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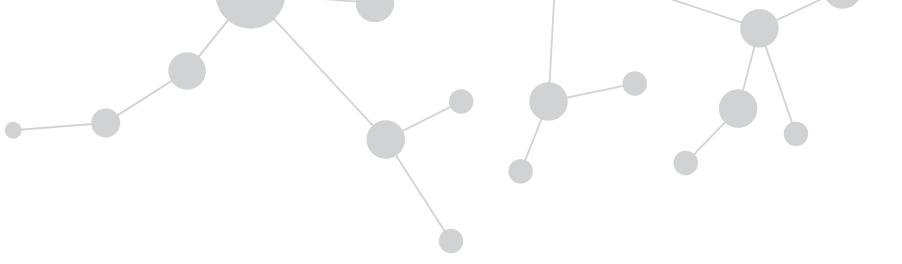
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REPORT ON OCCUPATIONAL RADIATION EXPOSURES IN **CANADA**

Canada



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Rapport de 2017 sur l'exposition professionnelle aux rayonnements au Canada

To obtain additional information, please contact:

Health Canada

Address Locator 0900C2

Ottawa, ON K1A 0K9

Tel.: 613-957-2991

Toll free: 1-866-225-0709

Fax: 613-941-5366

TTY: 1-800-465-7735

E-mail: hc.publications-publications.sc@canada.ca

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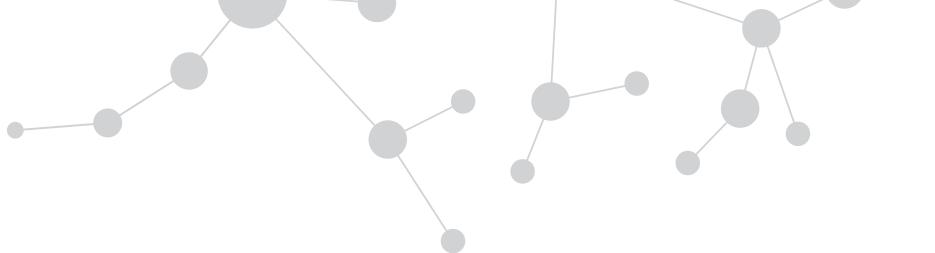
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SUMMARY

The National Dose Registry is Canada's national repository for dose records of Canadian workers who are monitored for occupational exposure to ionizing radiation. It is administered by Health Canada's Radiation Protection Bureau and supports Health Canada and Canadian regulatory authorities in their mandates to protect the health and safety of Canadians exposed to ionizing radiation in the workplace including, but not limited to, nuclear power plants, uranium mines, dental offices, and hospitals. It has been in continuous operation since 1951 and now contains the records of more than half a million individuals who have been monitored for radiation exposure as part of their jobs, including more than 150,000 members of the present-day workforce.

The 2017 Report on Occupational Radiation Exposures in Canada provides up-to-date statistics on occupational radiation exposures of monitored workers in Canada, spanning the period from 2007–2016. The report was developed primarily to summarize data from the National Dose Registry for use by regulatory authorities and facilitate analysis of national, regional, and sectorial trends. It may also be useful for researchers, employers and workers.

In 2016, dose records from a total of 158,398 unique workers (median age 39, 59% female) were reported to the National Dose Registry. From this number, 146,267 were monitored to ascertain effective dose (whole body), while the remaining were mainly monitored for extremities (hands and feet). Ontario had the highest number of monitored workers, followed by Quebec and Alberta.

Approximately 80% of the effective doses reported to the NDR were zero. The collective effective dose recorded in the National Dose Registry for 2016 was 32.3 person.Sv, and the mean annual effective dose was 0.20 mSv, which is the lowest mean dose reported since 1978. The mean non-zero annual effective dose was 0.96 mSv. More than half (57%) of the monitored workers in 2016 were from the medical sector, followed by the nuclear sector at 16%. With a few exceptions, mean doses for each job sector tended to decrease over the last 10-year period. The five job categories with the highest mean effective dose in 2016 were: Reactor – Fuel Handling (2.83 mSv); Reactor – Mechanical Maintenance (2.06 mSv); Reactor – Chemical and radiation control (1.48 mSv); Uranium Mining – Mill Workers (1.36 mSv); and Nuclear Medicine Technologists (1.23 mSv).

LIST OF ABBREVIATIONS

Alta:	Alberta
BC:	British Columbia
Man:	Manitoba
mSv:	millisievert
NDR:	National Dose Registry
NL:	Newfoundland and Labrador
NB:	New Brunswick
NS:	Nova Scotia
Ont:	Ontario
Part Accel:	Particle Accelerator
PEI:	Prince Edward Island
Que:	Quebec
Sask:	Saskatchewan
Terr:	Territories (including Yukon, Northwest Territories and Nunavut)
U:	Uranium
WLM:	Working Level Month

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DEFINITIONS

Effective dose: A measure of dose designed to reflect the amount of radiation detriment. The effective dose is obtained by multiplying the equivalent dose of each tissue or organ by an appropriate tissue weighting factor and summing the products. The equivalent dose is the absorbed dose weighted for the degree of biological effectiveness of different radiations. The absorbed dose can be defined as the radiation energy absorbed per unit mass of a substance (such as human tissue).

Source: http://nuclearsafety.gc.ca/eng/resources/radiation/introduction-to-radiation/nuclear-and-radiation-glossary.cfm#effective_dose

Effective collective dose (collective dose): The sum of all effective doses of all workers in a defined group for a given year.

Non-zero dose: A dose different (greater) than zero.

Job Sectors: Grouping of similar job categories (for a complete list of job categories by sector, see Appendix A):

Accelerator: Job categories where work is being performed in a particle accelerator environment. Includes scientists, technicians, maintenance staff, etc.

Industry: Industrial activities involving ionizing radiation that are not related to a nuclear reactor/power plant.

Medical: Work done with ionizing radiation in the human health sector, including environments such as hospitals, research centres, laboratories, dental and veterinarian clinics, etc.

Mining: All job categories in the uranium mining industry, as well as non-uranium mining activities where ionizing radiation is present.

Nuclear: Work done in and around nuclear power generating stations, including operation and maintenance, fuel handling, waste management, transport, etc.

Shared: Includes mainly support staff (such as administrative staff, students and inspectors) that can be found in the majority of workplaces, not already included in another job sector.

INTRODUCTION

The National Dose Registry (NDR) is the national repository for occupational dose records for Canadian workers. It is administered by Health Canada's Radiation Protection Bureau. It has been in continuous operation since 1951 and now contains the records of more than half a million individuals who have been monitored for radiation exposure as part of their jobs, including more than 150,000 members of the present-day workforce.

The main functions of the NDR are to:

- assist regulatory authorities by evaluating dose trends and statistics, and by notifying them of overexposures within their jurisdiction;
- contribute to health research and scientific knowledge about risks from occupational exposure to ionizing radiation; and
- provide dose histories to individual workers and organizations for work planning, and for compensation and litigation cases.

The 2017 Report on Occupational Radiation Exposures in Canada marks the resumption of regular reporting by the NDR after a hiatus of several years. It provides up-to-date statistics on occupational radiation exposures of monitored workers in Canada, spanning the period from 2007–2016. This information will assist regulatory authorities, organizations, and private individuals in comparing incurred occupational radiation exposures with national, regional, and sectorial means and trends.

The 2017 report follows a similar format to previous editions, with some changes that reflect recommendations from users, international best practice, and plans to use additional platforms for sharing data in the near future. The report is a series of tables describing the current workforce, as reflected in the NDR, and enumerating mean doses by type of job and/or location of work. Tables 2 to 4 present data by “job sector” in order to facilitate reading the tables and comparing the high-level results within them. Appendix A contains a list of the job categories included in each job sector, and Appendices B and C break down the information in Tables 2 and 4 by job category and present additional dose information in graph form.

Moving forward, NDR will issue summary reports like this one and make use of the Government of Canada’s Open Data portal to make summary data sets available electronically. Specific aggregate data can also be requested from the NDR using the contact information below.

This report and previous editions can be found on the *Government of Canada Publications* website (<http://publications.gc.ca/site/eng/411512/publication.html>) or by sending a request to the NDR:

National Dose Registry
Health Canada
Radiation Protection Building
775 Brookfield Road, AL 6302D
Ottawa (Ontario)
K1A 1C1
Email: hc.ndr-fdn.sc@canada.ca
Fax: 613-957-0960



GENERAL COMMENTS AND LIMITATIONS

The data presented in this report were extracted from the NDR on June 14th, 2017. Changes made after this date are not reflected in the report. Being an operational database, the NDR is constantly and regularly updated. The most frequent causes for changes to a record in the database are:

- dose corrections (including, but not limited to, situations where dose is judged to be non-personal after investigation);
- updates to a worker's job category;
- dosimeters or data returned late; and
- quality assurance improvements.

It is important to note that the regulations and requirements for monitoring differ between jurisdictions, and some do not require dose reporting to the NDR. This can impact the completeness of the datasets used for some job sectors and categories, particularly where x-rays are the primary source of exposure.

Doses are submitted to the NDR by licensed Dosimetry Service Providers, who measure, monitor and report ionizing radiation doses in accordance with regulatory requirements set by the Canadian Nuclear Safety Commission (CNSC). These service providers include commercial processors, as well as in-house services operated by, for example, nuclear power generating stations and uranium mines.

All doses in this report are reported as effective dose, in International System (SI) units. For a given individual, if effective doses due to more than one type of radiation are of relevance, and such doses have been measured or calculated separately, then these doses have been added together in reporting the final effective dose value for the individual. Examples of doses that may have been summed together include:

- 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).

In the report, the radon progeny exposures are converted in mSv. The conversion used in this report is 5 mSv/Working Level Month (WLM), in accordance with the *Radiation Protection Regulations* under the *Nuclear Safety and Control Act*. Skin doses and extremity doses are not included in the report but are recorded in the database.

For the external whole body doses, some Dosimetry Service Providers have set reporting thresholds ranging from 0.01 to 0.1 mSv, after background subtraction, and report doses below the threshold as zero. Others will calculate doses for workers based on area monitors or other methods and will not have a reporting threshold. In calculating descriptive dose statistics, all dose values have been used as reported.

This report is based on data as reported to the NDR with the presumption that dosimeters were worn properly and in accordance with regulations. In certain cases, exposures may have been over or underestimated if the dosimeter was not worn properly. The wearing period may also influence the reported doses. Since some Dosimetry Service Providers have a reporting threshold and are reporting dose values under that threshold as zeros, it is possible that, for a given exposure rate, a longer wearing period could result in a dose that just exceeds the reporting threshold (and thus result in a non-zero dose), while a shorter wearing period for that same exposure rate may not result in a dose that exceeds the reporting threshold (and thus the dose would be reported as zero). Finally, 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.

The province that is listed alongside a given dose in the NDR database may not always represent the province in which the radiation work has been performed. For example, a company based in one province could send workers to another province but report the dose as coming from the company's home province.

Workers may not always be assigned to job categories the same way by all employers. Job category designations are selected by each employer based on a standard list maintained by the NDR. Some have their own job classifications schemes and translate them into the NDR's standardized list prior to submission of the records.

A worker who has performed different types of work or who has been monitored by more than one Dosimetry Service Provider can have records under more than one job category or province for the same year. As a result, it should be noted that, in the tables, a worker is counted more than once if he (she) has worked in more than one job category or sector or in more than one province. For this reason, the totals and subtotals in the tables may appear to be inconsistent.

Finally, due to privacy considerations, some data were grouped or omitted to minimize the risk of re-identification, when numbers were small.

2016 FINAL DATA

A total of 158,398 unique workers were monitored by the NDR during the year 2016. Table 1 presents the general characteristics of these workers, grouped by province. The three territories have been combined in order to respect privacy requirements. The total number of workers for Canada reported in the table is slightly higher than the number of unique workers monitored due to some individuals doing work in more than one province/territory. In this case, they are counted in each province/territory.

Table 1: Characteristics of workers by province/territories

Province	Workers (n)	Sex (M/F)	Age (Median years)	Collective Effective Dose (person.Sv)	Mean effective Dose (mSv)	Mean Effective Non-zero Dose (mSv)
NL	2253	650 / 1603	37	0.18	0.08	0.45
PEI	293	58 / 235	37	0.03	0.12	0.60
NS	2517	594 / 1923	39	0.19	0.08	0.79
NB	3594	2506 / 1088	41	1.08	0.30	1.04
Que	36679	10036 / 26643	37	3.16	0.09	0.79
Ont	67654	35386 / 32268	41	20.83	0.31	1.31
Man	5880	1494 / 4386	38	0.33	0.06	0.56
Sask	8633	5454 / 3179	38	2.77	0.32	0.61
Alta	21080	5875 / 15205	36	2.89	0.14	0.67
BC	10392	3392 / 7000	38	0.72	0.07	0.32
Territories	466	99 / 367	42	0.09	0.19	0.68
Canada	159441	65544 / 93897	39	32.28	0.20	0.96

For Tables 2 to 4, job categories have been combined into sectors. Appendix A lists the job sectors and the categories included in each.

Table 2 shows dose information for each sector, as well as the number of workers who fall into different dose ranges. Doses below the reporting threshold of the Dosimetry Service Provider (when applicable) are considered zeros. For distribution of doses by individual job categories, see Appendix B.

Table 2: Breakdown of annual effective doses by job sector for all of Canada

Job Sector*	Workers (n)	Collective effective Dose (person.Sv)	Mean Effective Dose (mSv)	Mean Effective Non-zero Dose (mSv)	Distribution of workers per dose range (n)						
					0	>0-1	>1-5	>5-10	>10-15	>15-20	>20
Accelerator	1125	0.10	0.09	0.28	769	322	33	1	0	0	0
Industry	19261	6.07	0.32	0.76	11254	6427	1401	164	12	1	2
Medical	92220	6.40	0.07	0.55	80563	10060	1476	96	13	6	6
Mining	4715	2.33	0.49	0.59	747	3260	696	12	0	0	0
Nuclear	25572	16.64	0.65	2.20	17997	3730	2692	1024	103	17	9
Shared	19858	0.75	0.04	0.33	17610	2091	152	4	1	0	0
Total	162751	32.28	0.20	0.96	128940	25890	6450	1301	129	24	17

* Individuals working in 2 (or more) different job sectors are counted in each job sector

Table 3 shows the mean doses for each province and the territories by job sector. Territories have been combined due to small numbers. For privacy reasons, mean doses for very small sample sizes are not shown (represented by a dash sign).

Table 3: Number of workers and mean annual effective doses by job sector and province/territories

Job sector*	NL	PEI	NS	NB	Que	Ont	Man	Sask	Alta	BC	Terr	Canada
Accelerator												
Workers (n)	0	0	0	0	0	2	0	160	0	972	0	1134
Mean Dose (mSv)	-	-	-	-	-	-	-	0.01	-	0.10	-	0.09
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	0.05	-	0.30	-	0.28
Industry												
Workers (n)	269	16	350	243	2829	12382	325	1153	3481	1186	31	22265
Mean Dose (mSv)	0.07	0.02	0.10	0.13	0.19	0.25	0.14	0.22	0.58	0.14	0.68	0.28
Mean Non-Zero Dose (mSv)	0.23	0.11	0.61	0.50	0.87	0.51	0.73	1.09	1.39	0.66	1.32	0.70
Medical												
Workers (n)	1857	264	2091	913	31504	31868	5738	2993	18646	8956	444	105274
Mean Dose (mSv)	0.09	0.13	0.08	0.05	0.08	0.08	0.05	0.08	0.04	0.05	0.15	0.07
Mean Non-Zero Dose (mSv)	0.51	0.66	0.89	0.33	0.79	0.62	0.56	0.52	0.28	0.26	0.58	0.53
Mining												
Workers (n)	0	0	0	0	103	20	0	8292**	0	13	0	8428
Mean Dose (mSv)	-	-	-	-	0.49	0.05	-	0.28	-	-	-	0.28
Mean Non-Zero Dose (mSv)	-	-	-	-	0.61	0.99	-	0.36	-	-	-	0.36
Nuclear												
Workers (n)	0	0	0	2492	985	33962	0	0	0	2	0	37441
Mean Dose (mSv)	-	-	-	0.40	0.01	0.46	-	-	-	-	-	0.45
Mean Non-Zero Dose (mSv)	-	-	-	-	1.16	0.20	1.86	-	-	-	-	1.79
Shared												
Workers (n)	300	34	306	137	6844	9192	763	476	2649	810	22	21533
Mean Dose (mSv)	0.02	0.02	0.02	0.02	0.02	0.06	0.03	0.07	0.04	0.03	0.15	0.04
Mean Non-Zero Dose (mSv)	0.22	0.23	0.34	0.31	0.45	0.28	0.35	0.58	0.29	0.34	0.64	0.32

* Individuals working in 2 (or more) different job sectors and/or provinces/territories are counted in each job sector/province/territory.

** Saskatchewan's number of workers in the mining sector is high because most workers were monitored under 2 or more job categories.

The last report published by the NDR was in 2008 and included a complete analysis of data for the year 2006 and a partial analysis for 2007. Table 4 summarizes the mean dose data by job sector for 2007 to 2016. Information broken down further by job categories within the job sectors can be found in Appendix C.

Table 4: Ten-year trend of number of workers and mean effective annual doses by job sector for all of Canada

Year		Accelerator	Industry	Medical	Mining	Nuclear	Shared	Total
2007	Workers (n)	857	26038	89960	4847	24601	22627	168930
	Mean Dose (mSv)	0.37	0.48	0.10	0.74	1.04	0.05	0.31
	Mean Non-Zero Dose (mSv)	0.86	1.25	0.75	0.96	2.76	0.54	1.39
2008	Workers (n)	840	26198	91855	5605	26776	21747	173021
	Mean Dose (mSv)	0.33	0.54	0.10	0.67	1.09	0.05	0.34
	Mean Non-Zero Dose (mSv)	0.41	1.36	0.76	0.79	2.96	0.56	1.44
2009	Workers (n)	833	24376	89289	5229	28444	21500	169671
	Mean Dose (mSv)	0.24	0.50	0.10	0.75	0.97	0.04	0.32
	Mean Non-Zero Dose (mSv)	0.85	1.24	0.75	0.89	2.65	0.44	1.38
2010	Workers (n)	948	23877	91044	5003	28393	21835	171100
	Mean Dose (mSv)	0.20	0.49	0.09	0.83	0.95	0.05	0.31
	Mean Non-Zero Dose (mSv)	1.01	1.26	0.72	0.96	2.70	0.54	1.40
2011	Workers (n)	1054	23872	92246	5816	26707	22353	172048
	Mean Dose (mSv)	0.16	0.50	0.11	0.73	1.08	0.06	0.33
	Mean Non-Zero Dose (mSv)	0.42	1.27	0.83	0.83	2.95	0.56	1.45
2012	Workers (n)	1057	23552	93371	6604	25471	22347	172402
	Mean Dose (mSv)	0.17	0.54	0.09	0.60	1.03	0.04	0.30
	Mean Non-Zero Dose (mSv)	0.25	1.40	0.78	0.67	2.86	0.44	1.38
2013	Workers (n)	1117	23384	93484	7485	22324	21280	169074
	Mean Dose (mSv)	0.17	0.47	0.07	0.59	0.79	0.04	0.24
	Mean Non-Zero Dose (mSv)	0.40	1.22	0.61	0.69	2.48	0.38	1.12
2014	Workers (n)	1096	22305	94993	6190	22914	20776	168274
	Mean Dose (mSv)	0.13	0.48	0.08	0.64	0.70	0.04	0.24
	Mean Non-Zero Dose (mSv)	0.19	1.19	0.71	0.73	2.26	0.40	1.11
2015	Workers (n)	1107	20693	90945	6200	23889	20103	162937
	Mean Dose (mSv)	0.11	0.42	0.06	0.71	0.72	0.04	0.23
	Mean Non-Zero Dose (mSv)	0.25	1.01	0.58	0.83	2.41	0.36	1.11
2016	Workers (n)	1125	19261	92220	4715	25572	19858	162751
	Mean Dose (mSv)	0.09	0.32	0.07	0.49	0.65	0.04	0.20
	Mean Non-Zero Dose (mSv)	0.28	0.76	0.55	0.59	2.20	0.33	0.96



APPENDIX A

Classification of Job Categories by Sectors

Job Sector	Job Categories
Accelerator	Particle Accelerator – Scientific/professional
	Particle Accelerator – Administration
	Particle Accelerator – Health Physics
	Particle Accelerator – Chemical & Radiation Control
	Particle Accelerator – Electrical Maintenance
	Particle Accelerator – Mechanical Maintenance
	Particle Accelerator – General Maintenance
	Particle Accelerator – Operations
	Particle Accelerator – Control Technicians
	Particle Accelerator – Electrical Technicians
	Particle Accelerator – Mechanical Technicians
	Particle Accelerator – Designers
	Particle Accelerator – Machinists
	Particle Accelerator – Contractor
	Particle Accelerator – Student
	Particle Accelerator – Training
	Particle Accelerator – Construction
	Particle Accelerator – Visitor
Industry	Dial Painter
	Instructor (Non-medical)
	Instrument Technician
	Laboratory Technician (Industrial)
	Well Logger
	Industrial Radiographer
	Scientist Engineer (Field)
	Scientist/engineer (Laboratory)
	Other (Industrial)
	Fuel Processor
	Janitorial Staff
	Salesperson
	Tradesman
	Ground Transportation
	Security
	Aircrew

Job Sector	Job Categories
Medical	Chiropractor
	Dentist
	Gynaecologist
	Laboratory Technician (Medical)
	Medical Physicist
	Nurse
	Physician
	Radiological Technologist
	Radiation Therapist
	Radiologist (Diagnostic)
	Radiologist (Therapeutic)
	Veterinarian
	Ward Aid/orderly
	Other (Medical)
	Nuclear Medicine Technolgist
	Dental Hygienist
	Dental Assistant
	Dental Therapist/nurse
	Speech-language Pathologist
	Chiropractor Assistant
	Veterinary Technician
Mining	Uranium Mine Underground Personnel
	Uranium Mine Surface Personnel
	Uranium Mine Visitors
	Uranium Mine Office Staff
	Uranium Mine Underground Miner
	Uranium Mine Nurses
	Uranium Mine Support Workers
	Uranium Mine Underground Maintenance
	Uranium Mine Electrician
	Uranium Mine Surface Miner
	Uranium Mine Surface Support Workers
	Uranium Mine Surface Maintenance
	Uranium Mine Mill Maintenance
	Uranium Mine Mill Workers
	Non Uranium Mine Surface Personnel
	Non Uranium Mine Underground Miner
	Non Uranium Mine Surface Maintenance
	Non Uranium Mine Mill Workers



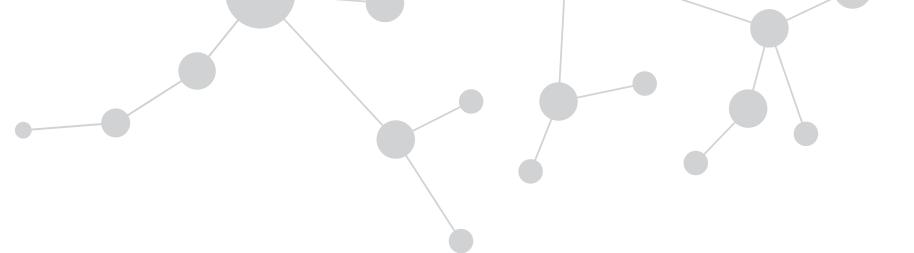
Job Sector	Job Categories
Nuclear	Reactor – Scientific/professional
	Reactor – Administration
	Reactor – Health Physics
	Reactor – Chemical And Radiation Control
	Reactor – Electrical Maintenance
	Reactor – Industrial Radiographer
	Reactor – Mechanical Maintenance
	Reactor – General Maintenance
	Reactor – Fuel Handling
	Reactor – Operations
	Reactor – Control Technicians
	Reactor – Contractor
	Reactor – Summer Student
	Reactor – Training
	Reactor – Construction
	Reactor – Visitor
Shared	Unknown
	Administrator
	Office Staff
	Safety Officer
	Other (Administration)
	Student
	Visitor
	Other (Miscellaneous)
	Inspector

APPENDIX B

Breakdown of annual effective doses by job category for all of Canada for 2016

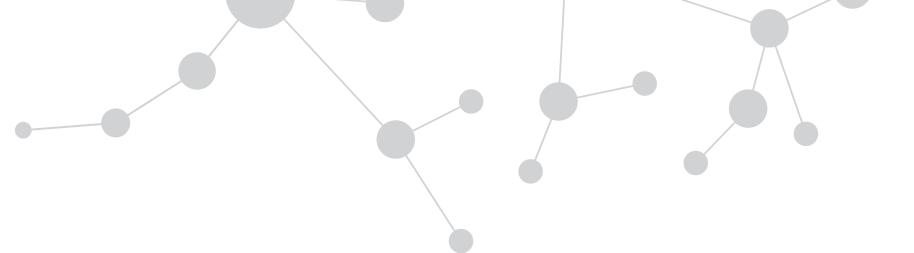
For privacy reasons, data for very small sample sizes are not shown (represented by a dash sign).

Job Category*	Workers (n)	Collective effective Dose (person.Sv)	Mean effective Dose (mSv)	Distribution of workers per dose range (n)						
				0	>0-1	>1-5	>5-10	>10-15	>15-20	>20
Total	167781	32.28	0.19	132664	27194	6485	1282	117	22	17
Accelerator										
Part Accel – Scientific/ Professional	360	0.01	0.04	260	97	3	0	0	0	0
Part Accel – Administration	67	0.00	0.00	57	10	0	0	0	0	0
Part Accel – Health Physics	2	-	-	-	-	-	-	-	-	-
Part Accel – Chemical & Radiation Control	9	-	-	-	-	-	-	-	-	-
Part Accel – Electrical Maintenance	6	-	-	-	-	-	-	-	-	-
Part Accel – Mechanic. Maintenance	7	-	-	-	-	-	-	-	-	-
Part Accel – General Maintenance	19	0.00	0.15	6	13	0	0	0	0	0
Part Accel – Operations	62	0.03	0.45	23	28	11	0	0	0	0
Part Accel – Control Technicians	42	0.00	0.07	35	6	1	0	0	0	0
Part Accel – Electrical Technicians	11	0.00	0.02	6	5	0	0	0	0	0
Part Accel – Mechanical Technicians	82	0.03	0.36	33	39	9	1	0	0	0
Part Accel – Designers	27	0.00	0.11	22	4	1	0	0	0	0
Part Accel – Machinists	24	0.00	0.29	19	2	3	0	0	0	0
Part Accel – Contractor	81	0.00	0.01	66	15	0	0	0	0	0
Part Accel – Student	158	0.00	0.03	115	41	2	0	0	0	0
Part Accel – Training	1	-	-	-	-	-	-	-	-	-
Part Accel – Construction	4	-	-	-	-	-	-	-	-	-
Part Accel – Visitor	163	0.00	0.01	108	55	0	0	0	0	0



Job Category*	Workers (n)	Collective effective Dose (person.Sv)	Mean effective Dose (mSv)	Distribution of workers per dose range (n)							
				0	>0-1	>1-5	>5-10	>10-15	>15-20	>20	
Industry											
Dial Painter	1	-	-	-	-	-	-	-	-	-	-
Well Logger	750	0.16	0.22	443	277	27	2	0	0	0	1
Industrial Radiographer	2524	2.29	0.91	1212	679	522	100	10	1	0	0
Scientist Engineer (Field)	1438	0.32	0.22	841	532	56	9	0	0	0	0
Scientist/Engineer (Laboratory)	2054	0.08	0.04	1747	300	7	0	0	0	0	0
Other (Industrial)	7322	1.62	0.22	3870	3105	310	37	0	0	0	0
Fuel Processor	1303	0.91	0.70	333	630	332	8	0	0	0	0
Janitorial Staff	28	0.00	0.04	24	4	0	0	0	0	0	0
Salesperson	76	0.02	0.21	50	22	4	0	0	0	0	0
Instructor (Non- Medical)	437	0.01	0.03	412	24	0	1	0	0	0	0
Instrument Technician	1443	0.25	0.17	1037	357	44	3	1	0	1	
Laboratory Technician (Industrial)	1464	0.28	0.19	963	433	65	3	0	0	0	0
Tradesman	150	0.06	0.40	84	48	18	0	0	0	0	0
Ground Transportation	165	0.05	0.31	94	56	14	1	0	0	0	0
Security	532	0.02	0.03	500	28	4	0	0	0	0	0

Job Category*	Workers (n)	Collective effective Dose (person.Sv)	Mean effective Dose (mSv)	Distribution of workers per dose range (n)						
				0	>0-1	>1-5	>5-10	>10-15	>15-20	>20
Medical										
Chiropractor	1019	0.03	0.03	965	49	3	2	0	0	0
Dentist	8302	0.08	0.01	8036	251	15	0	0	0	0
Gynaecologist	5	-	-	-	-	-	-	-	-	-
Laboratory Technician (Medical)	1082	0.12	0.11	896	150	35	1	0	0	0
Medical Physicist	299	0.02	0.05	246	51	1	1	0	0	0
Nurse	6695	0.36	0.05	5416	1207	66	6	0	0	0
Physician	3135	0.59	0.19	2357	644	112	13	7	2	0
Radiological Tech	13508	1.51	0.11	9946	3286	255	14	2	2	3
Radiation Therapist	890	0.04	0.04	720	165	4	1	0	0	0
Radiologist (Diagnostic)	1725	0.29	0.17	1297	374	44	5	1	2	2
Radiologist (Therapeutic)	120	0.01	0.05	106	13	1	0	0	0	0
Veterinarian	7263	0.13	0.02	6874	367	22	0	0	0	0
Veterinary Technician	14198	0.03	0.02	13379	773	45	0	1	0	0
Ward Aid/Orderly	468	0.02	0.05	413	50	5	0	0	0	0
Other (Medical)	5356	0.56	0.10	3904	1308	134	8	1	0	1
Nuclear Medicine Technologist	1703	2.10	1.23	409	542	711	41	0	0	0
Dental Hygienist	12371	0.09	0.01	12013	347	11	0	0	0	0
Dental Assistant	15295	0.16	0.01	14697	579	18	1	0	0	0
Dental Therapist/Nurse	126	0.00	0.00	113	13	0	0	0	0	0
Speech-Language Pathologist	177	0.00	0.02	158	19	0	0	0	0	0
Chiropractor Assistant	42	0.00	0.01	39	3	0	0	0	0	0



Job Category*	Workers (n)	Collective effective Dose (person.Sv)	Mean effective Dose (mSv)	Distribution of workers per dose range (n)						
				0	>0-1	>1-5	>5-10	>10-15	>15-20	>20
Mining										
U Mine Underground Personnel	288	0.11	0.38	77	182	29	0	0	0	0
U Mine Surface Personnel	580	0.12	0.21	149	420	11	0	0	0	0
U Mine Visitors	6	-	-	-	-	-	-	-	-	-
U Mine Office Staff	700	0.11	0.16	184	511	5	0	0	0	0
U Mine Underground Miner	405	0.31	0.78	21	276	108	0	0	0	0
U Mine Nurses	20	0.00	0.11	1	19	0	0	0	0	0
U Mine Support Workers	394	0.24	0.62	46	261	87	0	0	0	0
U Mine Underground Maintenance	357	0.15	0.41	66	236	55	0	0	0	0
U Mine Electrician	52	0.03	0.49	5	41	6	0	0	0	0
U Mine Surface Miner	22	0.00	0.20	1	21	0	0	0	0	0
U Mine Surface Support Workers	1445	0.28	0.20	352	1045	48	0	0	0	0
U Mine Surface Maintenance	647	0.20	0.31	106	506	35	0	0	0	0
U Mine Mill Maintenance	509	0.29	0.56	39	378	92	0	0	0	0
U Mine Mill Workers	312	0.43	1.36	9	157	136	10	0	0	0
Non U Mine Surface Maintenance	11	0.00	0.18	3	8	0	0	0	0	0
Non U Mine Mill Workers	92	0.05	0.53	17	55	20	0	0	0	0

Job Category*	Workers (n)	Collective effective Dose (person.Sv)	Mean effective Dose (mSv)	Distribution of workers per dose range (n)						
				0	>0-1	>1-5	>5-10	>10-15	>15-20	>20
Nuclear										
Reactor – Scientific/ Professional	4057	0.28	0.07	3665	310	75	7	0	0	0
Reactor – Administration	2336	0.34	0.14	2041	211	62	22	0	0	0
Reactor – Health Physics	230	0.16	0.71	141	66	6	14	3	0	0
Reactor – Chemical And Radiation Control	933	1.38	1.48	347	288	172	126	0	0	0
Reactor – Electrical Maintenance	997	0.82	0.82	518	249	188	40	2	0	0
Reactor – Industrial Radiographer	115	0.14	1.18	42	36	31	6	0	0	0
Reactor – Mechanical Maintenance	1486	3.06	2.06	525	351	354	223	33	0	0
Reactor – General Maintenance	1900	1.37	0.72	1194	382	223	97	4	0	0
Reactor – Fuel Handling	73	0.21	2.83	22	15	19	13	4	0	0
Reactor – Operations	2407	2.19	0.91	1202	622	449	129	5	0	0
Reactor – Control Technicians	440	0.17	0.38	251	128	60	1	0	0	0
Reactor – Contractor	4963	2.22	0.45	3626	729	499	104	5	0	0
Reactor – Summer Student	253	0.00	0.02	238	13	2	0	0	0	0
Reactor – Training	128	0.02	0.14	106	17	4	1	0	0	0
Reactor – Construction	1329	1.30	0.98	629	285	369	46	0	0	0
Reactor – Visitor	5726	2.99	0.52	4968	247	269	181	37	15	9



Job Category*	Workers (n)	Collective effective Dose (person.Sv)	Mean effective Dose (mSv)	Distribution of workers per dose range (n)						
				0	>0-1	>1-5	>5-10	>10-15	>15-20	>20
Shared										
Unknown	2	-	-	-	-	-	-	-	-	-
Administrator	757	0.02	0.03	619	137	1	0	0	0	0
Office Staff	3469	0.12	0.03	3029	420	19	1	0	0	0
Safety Officer	532	0.04	0.08	439	80	13	0	0	0	0
Other (Administration)	604	0.12	0.21	232	351	20	1	0	0	0
Student	13571	0.33	0.02	12706	786	76	2	1	0	0
Visitor	269	0.03	0.12	105	163	1	0	0	0	0
Other (Miscellaneous)	498	0.06	0.11	324	160	14	0	0	0	0
Inspector	274	0.02	0.08	248	18	8	0	0	0	0

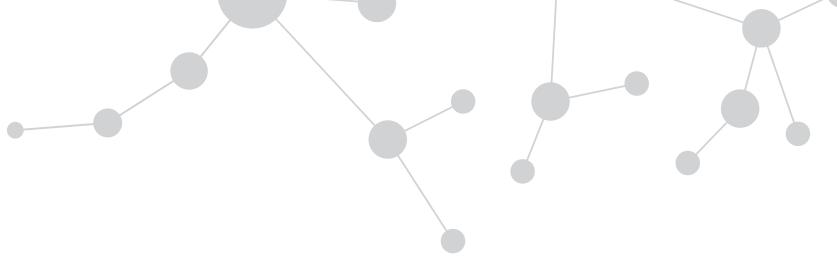
* Individuals working in 2 (or more) different job categories are counted in each job category.

APPENDIX C

Ten-year trend of number of workers, mean annual effective doses and mean annual non-zero doses by job category, for all of Canada

For privacy reasons, mean doses for very small sample sizes are not shown (represented by a dash sign).

Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total (n)	174878	180115	174908	177312	178367	178864	174672	173417	168243	167781
Mean Dose (mSv)	0.30	0.32	0.31	0.30	0.32	0.29	0.23	0.23	0.22	0.20
Mean Non-Zero Dose (mSv)	1.34	1.37	1.33	1.33	1.38	1.32	1.07	1.07	1.05	0.96
Accelerator										
Part Accel – Scientific/Professional	300	293	302	319	319	308	344	359	352	360
Mean Dose (mSv)	0.20	0.21	0.14	0.08	0.08	0.10	0.11	0.05	0.05	0.04
Mean Non-Zero Dose (mSv)	0.51	0.25	0.60	0.54	0.25	0.15	0.24	0.08	0.12	0.13
Part Accel – Administration	43	47	44	55	58	69	71	69	66	67
Mean Dose (mSv)	0.05	0.05	0.01	0.00	0.03	0.02	0.11	0.02	0.01	0.00
Mean Non-Zero Dose (mSv)	0.18	0.07	0.06	0.08	0.08	0.03	0.23	0.03	0.03	0.02
Part Accel – Health Physics	1	1	1	1	3	5	4	3	2	2
Mean Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Part Accel – Chemical & Radiation Control	5	5	5	9	8	7	7	8	9	9
Mean Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Part Accel – Electrical Maintenance	2	3	3	3	4	5	5	5	5	6
Mean Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Part Accel – Mechanic. Maintenance	1	3	2	8	7	7	4	4	6	7
Mean Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Part Accel – General Maintenance	18	17	16	15	19	18	20	19	18	19
Mean Dose (mSv)	1.30	0.90	0.75	0.51	0.68	0.48	0.50	0.24	0.29	0.15
Mean Non-Zero Dose (mSv)	1.67	0.96	1.09	0.63	0.86	0.48	0.67	0.25	0.38	0.21
Part Accel – Operations	44	51	50	62	65	62	61	62	64	62
Mean Dose (mSv)	1.23	1.40	0.87	0.77	0.50	0.67	0.53	0.71	0.44	0.45
Mean Non-Zero Dose (mSv)	1.54	1.59	1.24	1.30	0.63	0.75	0.74	0.98	0.67	0.71

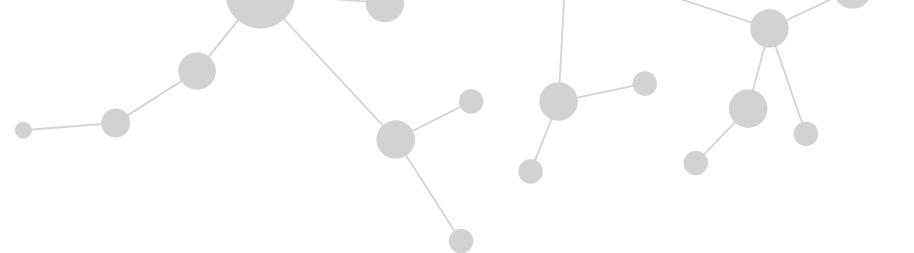


Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Part Accel – Control Technicians	30	29	31	48	48	45	46	45	41	42
Mean Dose (mSv)	0.27	0.26	0.38	0.13	0.10	0.11	0.26	0.13	0.10	0.07
Mean Non-Zero Dose (mSv)	0.68	0.33	1.30	1.06	0.27	0.22	0.51	0.27	0.35	0.42
Part Accel – Electrical Technicians	3	4	6	6	9	10	8	8	10	11
Mean Dose (mSv)	-	-	-	-	-	0.03	-	-	0.02	0.02
Mean Non-Zero Dose (mSv)	-	-	-	-	-	0.06	-	-	0.03	0.03
Part Accel – Mechanical Technicians	76	63	65	75	75	72	76	76	74	82
Mean Dose (mSv)	1.40	1.08	0.87	0.92	0.73	0.77	0.64	0.38	0.49	0.36
Mean Non-Zero Dose (mSv)	2.18	1.09	1.49	1.86	0.92	0.97	0.92	0.48	0.76	0.60
Part Accel – Designers	18	21	22	28	31	34	30	29	28	27
Mean Dose (mSv)	0.86	0.51	0.60	0.23	0.14	0.16	0.22	0.14	0.08	0.11
Mean Non-Zero Dose (mSv)	1.41	0.64	2.21	1.58	0.25	0.17	0.44	0.33	0.26	0.59
Part Accel – Machinists	25	31	28	28	29	24	23	25	25	24
Mean Dose (mSv)	0.30	0.30	0.24	0.30	0.34	0.25	0.38	0.26	0.35	0.29
Mean Non-Zero Dose (mSv)	1.49	0.30	1.10	1.66	0.65	0.34	1.73	0.36	0.74	1.39
Part Accel – Contractor	59	53	52	58	79	78	93	89	80	81
Mean Dose (mSv)	0.05	0.06	0.05	0.08	0.07	0.03	0.02	0.03	0.01	0.01
Mean Non-Zero Dose (mSv)	0.18	0.06	0.24	0.49	0.17	0.04	0.06	0.04	0.04	0.06
Part Accel – Student	118	112	102	101	119	135	138	148	165	158
Mean Dose (mSv)	0.08	0.06	0.03	0.03	0.05	0.05	0.04	0.04	0.03	0.03
Mean Non-Zero Dose (mSv)	0.23	0.08	0.23	0.30	0.27	0.08	0.16	0.05	0.08	0.12
Part Accel – Training	1	2	1	1	1	1	1	1	1	1
Mean Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Part Accel – Construction	1	0	0	0	8	48	46	6	6	4
Mean Dose (mSv)	-	-	-	-	-	0.01	0.00	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	0.02	0.02	-	-	-
Part Accel – Visitor	112	105	103	134	173	129	140	140	155	163
Mean Dose (mSv)	0.03	0.06	0.02	0.02	0.04	0.03	0.01	0.03	0.02	0.01
Mean Non-Zero Dose (mSv)	0.07	0.09	0.09	0.42	0.16	0.05	0.03	0.04	0.05	0.03

Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Industry										
Dial Painter	0	1	1	1	1	1	3	3	2	1
Mean Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Instructor (Non-Medical)	352	393	384	400	412	411	430	428	415	437
Mean Dose (mSv)	0.04	0.05	0.04	0.03	0.02	0.01	0.01	0.02	0.03	0.03
Mean Non-Zero Dose (mSv)	0.37	0.72	0.33	0.38	0.45	0.16	0.35	0.27	0.69	0.51
Instrument Technician	2163	2071	1870	1882	1988	1961	1812	1713	1541	1443
Mean Dose (mSv)	0.17	0.16	0.21	0.22	0.19	0.17	0.19	0.17	0.13	0.17
Mean Non-Zero Dose (mSv)	0.60	0.61	0.63	0.69	0.6	0.63	0.67	0.59	0.51	0.61
Laboratory Technician (Industrial)	2924	2723	2538	2409	2276	2256	2174	1879	1616	1464
Mean Dose (mSv)	0.19	0.24	0.25	0.21	0.18	0.15	0.16	0.16	0.15	0.19
Mean Non-Zero Dose (mSv)	0.71	0.81	0.81	0.66	0.54	0.59	0.54	0.53	0.48	0.55
Well Logger	2477	2119	1756	1667	1603	1475	1510	1528	1227	750
Mean Dose (mSv)	0.48	0.43	0.35	0.38	0.33	0.31	0.41	0.31	0.18	0.22
Mean Non-Zero Dose (mSv)	0.74	0.75	0.66	0.74	0.64	0.65	0.88	0.70	0.43	0.54
Industrial Radiographer	2942	2927	2833	2754	3005	3144	3491	3179	2996	2524
Mean Dose (mSv)	2.01	1.98	1.53	1.61	1.86	2.11	1.61	1.74	1.50	0.91
Mean Non-Zero Dose (mSv)	3.54	3.45	2.65	2.91	3.23	3.44	2.76	2.99	2.59	1.75
Scientist/Engineer (Field)	1674	1649	1661	1619	1600	1672	1644	1558	1502	1438
Mean Dose (mSv)	0.36	0.34	0.33	0.33	0.3	0.27	0.22	0.23	0.22	0.22
Mean Non-Zero Dose (mSv)	0.73	0.72	0.69	0.76	0.64	0.63	0.53	0.53	0.54	0.54
Scientist/Engineer (Laboratory)	4062	3858	3488	3318	3082	2956	2613	2421	2142	2054
Mean Dose (mSv)	0.05	0.05	0.05	0.05	0.04	0.06	0.08	0.05	0.07	0.04
Mean Non-Zero Dose (mSv)	0.34	0.41	0.35	0.47	0.41	0.50	0.65	0.36	0.47	0.27
Other (Industrial)	7995	8870	8261	8299	8399	8173	8219	7721	7303	7322
Mean Dose (mSv)	0.32	0.38	0.42	0.40	0.33	0.26	0.23	0.22	0.23	0.22
Mean Non-Zero Dose (mSv)	0.81	0.88	0.95	0.93	0.82	0.65	0.59	0.53	0.50	0.47
Fuel Processor	1260	1487	1315	1220	1199	1170	1344	1524	1521	1303
Mean Dose (mSv)	0.81	1.35	1.49	1.33	1.27	1.66	1.02	1.00	0.79	0.70
Mean Non-Zero Dose (mSv)	1.51	2.18	2.32	1.95	1.78	2.28	1.37	1.48	1.08	0.94
Janitorial Staff	109	98	78	80	59	59	46	41	29	28
Mean Dose (mSv)	0.08	0.23	0.06	0.24	0.26	0.27	0.21	0.22	0.19	0.04
Mean Non-Zero Dose (mSv)	0.35	0.85	0.29	0.83	1.68	3.23	0.97	1.50	1.40	0.29
Salesperson	55	114	114	111	86	65	58	68	80	76
Mean Dose (mSv)	0.13	0.05	0.13	0.09	0.09	0.14	0.13	0.19	0.12	0.21
Mean Non-Zero Dose (mSv)	0.66	0.21	0.41	0.30	0.25	0.46	0.53	0.61	0.37	0.61

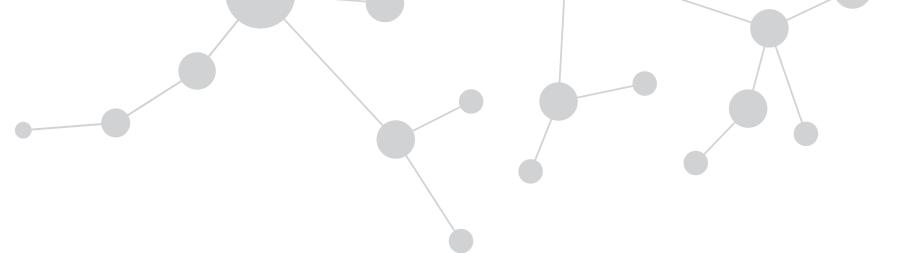
Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Tradesman	167	155	165	153	169	206	200	170	158	150
Mean Dose (mSv)	0.10	0.17	0.08	0.08	0.10	0.40	1.17	1.42	0.97	0.40
Mean Non-Zero Dose (mSv)	0.33	0.38	0.25	0.23	0.31	0.92	2.32	2.93	2.41	0.91
Ground Transportation	97	114	130	110	134	118	117	143	151	165
Mean Dose (mSv)	0.87	1.05	0.52	0.76	0.63	0.61	0.53	0.51	0.53	0.31
Mean Non-Zero Dose (mSv)	1.51	1.93	1.14	1.27	1.23	1.17	1.02	1.05	1.15	0.71
Security	219	185	217	212	231	287	304	399	482	532
Mean Dose (mSv)	0.02	0.01	0.02	0.03	0.02	0.06	0.05	0.03	0.01	0.03
Mean Non-Zero Dose (mSv)	0.19	0.20	0.25	0.53	0.24	0.73	0.59	0.38	0.35	0.51
Aircrew	16	22	16	7	3	3	1	1	1	0
Mean Dose (mSv)	0.26	0.33	0.10	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	0.85	0.74	0.56	-	-	-	-	-	-	-
Medical										
Chiropractor	1149	1153	1136	1119	1080	1063	1042	1035	1003	1019
Mean Dose (mSv)	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.03
Mean Non-Zero Dose (mSv)	0.48	0.57	0.44	0.53	0.94	0.77	0.47	0.68	1.41	0.52
Dentist	7852	7912	7698	7860	7870	7807	7993	8085	8154	8302
Mean Dose (mSv)	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mean Non-Zero Dose (mSv)	0.35	0.25	0.22	0.24	0.23	0.33	0.27	0.27	0.25	0.30
Gynaecologist	11	11	7	4	3	6	4	3	5	5
Mean Dose (mSv)	0.01	0.00	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	0.12	0.00	-	-	-	-	-	-	-	-
Laboratory Technician (Medical)	2932	2757	2446	2246	2050	1800	1543	1454	1154	1082
Mean Dose (mSv)	0.09	0.09	0.10	0.09	0.11	0.10	0.07	0.12	0.08	0.11
Mean Non-Zero Dose (mSv)	0.76	0.73	0.74	0.65	0.82	0.73	0.60	0.96	0.54	0.63
Medical Physicist	447	440	367	368	404	419	413	402	306	299
Mean Dose (mSv)	0.04	0.03	0.13	0.03	0.09	0.05	0.03	0.05	0.04	0.05
Mean Non-Zero Dose (mSv)	0.40	0.32	1.04	0.23	0.62	0.42	0.26	0.30	0.19	0.29
Nurse	7805	8157	8016	7866	8014	8001	7503	7587	6578	6695
Mean Dose (mSv)	0.08	0.09	0.11	0.12	0.12	0.09	0.07	0.05	0.04	0.05
Mean Non-Zero Dose (mSv)	0.42	0.51	0.55	0.58	0.59	0.55	0.42	0.34	0.23	0.28
Physician	3231	3393	3326	3393	3448	3486	3365	3439	2995	3135
Mean Dose (mSv)	0.30	0.30	0.42	0.36	0.44	0.32	0.22	0.18	0.23	0.19
Mean Non-Zero Dose (mSv)	1.19	1.16	1.49	1.41	1.7	1.36	0.97	0.84	0.97	0.76
Radiological Technologist	13825	14145	13851	14008	14248	14223	13884	14189	13305	13508
Mean Dose (mSv)	0.09	0.10	0.10	0.09	0.11	0.10	0.09	0.09	0.09	0.11
Mean Non-Zero Dose (mSv)	0.41	0.45	0.45	0.44	0.51	0.48	0.41	0.42	0.41	0.42

Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Radiation Therapist	1673	1769	1486	1501	1489	1441	1383	1302	945	890
Mean Dose (mSv)	0.07	0.05	0.11	0.04	0.12	0.04	0.04	0.07	0.06	0.04
Mean Non-Zero Dose (mSv)	0.34	0.25	0.51	0.24	0.65	0.26	0.27	0.35	0.27	0.24
Radiologist (Diagnostic)	2042	2041	1926	2111	2231	2202	2036	2018	1713	1725
Mean Dose (mSv)	0.32	0.44	0.29	0.26	0.38	0.34	0.23	0.26	0.13	0.17
Mean Non-Zero Dose (mSv)	1.46	2.11	1.29	1.26	1.76	1.90	1.04	1.34	0.65	0.67
Radiologist (Therapeutic)	203	222	179	176	192	194	168	147	118	120
Mean Dose (mSv)	0.16	0.14	0.06	0.07	0.11	0.07	0.33	0.33	0.08	0.05
Mean Non-Zero Dose (mSv)	1.24	0.81	0.36	0.37	0.55	0.47	1.59	1.58	0.44	0.41
Veterinarian	5883	5984	6082	6292	6444	6564	6831	6959	7024	7263
Mean Dose (mSv)	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02
Mean Non-Zero Dose (mSv)	0.24	0.31	0.29	0.31	0.39	0.33	0.27	0.32	0.34	0.33
Ward Aid/Orderly	1096	1037	952	908	854	829	720	664	500	468
Mean Dose (mSv)	0.04	0.05	0.04	0.04	0.04	0.02	0.03	0.04	0.05	0.05
Mean Non-Zero Dose (mSv)	0.41	0.42	0.34	0.31	0.35	0.32	0.32	0.34	0.44	0.39
Other (Medical)	9025	8981	8255	7926	7732	7699	7267	7032	5648	5356
Mean Dose (mSv)	0.16	0.15	0.14	0.13	0.15	0.13	0.09	0.25	0.09	0.10
Mean Non-Zero Dose (mSv)	0.68	0.67	0.60	0.59	0.67	0.59	0.40	1.11	0.39	0.39
Nuclear Medicine Technologist	1916	1935	1848	1885	1961	2036	1925	1851	1690	1703
Mean Dose (mSv)	1.50	1.56	1.37	1.31	1.39	1.28	1.24	1.22	1.22	1.23
Mean Non-Zero Dose (mSv)	1.99	2.05	1.81	1.72	1.81	1.74	1.69	1.73	1.67	1.62
Dental Hygienist	10140	10359	10067	10629	10968	11364	11785	11968	12241	12371
Mean Dose (mSv)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Mean Non-Zero Dose (mSv)	0.43	0.22	0.22	0.24	0.22	0.34	0.31	0.22	0.25	0.25
Dental Assistant	14194	14387	13623	14148	14217	14332	14879	15302	15312	15295
Mean Dose (mSv)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mean Non-Zero Dose (mSv)	0.28	0.25	0.21	0.24	0.19	0.22	0.18	0.28	0.26	0.26
Dental Therapist/Nurse	158	141	134	140	164	161	156	145	138	126
Mean Dose (mSv)	0.02	0.03	0.03	0.03	0.02	0.01	0.02	0.01	0.01	0.03
Mean Non-Zero Dose (mSv)	0.23	0.19	0.17	0.24	0.21	0.20	0.18	0.19	0.14	0.29
Speech-Language Pathologist	79	106	112	125	139	125	135	146	169	177
Mean Dose (mSv)	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.02
Mean Non-Zero Dose (mSv)	0.18	0.11	0.16	0.16	0.19	0.20	0.11	0.15	0.11	0.16
Chiropractor Assistant	57	74	64	72	57	46	45	40	41	42
Mean Dose (mSv)	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01
Mean Non-Zero Dose (mSv)	0.13	0.13	0.13	0.40	0.00	0.10	0.10	0.00	0.00	0.15
Veterinary Technician	8101	8835	9278	9988	10695	11367	12163	12890	13459	14198
Mean Dose (mSv)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Mean Non-Zero Dose (mSv)	0.27	0.34	0.28	0.26	0.32	0.35	0.27	0.31	0.32	0.36



Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mining										
Uranium Mine Underground Personnel										
Mean Dose (mSv)	0.79	0.78	1.00	0.91	0.94	0.68	0.67	0.74	0.81	0.38
Mean Non-Zero Dose (mSv)	1.01	0.97	1.18	1.05	1.06	0.78	0.77	0.82	0.88	0.51
Uranium Mine Surface Personnel										
Mean Dose (mSv)	0.19	0.20	0.18	0.18	0.19	0.17	0.19	0.19	0.24	0.21
Mean Non-Zero Dose (mSv)	0.29	0.27	0.25	0.25	0.25	0.22	0.26	0.26	0.32	0.28
Uranium Mine Visitors										
Mean Dose (mSv)	0.14	0.14	0.23	0.23	-	0.22	0.25	-	-	-
Mean Non-Zero Dose (mSv)	0.21	0.23	0.43	0.40	-	0.41	0.30	-	-	-
Uranium Mine Office Staff										
Mean Dose (mSv)	0.22	0.19	0.18	0.21	0.23	0.19	0.21	0.24	0.23	0.16
Mean Non-Zero Dose (mSv)	0.30	0.24	0.22	0.26	0.27	0.22	0.25	0.29	0.28	0.22
Uranium Mine Underground Miner										
Mean Dose (mSv)	2.92	2.36	2.93	2.33	2.21	1.77	1.52	1.91	2.13	0.78
Mean Non-Zero Dose (mSv)	3.11	2.54	3.14	2.48	2.31	1.92	1.69	2.10	2.20	0.82
Uranium Mine Nurses										
Mean Dose (mSv)	0.22	0.13	0.11	0.13	0.15	0.11	0.15	0.26	0.22	0.11
Mean Non-Zero Dose (mSv)	0.24	0.16	0.15	0.16	0.19	0.14	0.19	0.27	0.27	0.11
Uranium Mine Support Workers										
Mean Dose (mSv)	1.88	1.41	1.29	1.04	0.91	0.65	0.66	0.88	1.10	0.62
Mean Non-Zero Dose (mSv)	2.06	1.54	1.40	1.17	1.02	0.72	0.74	1.02	1.15	0.70
U Mine Underground Maintenance										
Mean Dose (mSv)	1.03	0.91	0.95	0.87	0.93	0.65	0.59	0.67	0.72	0.41
Mean Non-Zero Dose (mSv)	1.25	1.01	1.06	0.96	0.99	0.73	0.67	0.77	0.78	0.51
Uranium Mine Electrician										
Mean Dose (mSv)	0.05	0.19	0.26	0.29	-	0.17	0.12	0.26	0.14	0.49
Mean Non-Zero Dose (mSv)	0.12	0.22	0.35	0.36	-	0.22	0.25	0.28	0.21	0.54
Uranium Mine Surface Miner										
Mean Dose (mSv)	0.29	0.49	0.49	0.42	0.19	0.18	0.22	0.40	0.40	0.20
Mean Non-Zero Dose (mSv)	0.43	0.69	0.65	0.75	0.43	0.37	0.50	0.57	0.44	0.21
Uranium Mine Surface Support Workers										
Mean Dose (mSv)	0.15	0.23	0.19	0.25	0.24	0.22	0.24	0.21	0.27	0.20
Mean Non-Zero Dose (mSv)	0.25	0.31	0.26	0.34	0.30	0.27	0.32	0.28	0.34	0.26

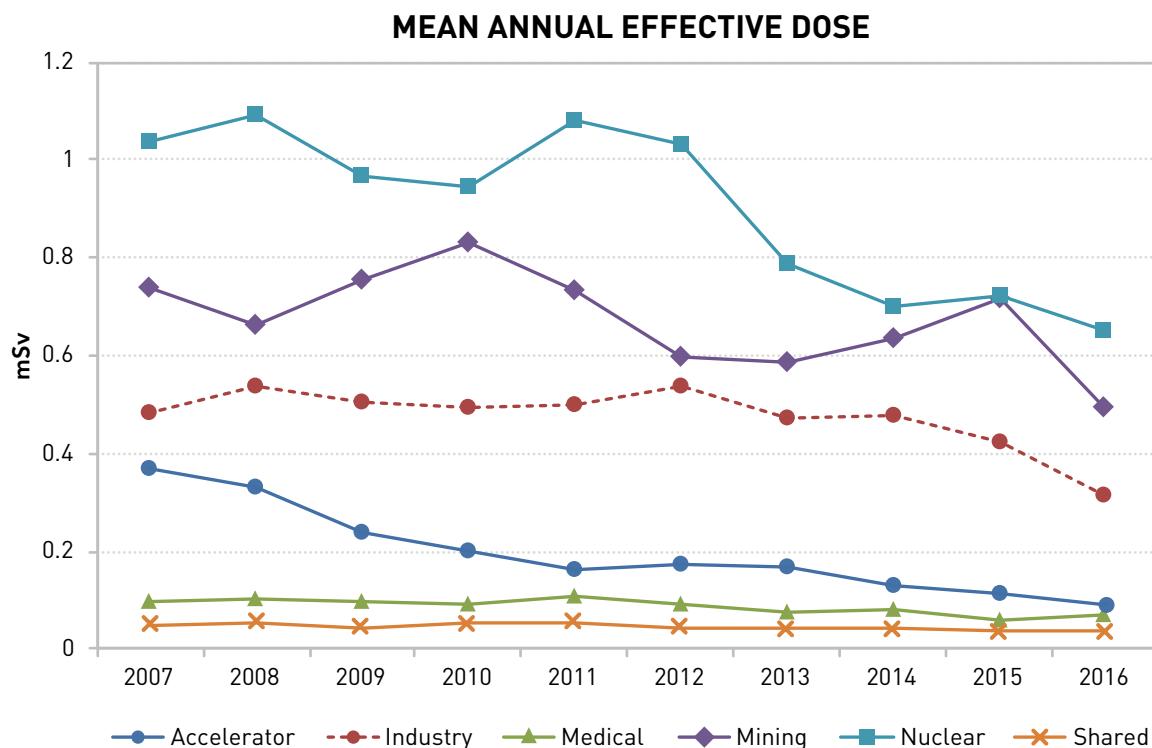
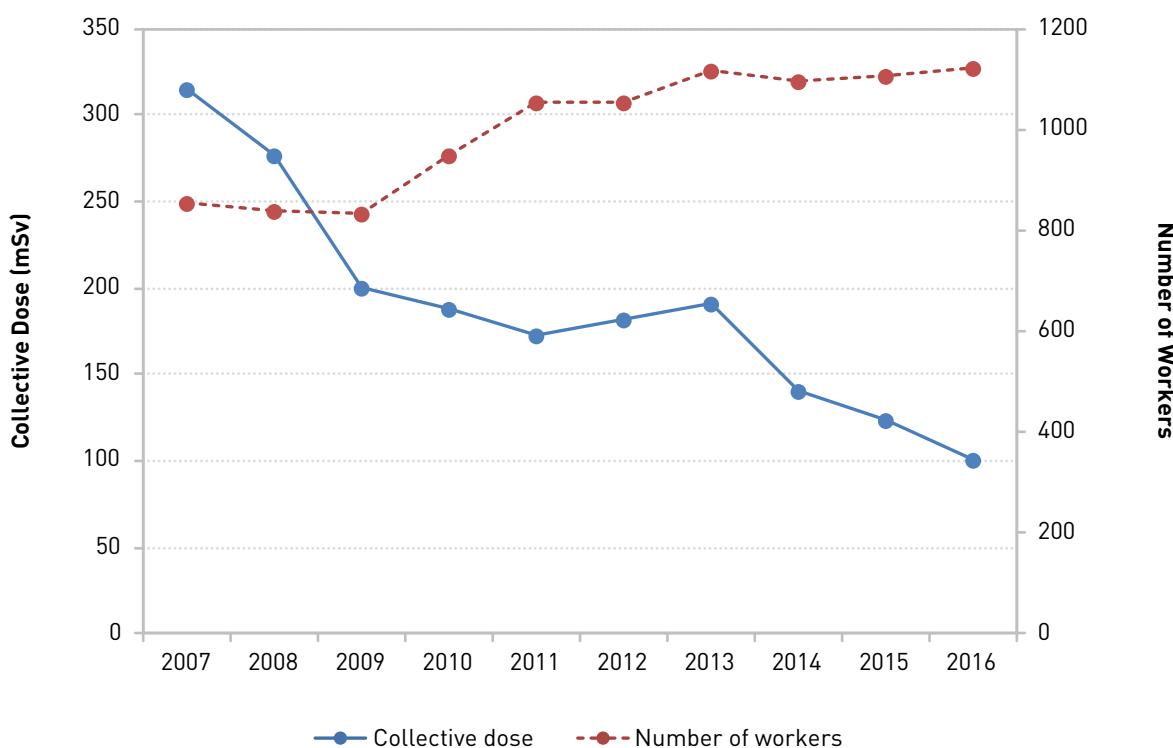
Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Uranium Mine Surface Maintenance	849	952	750	609	809	805	907	692	846	647
Mean Dose (mSv)	0.25	0.30	0.27	0.33	0.23	0.26	0.24	0.26	0.32	0.31
Mean Non-Zero Dose (mSv)	0.32	0.36	0.31	0.40	0.29	0.32	0.33	0.35	0.39	0.37
Uranium Mine Mill Maintenance	521	604	450	491	428	432	486	913	907	509
Mean Dose (mSv)	0.82	0.68	0.81	0.81	0.80	0.65	0.71	0.48	0.49	0.56
Mean Non-Zero Dose (mSv)	1.04	0.75	0.85	0.87	0.85	0.71	0.77	0.52	0.56	0.61
Uranium Mine Mill Workers	330	347	341	340	298	322	308	321	326	312
Mean Dose (mSv)	1.22	1.06	1.03	1.06	1.08	1.06	1.16	1.19	1.33	1.36
Mean Non-Zero Dose (mSv)	1.36	1.16	1.10	1.11	1.14	1.17	1.30	1.26	1.43	1.41
Non Uranium Mine Surface Personnel	69	17	10	6	6	4	0	0	0	0
Mean Dose (mSv)	0.04	0.01	0.01	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	0.13	0.05	0.04	-	-	-	-	-	-	-
Non Uranium Mine Underground Miner	1	1	1	1	1	1	1	1	0	0
Mean Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	-	-	-
Non Uranium Mine Surface Maintenance	0	0	0	0	0	0	8	12	12	11
Mean Dose (mSv)	-	-	-	-	-	-	-	0.24	0.15	0.18
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	-	0.37	0.26	0.25
Non Uranium Mine Mill Workers	0	0	0	0	0	0	82	94	95	92
Mean Dose (mSv)	-	-	-	-	-	-	0.14	0.55	0.46	0.53
Mean Non-Zero Dose (mSv)	-	-	-	-	-	-	0.28	0.73	0.66	0.65
Nuclear										
Reactor – Scientific/Professional	3661	4550	4992	5064	4920	4758	4258	4061	3995	4057
Mean Dose (mSv)	0.19	0.19	0.20	0.16	0.14	0.13	0.11	0.08	0.06	0.07
Mean Non-Zero Dose (mSv)	1.04	1.15	1.20	1.07	1.00	0.92	0.99	0.68	0.64	0.72
Reactor – Administration	3691	3256	2795	2987	2939	2928	2621	2513	2353	2336
Mean Dose (mSv)	0.15	0.15	0.14	0.14	0.16	0.20	0.22	0.18	0.16	0.14
Mean Non-Zero Dose (mSv)	1.23	1.12	1.46	1.52	1.36	1.50	1.48	1.19	1.28	1.14
Reactor – Health Physics	121	134	160	148	144	221	237	228	210	230
Mean Dose (mSv)	0.22	0.77	0.80	0.18	0.26	0.17	0.17	0.25	0.17	0.71
Mean Non-Zero Dose (mSv)	0.56	1.64	1.81	0.60	0.66	0.37	0.42	0.54	0.69	1.83
Reactor – Chemical And Radiation Control	925	1002	990	1060	1110	1152	1019	976	954	933
Mean Dose (mSv)	2.03	1.89	1.79	1.86	1.56	2.17	1.81	1.74	1.54	1.48
Mean Non-Zero Dose (mSv)	2.80	2.93	2.69	2.80	2.31	3.29	2.67	2.62	2.30	2.35

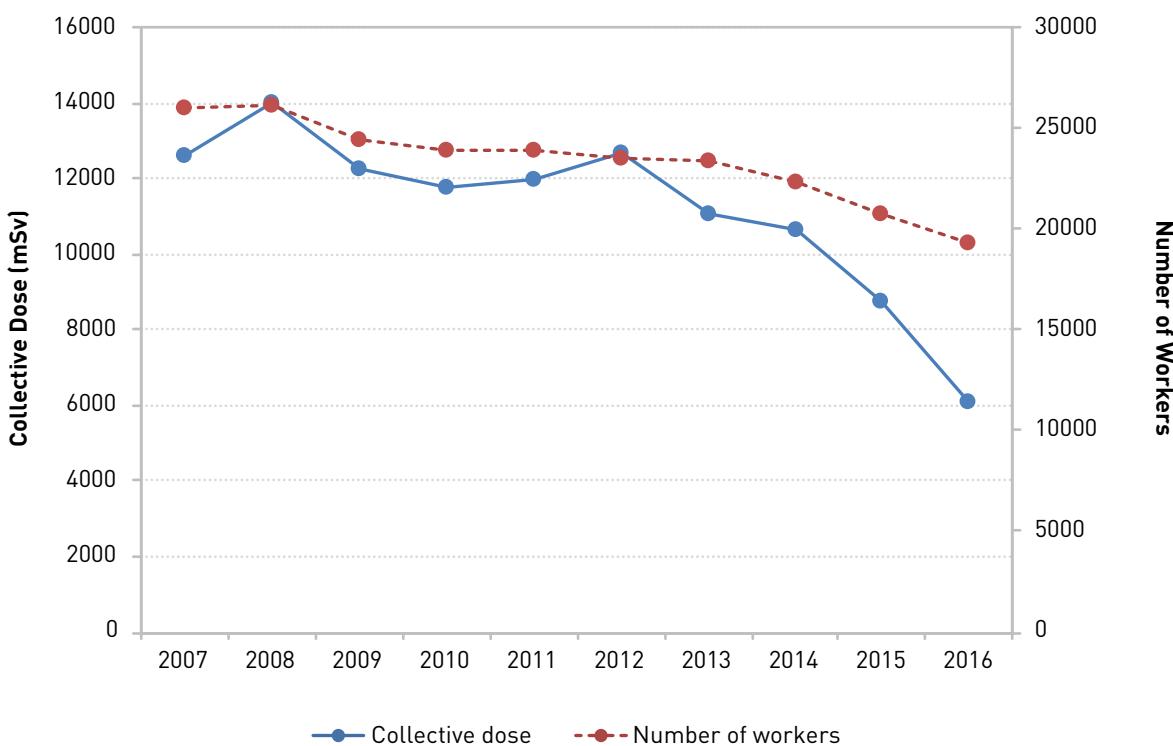
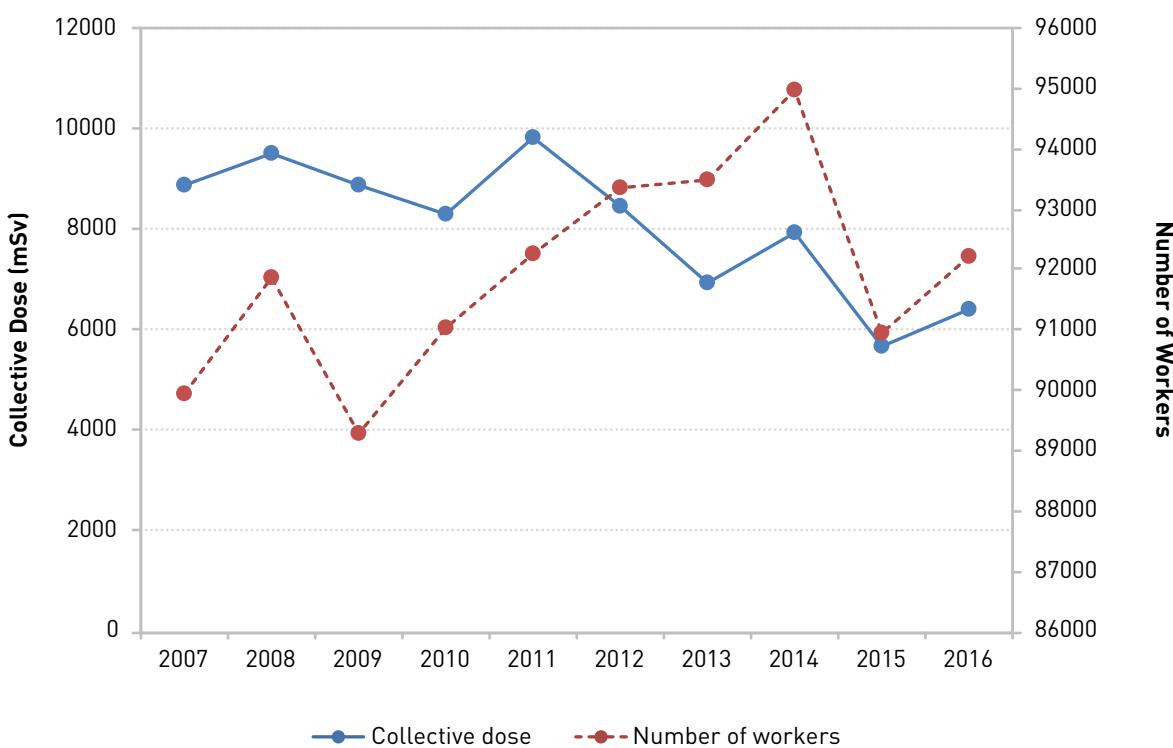


Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Reactor – Electrical Maintenance	1390	1377	1303	1210	1195	1221	999	1017	932	997
Mean Dose (mSv)	0.84	1.07	0.93	0.90	0.90	0.86	0.85	0.83	0.76	0.82
Mean Non-Zero Dose (mSv)	1.61	2.17	1.99	2.00	1.94	1.67	1.90	1.70	1.63	1.71
Reactor – Industrial Radiographer	67	86	101	107	108	107	123	120	111	115
Mean Dose (mSv)	1.85	1.79	1.52	1.48	1.38	1.92	1.11	0.78	0.84	1.18
Mean Non-Zero Dose (mSv)	2.38	2.52	2.33	2.17	2.27	2.77	2.11	1.19	1.58	1.85
Reactor – Mechanical Maintenance	1673	1797	1717	1654	1791	1646	1491	1458	1447	1486
Mean Dose (mSv)	2.08	2.08	1.75	1.95	2.20	2.58	1.95	2.27	1.90	2.06
Mean Non-Zero Dose (mSv)	3.06	3.20	2.82	3.35	3.45	4.04	2.98	3.42	2.87	3.18
Reactor – General Maintenance	1836	3046	3197	2764	2651	2550	1492	1721	1474	1900
Mean Dose (mSv)	1.00	2.12	1.41	0.88	1.17	0.88	0.88	0.76	0.62	0.72
Mean Non-Zero Dose (mSv)	2.37	4.04	2.64	1.93	2.48	1.74	2.52	1.96	2.04	1.94
Reactor – Fuel Handling	98	87	86	67	69	80	81	98	60	73
Mean Dose (mSv)	1.38	2.28	1.06	1.24	0.68	0.69	0.96	1.77	1.26	2.83
Mean Non-Zero Dose (mSv)	2.01	3.10	1.50	2.19	1.38	1.02	1.34	2.63	1.85	4.04
Reactor – Operations	2512	2583	2556	2604	2463	2504	2383	2334	2367	2407
Mean Dose (mSv)	1.13	1.20	1.07	1.01	0.94	1.01	0.96	1.03	0.91	0.91
Mean Non-Zero Dose (mSv)	2.02	2.18	2.03	1.97	1.78	1.83	1.84	1.99	1.75	1.82
Reactor – Control Technicians	464	622	595	616	570	534	478	440	390	440
Mean Dose (mSv)	0.48	0.62	0.59	0.81	0.74	0.72	0.90	0.57	0.83	0.38
Mean Non-Zero Dose (mSv)	1.05	1.24	1.08	1.49	1.36	1.42	1.85	1.16	1.66	0.88
Reactor – Contractor	2511	2405	2686	2900	1900	2257	2594	2945	4148	4963
Mean Dose (mSv)	1.63	0.92	1.30	1.62	1.50	1.71	1.15	0.58	1.06	0.45
Mean Non-Zero Dose (mSv)	3.92	2.58	2.98	3.66	3.15	3.48	2.86	1.90	2.91	1.66
Reactor – Summer Student	162	191	226	191	173	139	161	221	244	253
Mean Dose (mSv)	0.10	0.18	0.08	0.12	0.02	0.04	0.07	0.02	0.06	0.02
Mean Non-Zero Dose (mSv)	0.48	0.76	0.41	0.56	0.21	0.27	0.89	0.19	0.47	0.32
Reactor – Training	112	117	120	128	113	133	135	129	133	128
Mean Dose (mSv)	0.14	0.28	0.19	0.12	0.08	0.11	0.17	0.16	0.08	0.14
Mean Non-Zero Dose (mSv)	0.62	1.42	1.17	1.34	0.95	1.37	1.25	1.05	0.53	0.81
Reactor – Construction	1315	1527	1599	1968	1838	1299	1136	1090	1182	1329
Mean Dose (mSv)	0.66	0.74	1.39	1.59	1.09	1.08	1.44	0.95	1.31	0.98
Mean Non-Zero Dose (mSv)	1.72	1.85	2.53	2.90	2.10	2.33	2.72	1.85	2.49	1.86
Reactor – Visitor	6596	7151	7473	7630	7279	6655	4737	5067	5610	5726
Mean Dose (mSv)	1.16	0.98	0.87	0.74	1.37	0.99	0.42	0.47	0.38	0.52
Mean Non-Zero Dose (mSv)	3.63	3.70	3.41	3.03	4.44	4.29	3.35	4.21	3.52	3.95

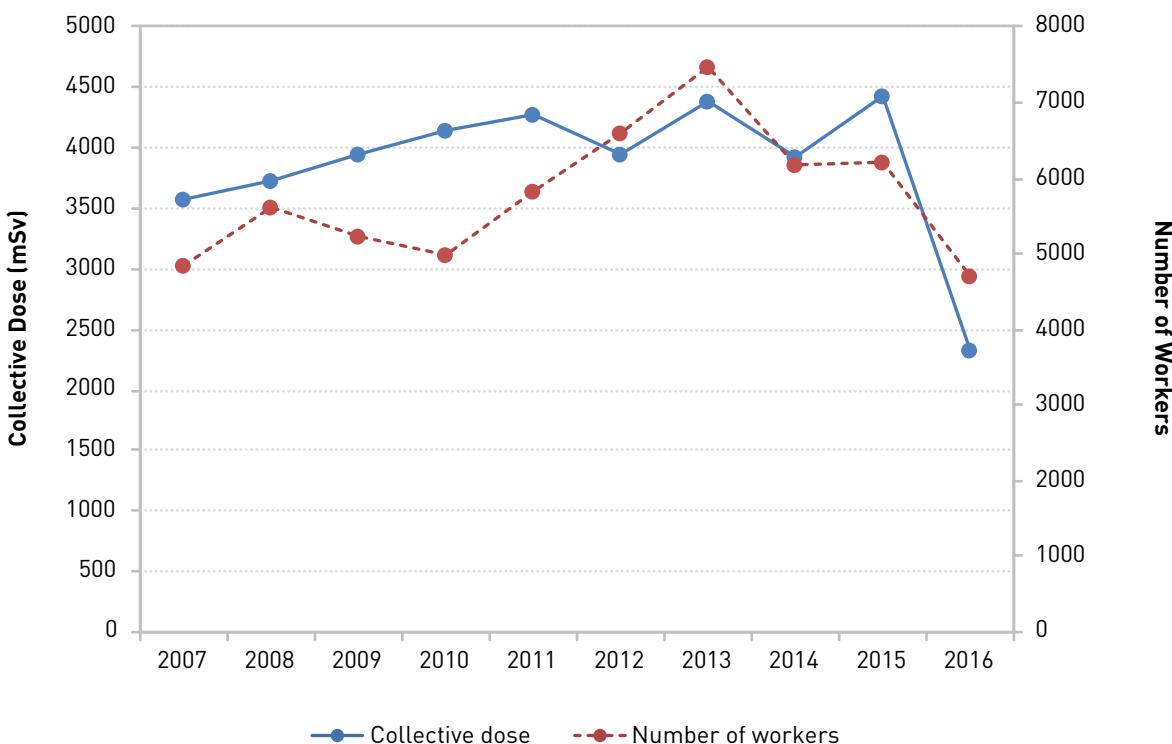
Job Category*	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Shared										
Unknown	32	9	14	24	73	10	2	4	1	2
Mean Dose (mSv)	2.75	-	0.00	0.09	0.08	0.02	-	-	-	-
Mean Non-Zero Dose (mSv)	3.14	-	0.00	0.20	0.22	0.11	-	-	-	-
Administrator	715	675	630	637	658	661	671	678	649	757
Mean Dose (mSv)	0.10	0.12	0.09	0.08	0.06	0.06	0.05	0.04	0.04	0.03
Mean Non-Zero Dose (mSv)	0.36	0.46	0.37	0.40	0.29	0.30	0.28	0.26	0.24	0.16
Office Staff	4099	3985	3700	3732	3623	3481	3502	3370	3368	3469
Mean Dose (mSv)	0.04	0.05	0.03	0.03	0.08	0.04	0.03	0.03	0.02	0.03
Mean Non-Zero Dose (mSv)	0.39	0.43	0.32	0.31	0.77	0.35	0.28	0.26	0.23	0.27
Safety Officer	397	270	241	256	517	613	615	627	583	532
Mean Dose (mSv)	0.10	0.16	0.12	0.11	0.08	0.06	0.04	0.05	0.06	0.08
Mean Non-Zero Dose (mSv)	0.48	0.59	0.49	0.44	0.51	0.37	0.38	0.43	0.39	0.44
Other (Administration)	473	473	490	529	582	549	547	549	603	604
Mean Dose (mSv)	0.23	0.32	0.25	0.25	0.16	0.16	0.12	0.13	0.12	0.21
Mean Non-Zero Dose (mSv)	0.53	0.69	0.51	0.48	0.34	0.31	0.24	0.24	0.21	0.33
Student	15908	15366	15256	15541	15741	15405	14253	14090	13817	13571
Mean Dose (mSv)	0.03	0.04	0.03	0.04	0.04	0.03	0.03	0.04	0.03	0.02
Mean Non-Zero Dose (mSv)	0.55	0.61	0.48	0.61	0.57	0.54	0.49	0.57	0.50	0.38
Visitor	328	370	567	559	486	757	888	595	318	269
Mean Dose (mSv)	0.05	0.03	0.07	0.16	0.04	0.04	0.05	0.06	0.10	0.12
Mean Non-Zero Dose (mSv)	0.36	0.18	0.34	0.67	0.19	0.17	0.17	0.16	0.17	0.19
Other (Miscellaneous)	653	574	576	575	640	805	699	655	526	498
Mean Dose (mSv)	0.14	0.18	0.13	0.16	0.17	0.16	0.15	0.12	0.14	0.11
Mean Non-Zero Dose (mSv)	0.67	0.73	0.52	0.68	0.68	0.55	0.49	0.41	0.43	0.33
Inspector	73	79	89	105	120	129	178	263	303	274
Mean Dose (mSv)	0.19	0.05	0.12	0.24	0.47	0.13	0.10	0.11	0.07	0.08
Mean Non-Zero Dose (mSv)	2.37	0.51	0.79	0.93	1.57	0.75	0.42	0.87	0.71	0.85

* Individuals working in 2 (or more) different job categories are counted in each job category.

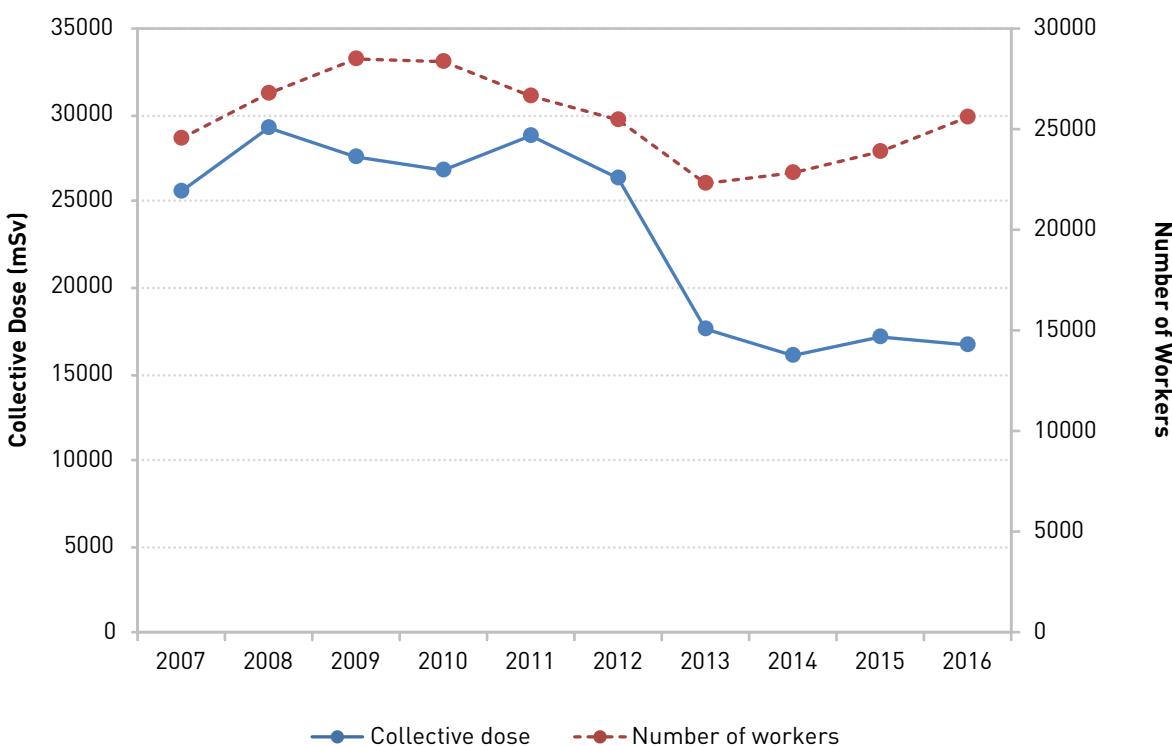
Figure C.1: Ten-year trend; mean annual effective doses by job sector, for all of Canada**Figure C.2:** Ten-year trend of number of workers and collective effective doses by job sector, for all of Canada**a) Accelerator**

b) Industry**c) Medical**

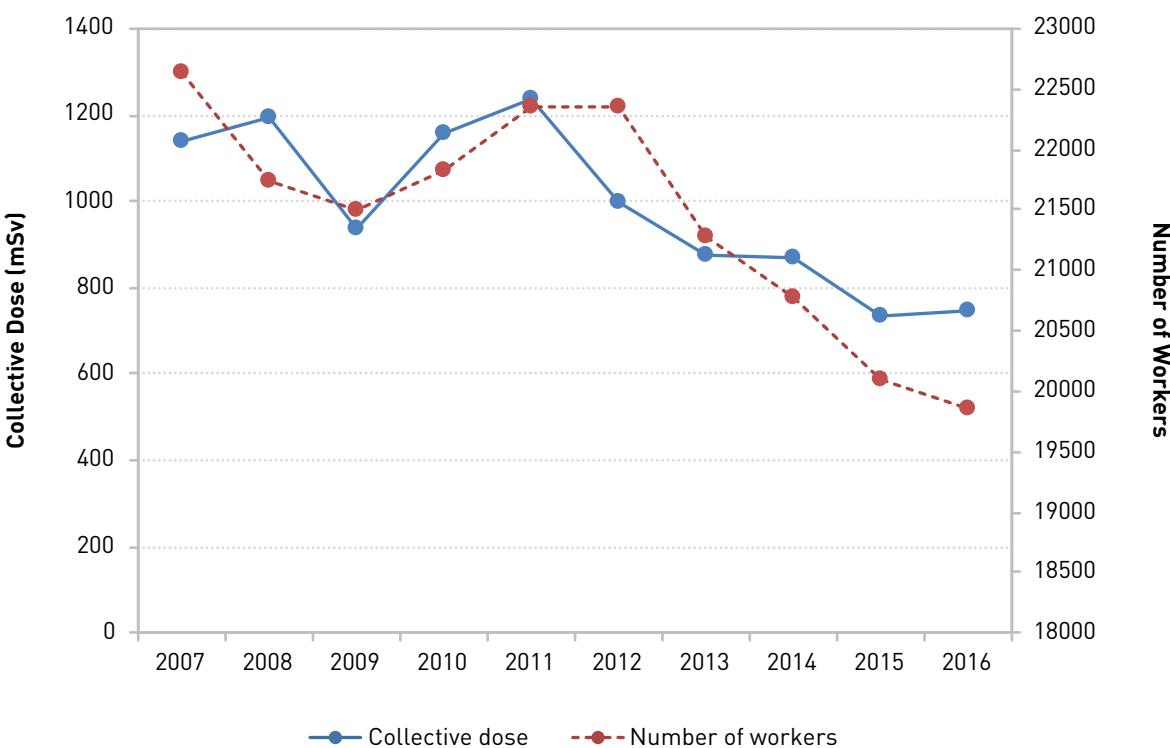
d) Mining



e) Nuclear



f) Shared



g) Total (all sectors combined)

