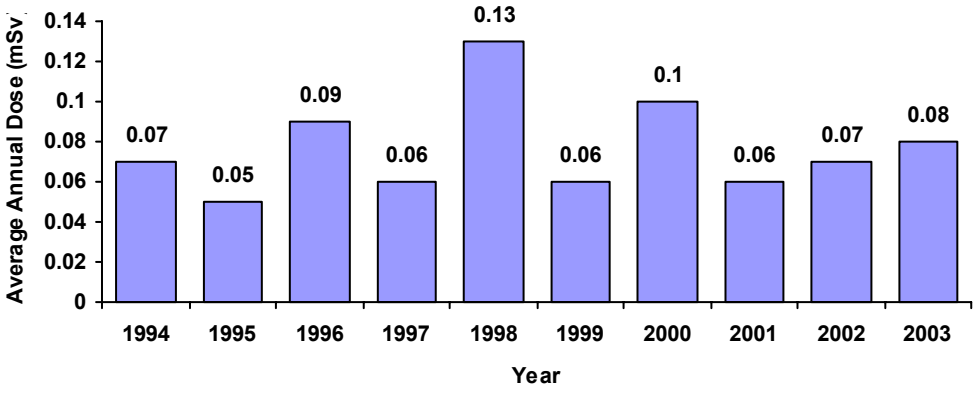


Table 4 (Cont'd)

Reactor - administration

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	3694	0.00	0.00	0
>0-1	468	112.87	0.24	39
>1-2	91	135.96	1.49	40
>2-5	76	236.99	3.12	33
>5-20	52	413.89	7.96	21
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	4381	899.71	0.21	29
				Five year period 1999 - 2003
0	5418	0.00	0.00	0
>0-5	1456	1197.79	0.82	37
>5-25	232	2376.22	10.24	33
>25-100	24	807.99	33.67	25
>100	0	0.00	0.00	0
Total	7130	4382.00	0.61	33

Parameters of the distribution in 2003:

A: 0.1420
B: 0.0990
C: 0.0046
D: 1.5595
Sample size: 4381

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

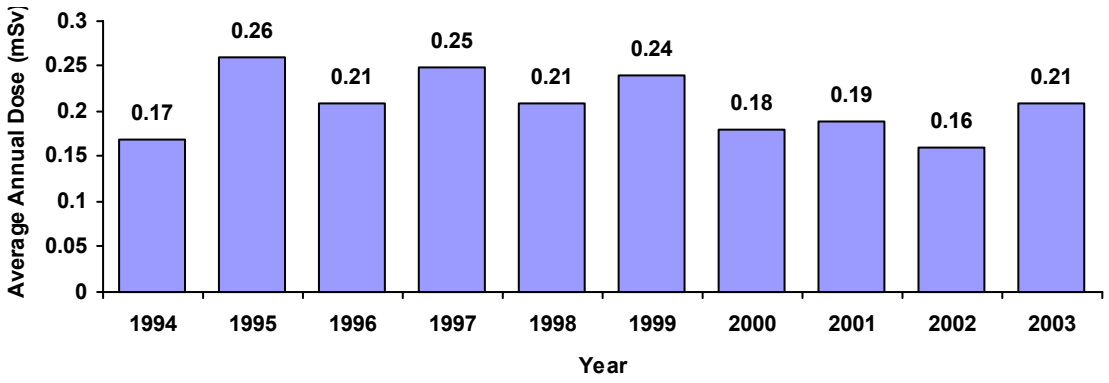


Table 4 (Cont'd)

Reactor - chemical and radiation control

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	132	0.00	0.00	0
>0-1	182	77.68	0.43	33
>1-2	64	91.90	1.44	34
>2-5	68	230.94	3.40	19
>5-20	75	622.22	8.30	18
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	521	1022.74	1.96	21
				Five year period 1999 - 2003
0	128	0.00	0.00	0
>0-5	355	577.92	1.63	36
>5-25	176	1949.88	11.08	17
>25-100	25	1006.60	40.26	15
>100	0	0.00	0.00	0
Total	684	3534.40	5.17	20

Parameters of the distribution in 2003:

A: 0.3108
B: 0.1027
C: 0
D: 0.1087
Sample size: 521

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

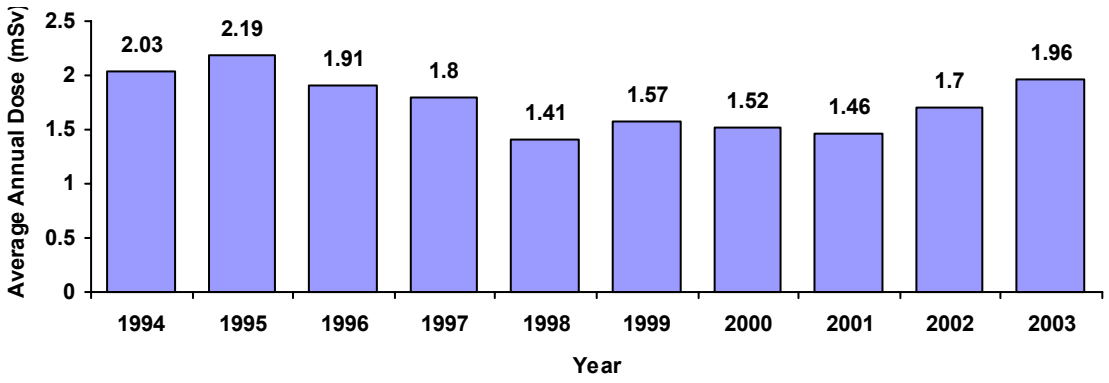


Table 4 (Cont'd)

Reactor - construction

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	911	0.00	0.00	0
>0-1	428	154.18	0.36	21
>1-2	155	230.19	1.49	13
>2-5	225	760.22	3.38	15
>5-20	143	1081.77	7.56	10
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	1862	2226.36	1.20	13
				Five year period 1999 - 2003
0	1473	0.00	0.00	0
>0-5	1306	1951.22	1.49	16
>5-25	687	8169.41	11.89	11
>25-100	123	4275.73	34.76	9
>100	0	0.00	0.00	0
Total	3589	14396.36	4.01	11

Parameters of the distribution in 2003:

A: 0.1581
B: 0.1505
C: 0.0042
D: 0.4246
Sample size: 1862

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

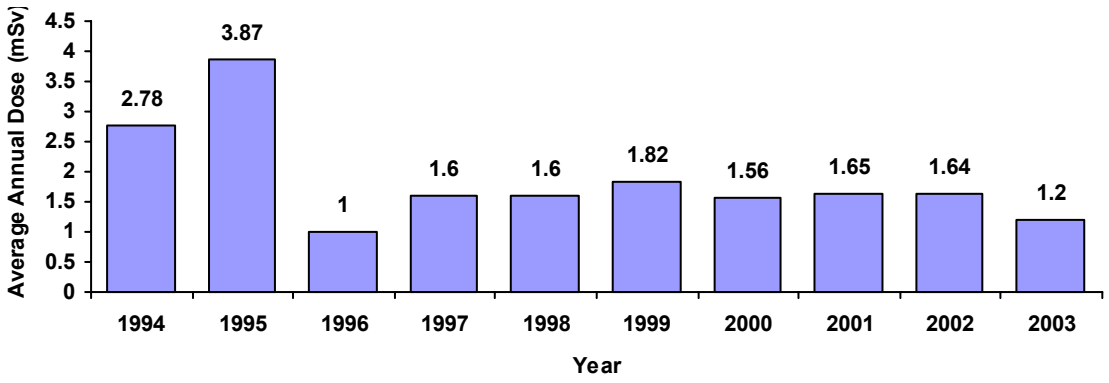


Table 4 (Cont'd)

Reactor - control technician

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	78	0.00	0.00	0
>0-1	40	15.16	0.38	34
>1-2	22	34.10	1.55	25
>2-5	16	51.99	3.25	18
>5-20	29	304.49	10.50	7
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	185	405.74	2.19	11
				Five year period 1999 - 2003
0	127	0.00	0.00	0
>0-5	111	154.02	1.39	27
>5-25	51	563.70	11.05	15
>25-100	11	391.12	35.56	4
>100	0	0.00	0.00	0
Total	300	1108.84	3.70	13

Parameters of the distribution in 2003:

A: 0.1738
B: 0.0853
C: 0
D: 0.2829
Sample size: 185

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

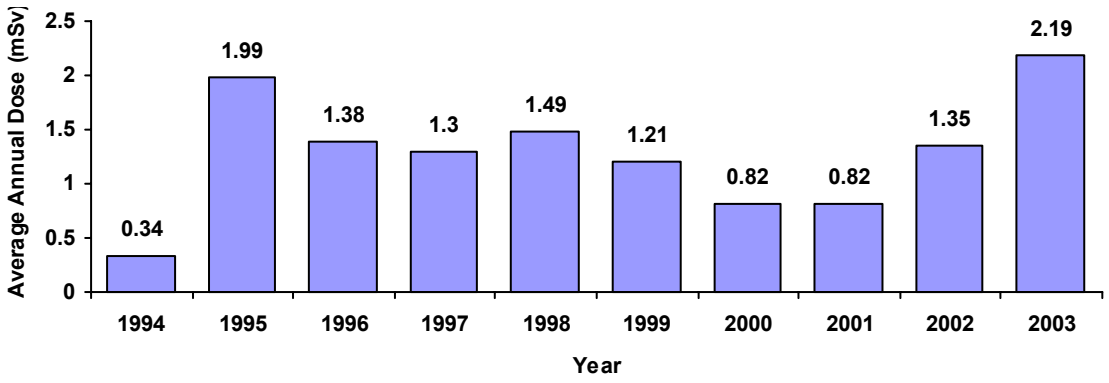


Table 4 (Cont'd)

Reactor - electrical maintenance

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	601	0.00	0.00	0
>0-1	413	145.22	0.35	35
>1-2	134	191.35	1.43	25
>2-5	176	568.55	3.23	17
>5-20	85	650.04	7.65	11
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	1409	1555.16	1.10	17
				Five year period 1999 - 2003
0	671	0.00	0.00	0
>0-5	975	1353.44	1.39	26
>5-25	324	3448.70	10.64	17
>25-100	39	1233.51	31.63	10
>100	0	0.00	0.00	0
Total	2009	6035.65	3.00	18

Parameters of the distribution in 2003:

A: 0.2321
B: 0.1405
C: 0
D: 0.4501
Sample size: 1409

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

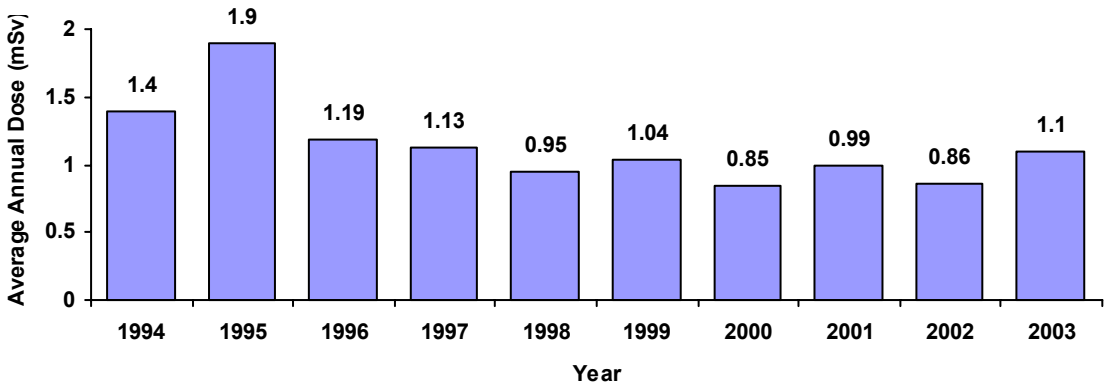


Table 4 (Cont'd)

Reactor - fuel handling

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	24	0.00	0.00	0
>0-1	20	7.04	0.35	19
>1-2	20	29.15	1.46	14
>2-5	26	85.02	3.27	15
>5-20	37	303.18	8.19	11
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	127	424.39	3.34	13
				Five year period 1999 - 2003
0	21	0.00	0.00	0
>0-5	57	77.94	1.37	12
>5-25	55	630.64	11.47	13
>25-100	16	645.72	40.36	23
>100	0	0.00	0.00	0
Total	149	1354.30	9.09	18

Parameters of the distribution in 2003:

A: 0.1109
B: 0.1811
C: 0.0159
D: -0.4920
Sample size: 127

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

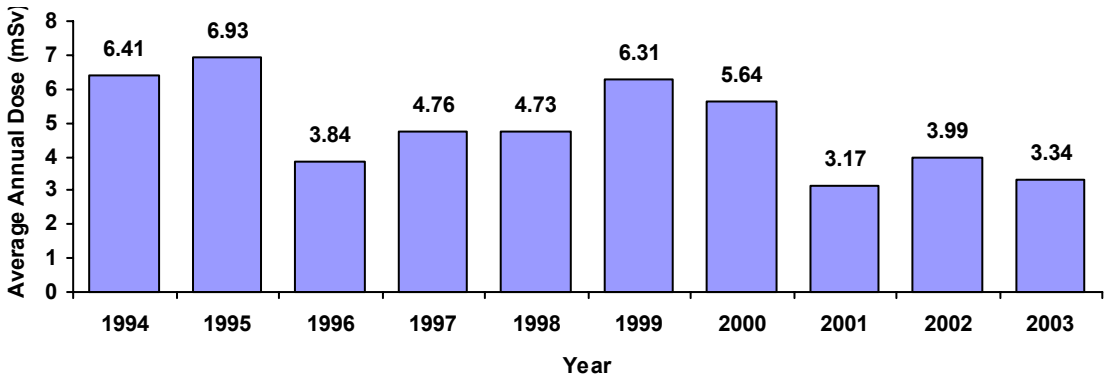


Table 4 (Cont'd)

Reactor - general maintenance

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	823	0.00	0.00	0
>0-1	269	89.16	0.33	24
>1-2	74	110.55	1.49	28
>2-5	107	360.78	3.37	21
>5-20	121	1006.20	8.32	15
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	1394	1566.69	1.12	18
				Five year period 1999 - 2003
0	1468	0.00	0.00	0
>0-5	830	1065.87	1.28	22
>5-25	268	2986.81	11.14	17
>25-100	78	2734.63	35.06	14
>100	0	0.00	0.00	0
Total	2644	6787.31	2.57	17

Parameters of the distribution in 2003:

A: 0.0988
B: 0.1197
C: 0.0126
D: 0.6479
Sample size: 1394

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

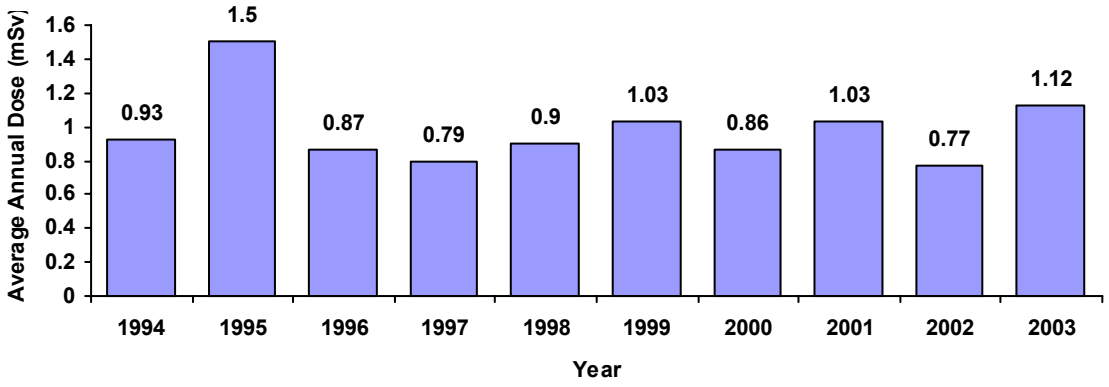


Table 4 (Cont'd)

Reactor - health physics

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	32	0.00	0.00	0
>0-1	8	2.70	0.34	13
>1-2	5	6.67	1.33	7
>2-5	8	31.03	3.88	10
>5-20	1	5.17	5.17	6
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	54	45.57	0.84	9
				Five year period 1999 - 2003
0	74	0.00	0.00	0
>0-5	45	48.49	1.08	18
>5-25	12	142.32	11.86	13
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	131	190.81	1.46	14

Parameters of the distribution in 2003:

A: 0
B: 0.3128
C: 0.0000
D: 0.3134
Sample size: 54

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

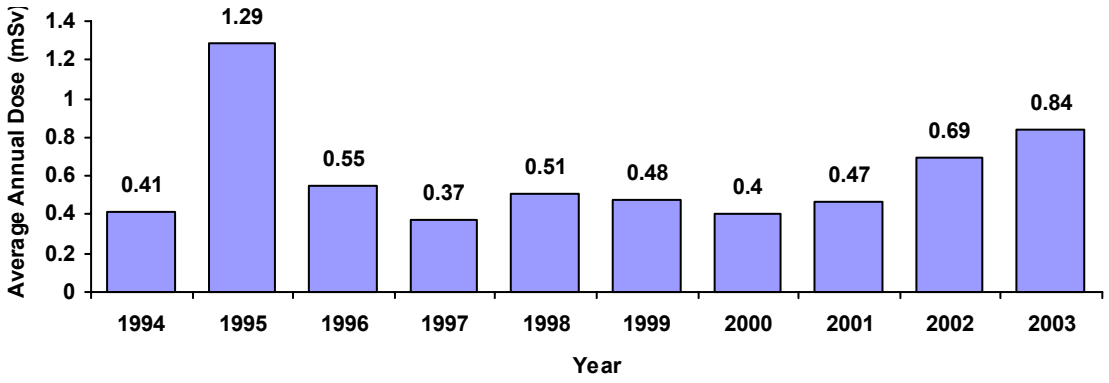


Table 4 (Cont'd)

Reactor - industrial radiographer

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	10	0.00	0.00	0
>0-1	33	8.02	0.24	22
>1-2	8	11.41	1.43	32
>2-5	24	76.24	3.18	15
>5-20	19	166.41	8.76	6
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	94	262.08	2.79	10
				Five year period 1999 - 2003
0	11	0.00	0.00	0
>0-5	92	168.04	1.83	11
>5-25	44	413.27	9.39	7
>25-100	4	129.90	32.48	12
>100	0	0.00	0.00	0
Total	151	711.21	4.71	9

Parameters of the distribution in 2003:

A: 0.1135
B: 0.1635
C: 0
D: -0.2498
Sample size: 94

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

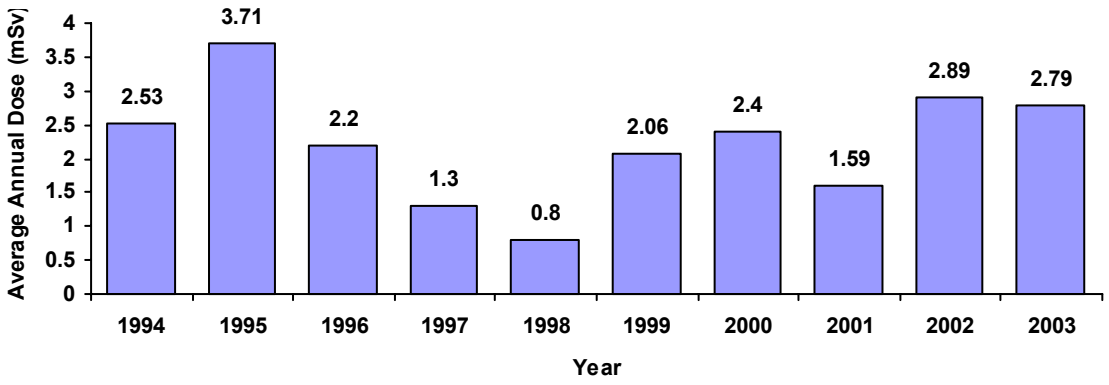


Table 4 (Cont'd)

Reactor - mechanical maintenance

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	479	0.00	0.00	0
>0-1	428	164.35	0.38	25
>1-2	189	281.43	1.49	21
>2-5	263	877.38	3.34	18
>5-20	273	2467.15	9.04	10
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	1632	3790.31	2.32	14
				Five year period 1999 - 2003
0	754	0.00	0.00	0
>0-5	1288	1892.03	1.47	20
>5-25	730	8801.76	12.06	14
>25-100	160	5631.29	35.20	12
>100	0	0.00	0.00	0
Total	2932	16325.08	5.57	14

Parameters of the distribution in 2003:

A: 0.2107
B: 0.1144
C: 0
D: 0.0317
Sample size: 1632

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

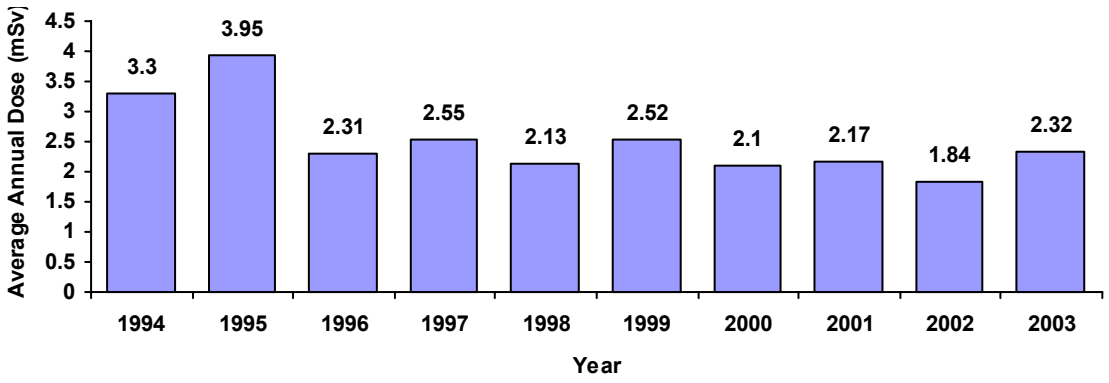


Table 4 (Cont'd)

Reactor - operations

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	893	0.00	0.00	0
>0-1	725	248.98	0.34	42
>1-2	268	392.90	1.47	40
>2-5	289	879.57	3.04	39
>5-20	137	1103.86	8.06	21
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	2312	2625.31	1.14	32
				Five year period 1999 - 2003
0	616	0.00	0.00	0
>0-5	1394	2117.84	1.52	45
>5-25	585	5704.70	9.75	36
>25-100	92	3876.56	42.14	15
>100	0	0.00	0.00	0
Total	2687	11699.10	4.35	31

Parameters of the distribution in 2003:

A: 0.2484
B: 0.1392
C: 0
D: 0.4196
Sample size: 2312

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

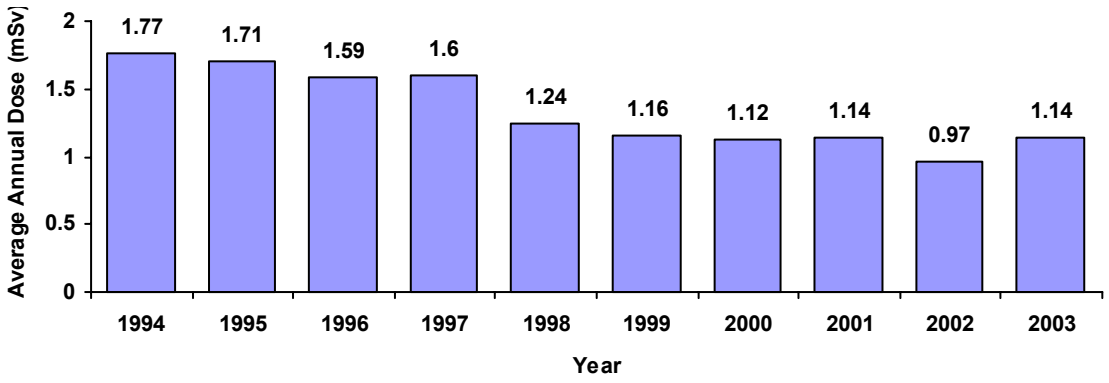


Table 4 (Cont'd)

Reactor - scientific/professional

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	1825	0.00	0.00	0
>0-1	411	114.26	0.28	27
>1-2	84	126.51	1.51	19
>2-5	108	357.59	3.31	16
>5-20	100	786.59	7.87	11
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	2528	1384.95	0.55	14
				Five year period 1999 - 2003
0	2858	0.00	0.00	0
>0-5	1088	1144.13	1.05	19
>5-25	285	3156.03	11.07	13
>25-100	38	1342.81	35.34	11
>100	0	0.00	0.00	0
Total	4269	5642.97	1.32	14

Parameters of the distribution in 2003:

A: 0.0809
B: 0.1152
C: 0.0252
D: 1.0964
Sample size: 2528

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

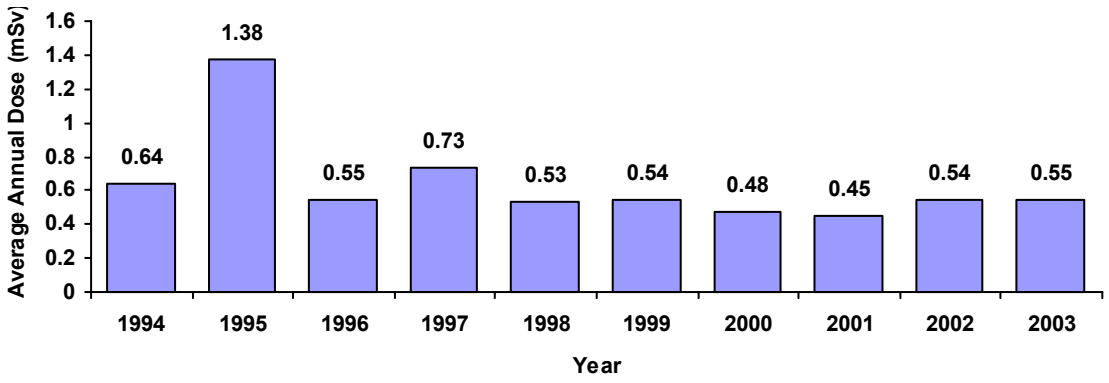


Table 4 (Cont'd)

Reactor - training

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	41	0.00	0.00	0
>0-1	10	4.28	0.43	12
>1-2	3	3.66	1.22	10
>2-5	4	14.27	3.57	12
>5-20	2	14.68	7.34	7
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	60	36.89	0.61	10
				Five year period 1999 - 2003
0	110	0.00	0.00	0
>0-5	36	41.15	1.14	16
>5-25	11	101.33	9.21	12
>25-100	2	66.59	33.30	7
>100	0	0.00	0.00	0
Total	159	209.07	1.31	11

Parameters of the distribution in 2003:

A: 0.1589
B: 0.1436
C: 0
D: 0.8535
Sample size: 60

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

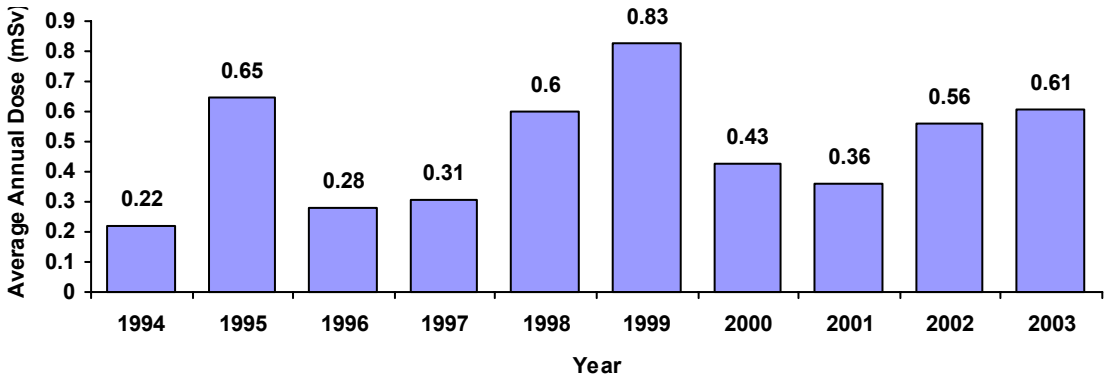


Table 4 (Cont'd)

Reactor - visitor

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Tritium
				Year 2003
0	4745	0.00	0.00	0
>0-1	1096	304.19	0.28	29
>1-2	237	347.59	1.47	13
>2-5	320	1053.30	3.29	11
>5-20	219	1830.68	8.36	6
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	6617	3535.76	0.53	10
				Five year period 1999 - 2003
0	10237	0.00	0.00	0
>0-5	2730	3290.21	1.21	20
>5-25	724	7597.45	10.49	11
>25-100	48	1801.78	37.54	7
>100	0	0.00	0.00	0
Total	13739	12689.44	0.92	13

Parameters of the distribution in 2003:

A: 0.1525
B: 0.1006
C: 0.0000
D: 1.0826
Sample size: 6617

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

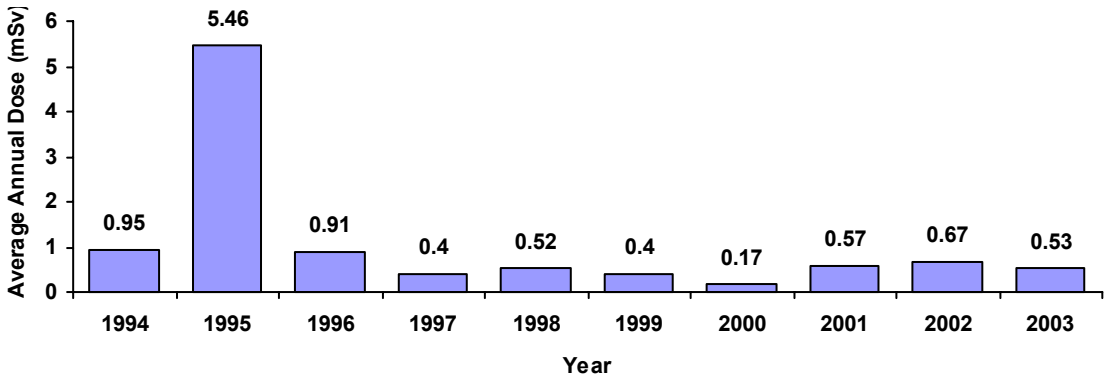


Table 4 (Cont'd)

Uranium mine electrician

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	0	0.00	0.00	0
>0-1	0	0.00	0.00	0
>1-2	0	0.00	0.00	0
>2-5	0	0.00	0.00	0
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	0	0.00	0.00	0
				Five year period 1999 - 2003
0	7	0.00	0.00	0
>0-5	14	5.50	0.39	100
>5-25	0	0.00	0.00	0
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	21	5.50	0.26	100

Parameters of the distribution in 2003:

A: N/A
B: N/A
C: N/A
D: N/A
Sample size:

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

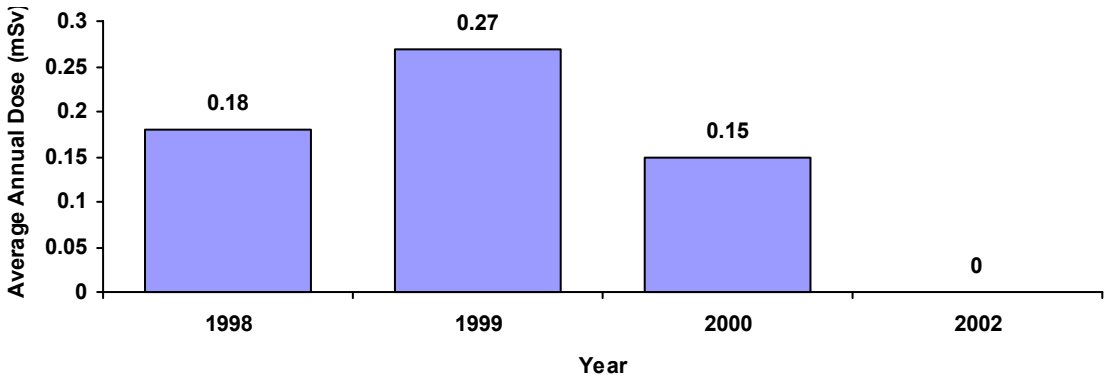


Table 4 (Cont'd)

Uranium mine mill maintenance

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	16	0.00	0.00	0
>0-1	108	51.25	0.47	59
>1-2	56	78.85	1.41	53
>2-5	28	78.05	2.79	54
>5-20	1	7.75	7.75	11
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	209	215.90	1.03	53
				Five year period 1999 - 2003
0	19	0.00	0.00	0
>0-5	192	296.50	1.54	65
>5-25	104	966.45	9.29	54
>25-100	1	39.30	39.30	13
>100	0	0.00	0.00	0
Total	316	1302.25	4.12	55

Parameters of the distribution in 2003:

A: 0.5523
B: 0.3627
C: 0
D: -0.0773
Sample size: 209

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

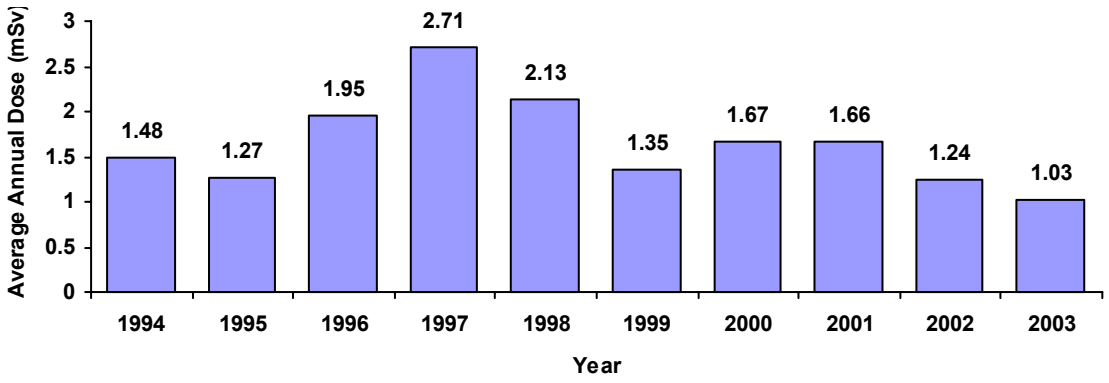


Table 4 (Cont'd)

Uranium mine mill worker

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	35	0.00	0.00	0
>0-1	90	46.60	0.52	59
>1-2	75	111.70	1.49	58
>2-5	54	157.65	2.92	61
>5-20	6	35.25	5.88	51
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	260	351.20	1.35	59
				Five year period 1999 - 2003
0	51	0.00	0.00	0
>0-5	222	364.20	1.64	62
>5-25	160	1886.25	11.79	54
>25-100	2	54.00	27.00	42
>100	0	0.00	0.00	0
Total	435	2304.45	5.30	55

Parameters of the distribution in 2003:

A: 0.3362
B: 0.4291
C: 0
D: -0.4412
Sample size: 260

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

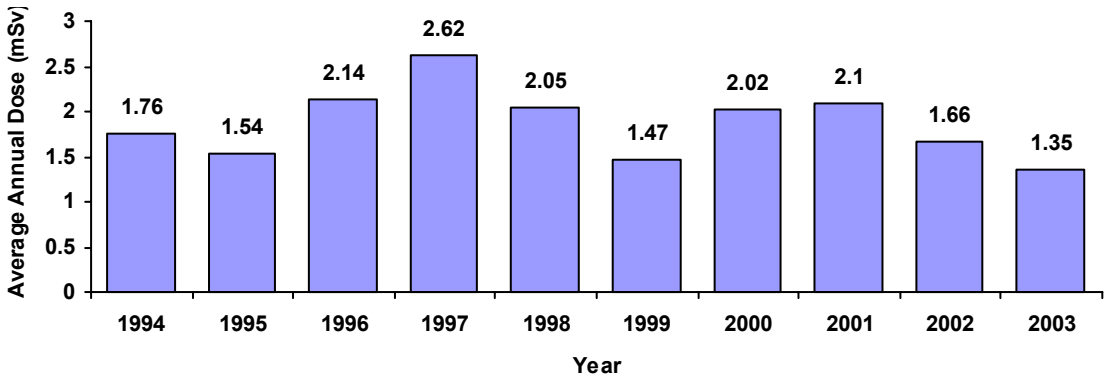


Table 4 (Cont'd)

Uranium mine nurse

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	4	0.00	0.00	0
>0-1	9	2.70	0.30	59
>1-2	0	0.00	0.00	0
>2-5	0	0.00	0.00	0
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	13	2.70	0.21	59
				Five year period 1999 - 2003
0	27	0.00	0.00	0
>0-5	14	8.85	0.63	72
>5-25	0	0.00	0.00	0
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	41	8.85	0.22	72

Parameters of the distribution in 2003:

A: 0
B: 1.8980
C: 0.0000
D: 0.0923
Sample size: 13

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

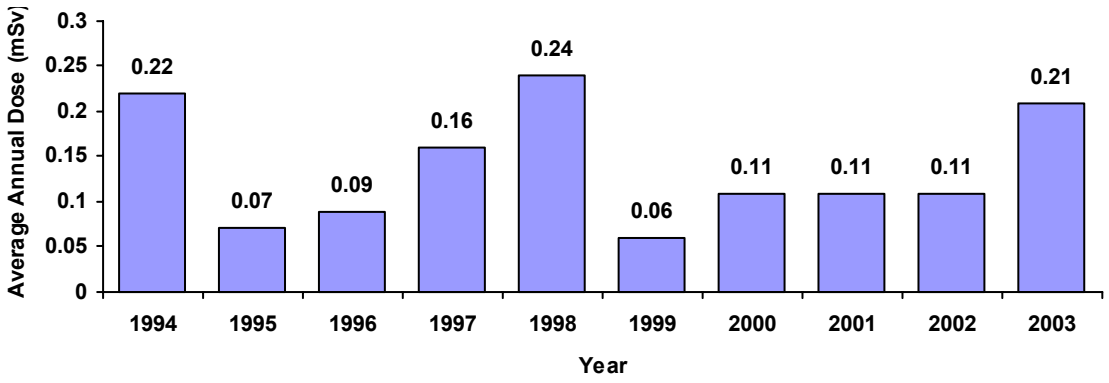


Table 4 (Cont'd)

Uranium mine office staff

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	52	0.00	0.00	0
>0-1	93	20.70	0.22	73
>1-2	0	0.00	0.00	0
>2-5	0	0.00	0.00	0
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	145	20.70	0.14	73
				Five year period 1999 - 2003
0	136	0.00	0.00	0
>0-5	232	152.70	0.66	62
>5-25	0	0.00	0.00	0
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	368	152.70	0.41	62

Parameters of the distribution in 2003:

A: 0
B: 1.7933
C: 0.2108
D: 1.1905
Sample size: 145

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

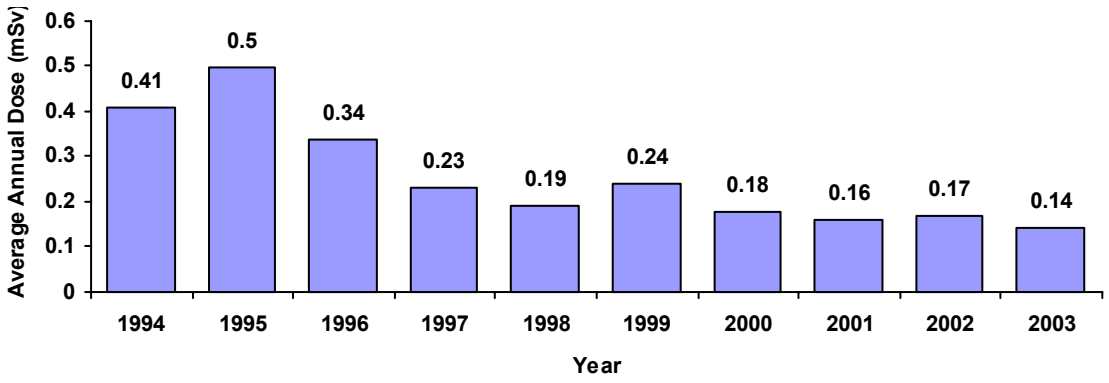


Table 4 (Cont'd)

Uranium mine support worker

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	7	0.00	0.00	0
>0-1	67	30.90	0.46	62
>1-2	24	32.85	1.37	51
>2-5	38	123.00	3.24	49
>5-20	7	49.95	7.14	72
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	143	236.70	1.66	56
				Five year period 1999 - 2003
0	81	0.00	0.00	0
>0-5	579	648.35	1.12	70
>5-25	90	881.80	9.80	46
>25-100	3	85.30	28.43	25
>100	0	0.00	0.00	0
Total	753	1615.45	2.15	54

Parameters of the distribution in 2003:

A: 0.3313
B: 0.2218
C: 0.0992
D: -0.0962
Sample size: 143

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

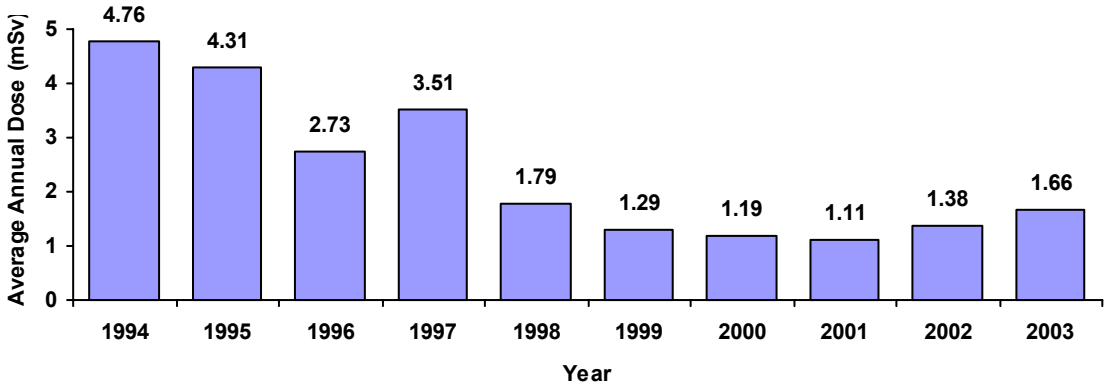


Table 4 (Cont'd)

Uranium mine surface maintenance

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	32	0.00	0.00	0
>0-1	180	65.55	0.36	74
>1-2	14	20.90	1.49	38
>2-5	3	10.20	3.40	37
>5-20	1	10.50	10.50	93
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	230	107.15	0.47	65
				Five year period 1999 - 2003
0	95	0.00	0.00	0
>0-5	359	403.05	1.12	64
>5-25	34	231.10	6.80	37
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	488	634.15	1.30	54

Parameters of the distribution in 2003:

A: 0.9229
B: 0
C: 0
D: 1.237
Sample size: 230

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

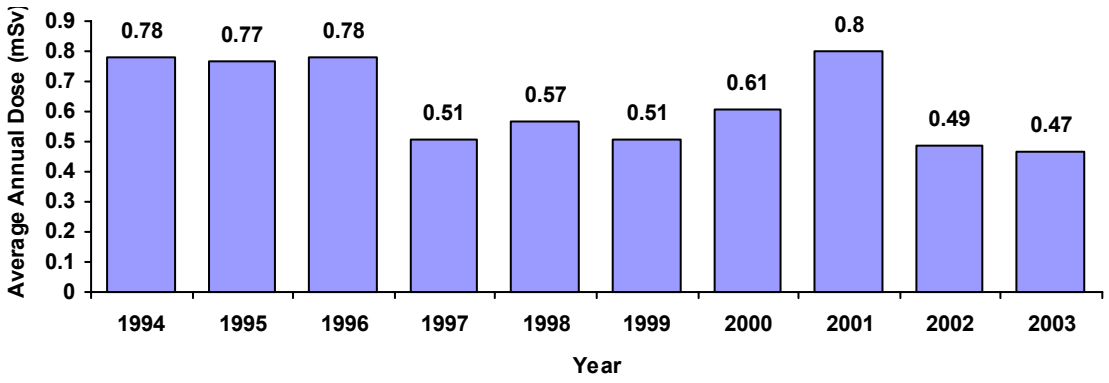


Table 4 (Cont'd)

Uranium mine surface miner

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	13	0.00	0.00	0
>0-1	17	8.20	0.48	4
>1-2	6	8.65	1.44	19
>2-5	2	6.95	3.48	18
>5-20	4	26.05	6.51	26
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	42	49.85	1.19	20
				Five year period 1999 - 2003
0	30	0.00	0.00	0
>0-5	85	68.75	0.81	44
>5-25	34	334.30	9.83	41
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	149	403.05	2.71	42

Parameters of the distribution in 2003:

A: 0.3927
B: 0.1195
C: 0
D: 0.3535
Sample size: 42

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

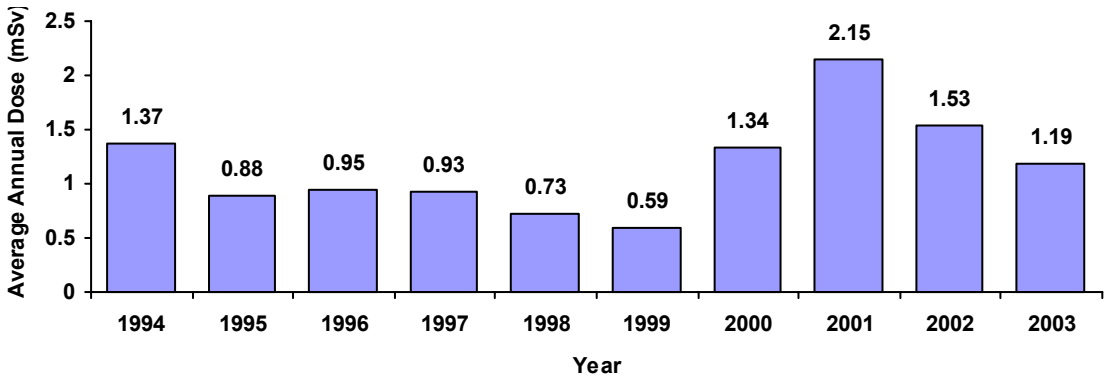


Table 4 (Cont'd)

Uranium mine surface personnel

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	60	0.00	0.00	0
>0-1	95	33.40	0.35	70
>1-2	14	20.60	1.47	83
>2-5	12	32.00	2.67	85
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	181	86.00	0.48	79
				Five year period 1999 - 2003
0	131	0.00	0.00	0
>0-5	269	258.50	0.96	67
>5-25	28	218.05	7.79	82
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	428	476.55	1.11	74

Parameters of the distribution in 2003:

A: 0
B: 0.4876
C: 0.1651
D: 0.7085
Sample size: 181

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

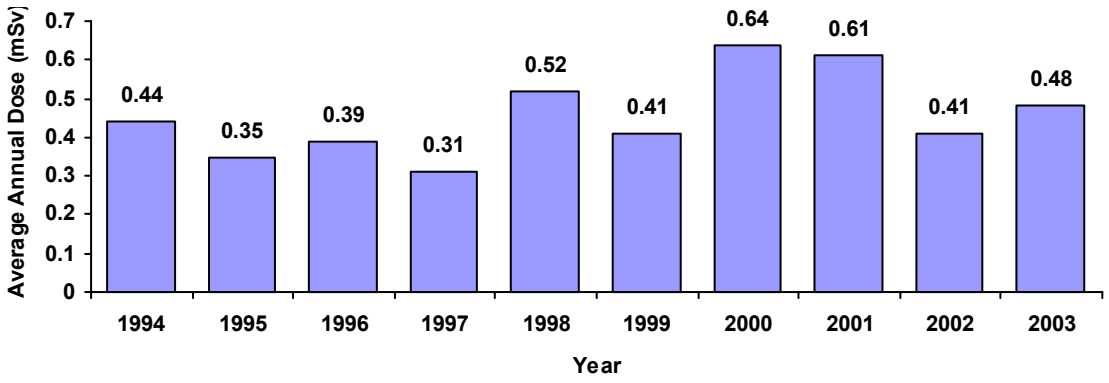


Table 4 (Cont'd)

Uranium mine surface support worker

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	165	0.00	0.00	0
>0-1	195	49.40	0.25	56
>1-2	6	7.70	1.28	68
>2-5	1	2.60	2.60	88
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	367	59.70	0.16	59
				Five year period 1999 - 2003
0	391	0.00	0.00	0
>0-5	458	306.70	0.67	51
>5-25	14	89.35	6.38	58
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	863	396.05	0.46	53

Parameters of the distribution in 2003:

A: 0.7884
B: 0.3121
C: 0
D: 1.7630
Sample size: 367

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

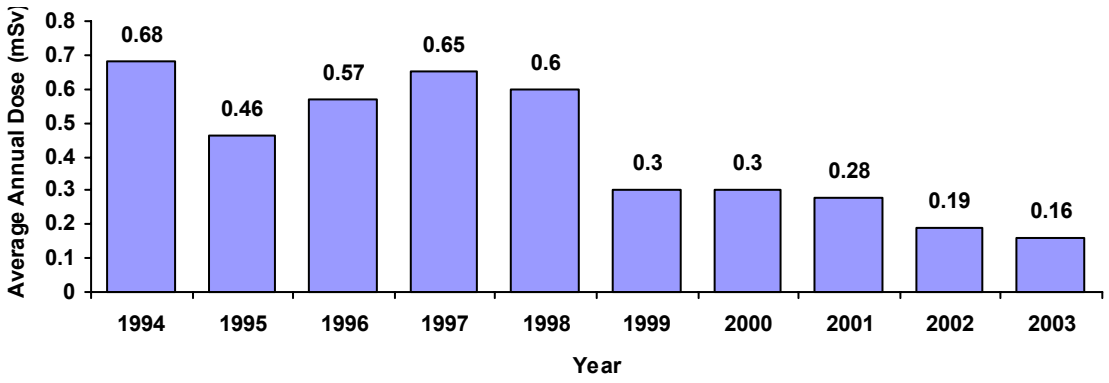


Table 4 (Cont'd)

Uranium mine underground maintenance

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	14	0.00	0.00	0
>0-1	82	41.00	0.50	75
>1-2	43	61.55	1.43	61
>2-5	19	52.25	2.75	49
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	158	154.80	0.98	61
				Five year period 1999 - 2003
0	30	0.00	0.00	0
>0-5	351	458.15	1.31	70
>5-25	23	167.15	7.27	60
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	404	625.30	1.55	67

Parameters of the distribution in 2003:

A: 0.3671
B: 0.6358
C: 0
D: -0.3801
Sample size: 158

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

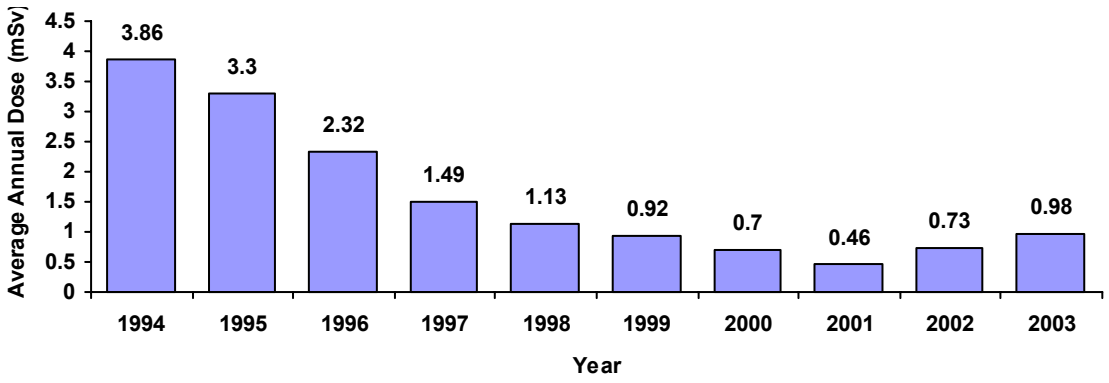


Table 4 (Cont'd)

Uranium mine underground miner

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	47	0.00	0.00	0
>0-1	57	28.35	0.50	69
>1-2	38	55.80	1.47	50
>2-5	82	272.00	3.32	55
>5-20	50	362.30	7.25	52
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	274	718.45	2.62	53
				Five year period 1999 - 2003
0	56	0.00	0.00	0
>0-5	355	555.67	1.57	67
>5-25	183	2036.46	11.13	49
>25-100	23	802.00	34.87	24
>100	0	0.00	0.00	0
Total	617	3394.13	5.50	46

Parameters of the distribution in 2003:

A: 0.2028
B: 0.2204
C: 0
D: -0.5251
Sample size: 274

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

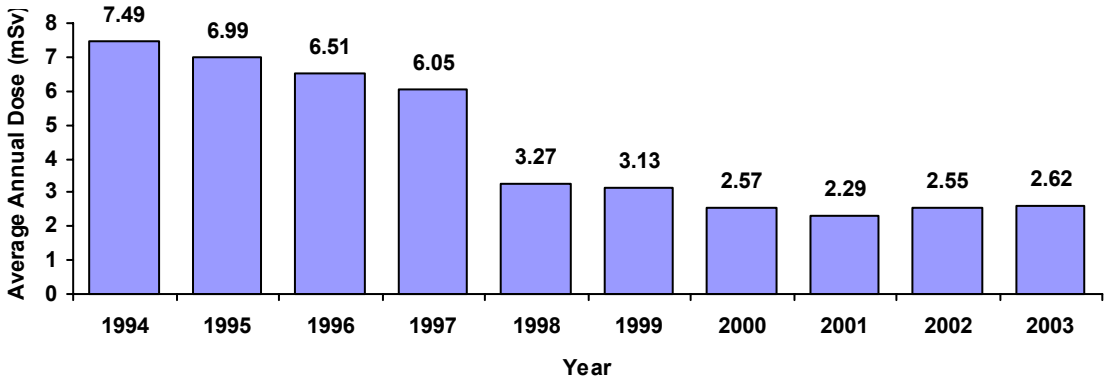


Table 4 (Cont'd)

Uranium mine underground personnel

Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	15	0.00	0.00	0
>0-1	39	15.00	0.38	71
>1-2	23	36.50	1.59	68
>2-5	20	51.05	2.55	53
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	97	102.55	1.06	61
				Five year period 1999 - 2003
0	53	0.00	0.00	0
>0-5	181	273.40	1.51	68
>5-25	22	156.67	7.12	56
>25-100	1	28.60	28.60	19
>100	0	0.00	0.00	0
Total	257	458.67	1.78	61

Parameters of the distribution in 2003:

A: 0
B: 0.7001
C: 0.0682
D: -0.4343
Sample size: 97

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003

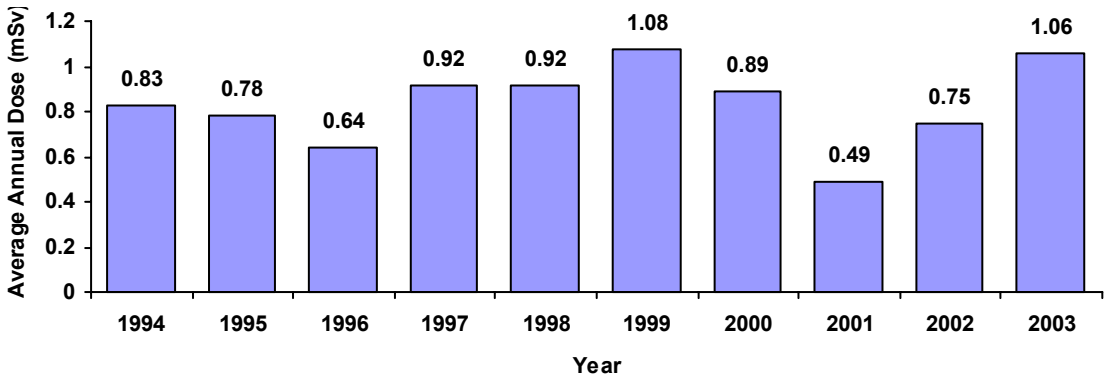


Table 4 (Cont'd)

Uranium mine visitor

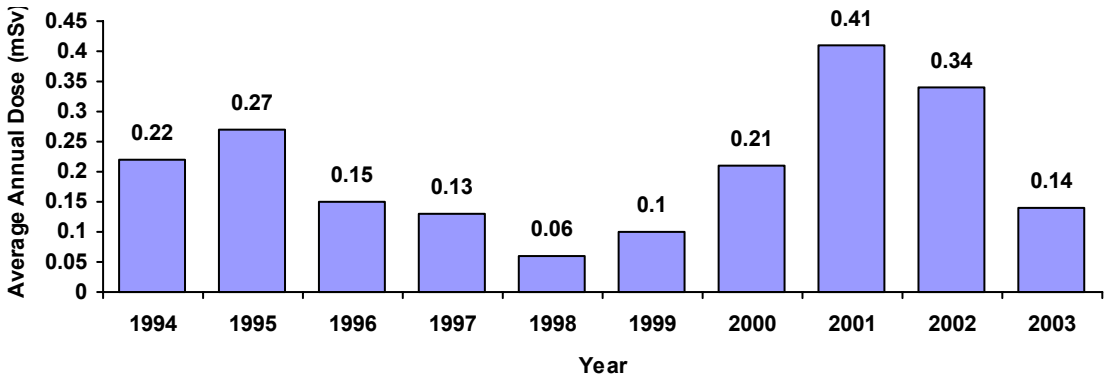
Dose Interval (mSv)	Number of Workers	Collective Dose	Average Dose	% Radon
				Year 2003
0	81	0.00	0.00	0
>0-1	36	10.70	0.30	16
>1-2	2	2.80	1.40	11
>2-5	1	3.85	3.85	14
>5-20	0	0.00	0.00	0
>20-50	0	0.00	0.00	0
>50	0	0.00	0.00	0
Total	120	17.35	0.14	15
				Five year period 1999 - 2003
0	278	0.00	0.00	0
>0-5	470	156.60	0.33	48
>5-25	6	44.50	7.42	21
>25-100	0	0.00	0.00	0
>100	0	0.00	0.00	0
Total	754	201.10	0.27	42

Parameters of the distribution in 2003:

A: 0.2667
B: 0.2012
C: 0.1116
D: 1.7531
Sample size: 120

(See Appendix for explanation)

Histogram of average annual doses over ten year period 1994 - 2003



Appendix
The new three component normal (TCN) distribution

The appendix explains how the data can be fitted to a statistical distribution, so that: (1) the sample of doses can be described by 5 quantities (the parameters of the distribution and sample size); and, (2) from these quantities, any dose statistic can be estimated, including any statistic not listed in this report, such as the 9-th decile.

Statistical distributions are defined by a probability density function, which is interpreted as follows:

The probability that a dose value lies between a and b equals

$$\int_a^b f(x)dx \quad ,$$

where f represents the probability density function and x assumes possible values of a random variable X which in our case represents the occupational dose.

The probability density function also contains a number of parameters, which determine the shape of the function. The distribution is defined by the mathematical formula for the density function, with the parameters as yet unspecified. Only when the parameters have been specified is the statistical model for the occupational dose defined. Parameters are adjusted to fit the data.

The TCN distribution has been designed to provide good fits especially to low dose distributions. Its probability density function is defined as:

$$f(x:A,B,C,D) =$$

$$\phi(A*\log(x) + B*x - C/x + D) *$$

$$(A/x + B + C/x^2) =$$

$$\phi(z) * (dz/dx)$$

where $\phi(t)$ denotes the standard normal probability density function $\exp(-t^2/2)/\sqrt{(2\pi)}$, and A, B, C and D are parameters of the distribution. In other words, the random variable:

$$Z = A*\log(X) + B*X - C/X + D$$

follows a standard normal distribution.

The parameters A, B and C are restricted to values >=0. If A=0 then B>0 and C>0. There are no restrictions on the parameter D.

Special cases of this distribution arise when B and C are fixed to 0, and when just C is fixed to 0, while A>0; they are reparametrized versions of respectively the lognormal and hybrid lognormal distributions[4], which were used in previous reports.

If the parameters for the probability density function f are known, one can estimate any dose statistic. For example, the mean dose is estimated as

$$\int_0^\infty xf(x)dx$$

(since the dose values x are between 0 and infinity).

The variance of the dose is estimated as:

$$\int_0^\infty (x-\text{mean})^2 f(x)dx$$

and the standard deviation as the square root thereof.

The probability that a dose exceeds, for example, 50 mSv, is estimated as:

$$\int_{50}^\infty f(x)dx \quad .$$

The 95-th percentile is estimated as that dose value v for which:

$$\int_{v}^{\infty} f(x)dx = 95/100 .$$

The fraction of the collective dose due to doses exceeding 15 mSv is estimated as:

$$\frac{\int_{15}^{\infty} xf(x)dx}{\int_{0}^{\infty} xf(x)dx} .$$

The parameters are determined from the actual dose data. They are chosen to give the best "fit" with the sample of observed data, for which purpose there exists a variety of methods. The parameters in Table 4 have been estimated with a form of the Maximum Likelihood method. With this method, dose statistics can be estimated with the formulas given above, with the tabulated parameter values substituted for A, B, C and D. Instead of single dose values, small dose intervals and their frequencies (i.e. number of doses within the intervals) are used to determine the parameters. Doses recorded as 0 are assumed to have small positive values within the lowest dose interval. The resulting models will be valid for complete sets of workers' doses, not just doses recorded as positive as in previous reports.