

Canadian Radioactive Waste Inventories and Lists

1. Scope of the section

This section addresses article 32(2) (Reporting) of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. It provides a list of the various spent fuel and radioactive waste management facilities in Canada and indicates the total inventory of each of the waste categories. Each licensee is required to develop and implement an accountability system, including the appropriate records. This system and associated records are subject to regulatory oversight. A map showing the locations of radioactive waste management sites in Canada (figure 1) is provided below.



Figure 1: Location of radioactive waste management sites in Canada

2. Inventory of spent fuel in Canada

Nuclear generating stations and research reactor sites store spent fuel onsite in irradiated fuel bays, or reactor pool in the case of McMaster, (wet storage) pending transfer to dedicated spent fuel dry storage facilities. Table 1 inventories spent fuel in wet storage in Canada and table 2 summarizes the spent fuel in dry storage.

Table 1: Inventory of spent fuel in wet storage in Canada as of December 31, 2016

Site	Number of fuel bundles in wet storage	Kilograms of uranium ^[1]
Bruce Power Nuclear Generating Stations	687,158 ^[2]	13,089,887
Darlington Nuclear Generating Station	333,078 ^[2]	6,402,480
Gentilly-2 Nuclear Generating Station	22,525	430,650
Pickering Nuclear Generating Stations	403,985 ^[2]	7,989,515
Point Lepreau Nuclear Generating Station	36,780	700,666
McMaster Nuclear Research Reactor	37 ^[3]	38
Chalk River Laboratories (CRL) – National Research Universal	1,205 ^[4]	3,559

^[1] Inventory includes depleted uranium, enriched uranium, natural uranium, plutonium and thorium in spent fuel.

^[2] Inventory is reported as the number of irradiated fuel bundles and rods.

^[3] Inventory is reported as the number of irradiated fuel assemblies.

^[4] Inventory is reported as the number of irradiated fuel bundles, rods, assemblies and other items.

Table 2: Inventory of spent fuel in dry storage facilities in Canada as of December 31, 2016

Site	Number of fuel bundles in dry storage	Kilograms of uranium ^[1]
CRL Waste Management Area (WMA) G	4,886	65,587
CRL WMA B (spent research reactor fuel)	10,106 ^[2]	35,639
Darlington Waste Management Facility	192,314	3,682,635
Douglas Point Waste Management Facility	22,252	300,891
Gentilly-1 Waste Management Facility	3,213	67,692
Gentilly-2 Waste Management Facility	107,400	2,047,937
Pickering Waste Management Facility	326,912	6,517,180
Point Lepreau Waste Management Facility	102,598	1,945,796
Western Waste Management Facility (located at Bruce site)	490,358	9,347,583
Whiteshell Laboratories	2,268	24,270

^[1] Inventory includes depleted uranium, enriched uranium, natural uranium, plutonium and thorium in spent fuel.

^[2] Inventory is reported as the number of irradiated fuel bundles, rods, assemblies and other items.

3. Radioactive waste inventory

Table 3 summarizes the low- and intermediate-level radioactive waste (L&ILW) generated from normal operations, including waste management methods used and the inventory of L&ILW in storage at each facility in Canada. L&ILW from decommissioning activities is reported separately in table 5.

Table 3: Inventory of low-level radioactive waste (LLW) and intermediate-level radioactive waste (ILW) from normal operations in storage in Canada as of December 31, 2016

Radioactive waste management or nuclear fuel cycle facility	Company name or responsible party	Description of stored waste	Storage method	Onsite waste inventory as of December 31, 2016			
				ILW		LLW	
				Volume (m ³)	Activity (TBq)	Volume (m ³)	Activity (TBq)
Western Waste Management Facility (WWMF)	Ontario Power Generation (OPG)	Interim storage of low- and intermediate-level reactor waste generated from Bruce Power, Darlington, and Pickering A and B	ILW: In-ground storage structures (trenches, tile holes, in-ground containers) and above-ground storage structures (retube waste storage building, quadricells) LLW: Above-ground storage structures (low-level storage buildings, steam generator storage buildings)	11,024 ^[1]	56,702 ^[2]	83,466 ^[3]	86 ^[2]
Pickering Waste Management Facility	OPG	Interim storage of intermediate-level reactor refurbishment waste from Pickering A (Units 1 to 4)	ILW: Dry storage modules	1,012 ^[4]	127,155	nil	nil
Radioactive waste operations site 1	OPG	Interim storage of low- and intermediate-level reactor waste generated from Douglas Point and Pickering A (Units 1 to 4)	ILW: In-ground storage structures (trenches, tile holes) LLW: In-ground storage structures (trenches)	5	12 ^[5]	325	<1 ^[3]
Gentilly-2	Hydro-Québec	Operational reactor waste	ILW: Radioactive waste storage area (ASDR) and solid radioactive waste management facility (SRWMF) (concrete cells) LLW: ASDR and SRWMF (concrete cells)	347	53 ^[6]	1,497	5

Radioactive waste management or nuclear fuel cycle facility	Company name or responsible party	Description of stored waste	Storage method	Onsite waste inventory as of December 31, 2016			
				ILW		LLW	
				Volume (m ³)	Activity (TBq)	Volume (m ³)	Activity (TBq)
Point Lepreau	NB Power	Operational waste: Drums, filters and compactable/non-compactible boxed waste	LLW: Concrete vault structures ILW: Concrete vault structures, filter storage structures and refurbishment canisters	158 ^[7]	792	2,586 ^[7]	178
CRL	Atomic Energy of Canada Limited (AECL)	Research reactor and isotope production waste, external waste	ILW: Tile holes and bunkers ILW/LLW: Shielded Modular Above-Ground Storage (SMAGS) LLW: Sand trenches, low-level storage buildings, above-ground stockpiles, modular above-ground storage (MAGS) and bulk materials landfill	19,468 ^[8]	N/A	123,709 ^[8]	N/A
		Contaminated soils	Luggers, 205-litre steel drums, B-25 containers in SMAGS, sand trenches and above-ground stockpiles	nil	nil	382,842	N/A
Whiteshell Laboratories	AECL	Research reactor waste and decommissioned reactor waste	ILW: In-ground concrete bunkers LLW: Above-ground concrete bunkers and trenches	863 ^[8]	2,794	19,700 ^[8,9]	325
Douglas Point Waste Management Facility	AECL	Contaminated soils	LLW: 205-litre drums	nil	nil	66	N/A

Radioactive waste management or nuclear fuel cycle facility	Company name or responsible party	Description of stored waste	Storage method	Onsite waste inventory as of December 31, 2016			
				ILW		LLW	
				Volume (m ³)	Activity (TBq)	Volume (m ³)	Activity (TBq)
Gentilly-1 Waste Management Facility	AECL	Contaminated soils	LLW: 205-litre drums	nil	nil	1	N/A
Port Hope Conversion Facility	Cameco	Non-combustible process waste	LLW: 205-litre drums	nil	nil	10,000	N/A
Blind River Refinery	Cameco	Non-combustible process waste	LLW: 205-litre drums	nil	nil	5,600	N/A
Port Hope Fuel Manufacturing	Cameco	Non-combustible process waste	LLW: 205-litre drums	nil	nil	1,000	N/A
BWXT Fuel Manufacturing Peterborough	BWX Technologies	Non-combustible process waste	LLW: 205-litre drums	nil	nil	5	<1
BWXT Fuel Manufacturing Toronto	BWX Technologies	Non-combustible process waste	LLW: 205-litre drums	nil	nil	36	<1
Best Theratronics Manufacturing Facility Kanata	Best Theratronics	Disused cobalt 60 sealed sources; disused cesium 137 sealed sources	Pool storage or dry containers	<1	7157	nil	nil
Nordion Manufacturing Facility Kanata	Nordion	Disused cobalt 60 sealed sources; disused cesium 137 sealed sources	Pool storage or dry containers	11.9 ^[10]	10,360	nil	nil
Bruce Power	OPG	Disused cobalt 60 sealed sources	Pool storage	2.5	23,384 ^[11]	nil	nil

Note: N/A means “not available.”

^[1] Volume reduced as a result of 2014 trench remediation project.

^[2] Approximate activity based on 2013 inventory.

^[3] Volume reduced since 2013 as a result of waste minimization initiatives.

^[4] Volume reduced since 2013 as a result of reassessment of ILW container count.

^[5] Radioactive Waste Operations Site 1 activity estimated based on activity of waste stored at the Western Waste Management Facility.

^[6] Excludes activity level of approximately 250 cubic metres of ILW in spent resins.

^[7] Volume reduced since 2013 as a result of waste volume minimization initiatives involving incineration/metal melting.

^[8] Volumes for ILW/LLW are based on method of storage and do not necessarily represent the actual breakdown of waste into ILW and LLW.

^[9] Volume reduced since 2013 as a result of repackaging, during which some materials were deemed to be clean wastes and removed.

^[10] Includes volume of flask where applicable.

^[11] Calculated based on the maximum average activity of 1000 Curies per returned spent cobalt bundle

Table 4 describes radioactive waste from past practices, including the volume that is stored at each site and how it is managed.

Table 4: Management of LLW from past practices

Site name or location	Company name or responsible party	Description of stored waste	Storage method	LLW	
				Volume (m ³)	Activity (TBq)
Port Hope	AECL	Contaminated soils	<i>In situ</i> and consolidated storage	720,000	N/A
Welcome Waste Management Facility	AECL	Contaminated soils	Above-ground mound	454,380	N/A
Port Granby	AECL	Waste and contaminated soils	Trench burial	438,200	N/A
Northern Transportation Route	AECL	Contaminated soils	<i>In situ</i> and consolidated storage	54,403	N/A
Greater Toronto Area	AECL Regional Municipality of Peel, Ontario	Radium-contaminated soils, radium contamination fixed to structural elements in buildings	<i>In situ</i> and consolidated storage Above-ground consolidated mound	15,941	N/A
Deloro Mine site	Ontario Ministry of the Environment	Contaminated soils and historical tailings	<i>In situ</i> (fenced-in area)	34,500 ^[1]	2

Note: N/A means “not available.”

^[1] A revised volume estimate for Young’s Creek has reduced the Deloro Mine site total volume by approximately 3,000 cubic metres since 2013.

Table 5 inventories the L&ILW resulting from decommissioning activities at Canadian facilities as of December 31, 2016.

Table 5: ILW and LLW in Canada from decommissioning activities as of December 31, 2016

Site name or location	Company name or responsible party	Description of stored waste	Storage method	Onsite waste inventory as of December 31, 2016			
				ILW		LLW	
				Volume (m ³)	Activity (TBq)	Volume (m ³)	Activity (TBq)
Whiteshell Laboratories	AECL	Decommissioning waste (January 1, 2005 to December 31, 2016)	ILW: In-ground concrete bunkers LLW: Above-ground concrete bunkers	22	148	1,598	6
CRL	AECL	Decommissioning waste (January 1, 2005 to December 31, 2016)	ILW: Tile holes and bunkers LLW: MAGS, SMAGS	125	N/A	2,876	N/A
Douglas Point Waste Management Facility	AECL	Decommissioned reactor waste	Reactor building	60 ^[1]	N/A	35 ^[2]	<1
Nuclear Power Demonstration Waste Management Facility	AECL	Decommissioned reactor waste	Reactor building	included in CRL numbers	N/A	12 ^[3]	<1
Gentilly-1 Waste Management Facility	AECL	Decommissioned reactor waste (IX resin)	Reactor building	58 ^[4]	<1	607 ^[2]	N/A
Port Hope Conversion Facility	Cameco	Decommissioning waste	Drums or other appropriate industrial packaging	nil	nil	6000	N/A

Note: N/A means “not available.”

^[1] Consists of IX resin, fuel transfer tunnel, booster flow tubes, ram extensions, empty flask and pool debris.

^[2] Volume has decreased since 2013 as a result of offsite supplier processing services or to CRL.

^[3] For the most part, waste has been transferred to CRL; volume is current best estimate and may not reflect material that has been shipped to CRL recently.

^[4] Consists of IX resin.

4. Uranium mining and milling waste

Uranium mining and milling generates two main forms of waste: tailings and waste rock. Historically, waste rock has been either stockpiled above ground or used as backfill in underground mines. Today, mineralized special waste rock is segregated and managed with due consideration given to the hazards associated with mineralization and particular contaminants. Tailings are managed in engineered tailings management facilities (TMFs). The unit of measure used in this report for uranium mine and mill wastes is tonne of dry mass, as this is the same unit used in the mining industry to track and report materials.

4.1 Operational mine and mill sites

Table 6 details the uranium tailings and waste rock in storage at operational mine and mill sites in Canada.

Table 6: Uranium tailings and waste rock at operational mine and mill sites as of December 31, 2016

Operating mine and mill sites	Company name or responsible party	Storage method	Onsite waste inventory as of December 31, 2016		
			Tailings	Waste rock	
			Mass (tonnes)	Mineralized (tonnes)	Non-mineralized (tonnes)
Key Lake	Cameco	Deilmann TMF	5,978,820 ^[1]	1,146,585 ^[2]	68,057,937
Rabbit Lake	Cameco	Rabbit Lake in-pit TMF	9,124,938	1,161,802 ^[3]	12,571,572 ^[4]
McClellan Lake	AREVA	In-pit TMF	1,953,300 ^[5]	10,200,000	51,700,000
McArthur River	Cameco	No tailings onsite; ore is transported to Key Lake for milling	nil	120,951	426,217 ^[6]
Cigar Lake	Cameco	No tailings onsite; ore is transported to McClellan Lake for milling	nil	625,538	62,334 ^[6]

Note: N/A means “not available.”

^[1] Includes tailings accumulated from the processing of ores from McArthur River.

^[2] Volume reduced since 2013 as a result of the processing of mineralized waste rock and a 2013 reporting error.

^[3] Volume reduced since 2013 as a result of a 2014 survey update and the processing of mineralized waste rock.

^[4] Volume reduced since 2013 as a result of the completion of the reclamation of the B-zone waste rock pile in 2014 and the historic (pre-2013) reclamation of the A-zone, D-zone and North waste rock piles.

^[5] Includes tailings accumulated from the processing of ores from Cigar Lake.

^[6] Volume reduced since 2013 as a result of the reclassification of potentially acid generating waste rock as mineralized.

4.2 Inventory of uranium mine and mill waste at inactive tailings sites

Table 7 inventories waste rock and mill tailings at sites that are no longer operational. The table also provides the tailings inventory for older, closed TMFs at operational sites – specifically, Key Lake and Rabbit Lake.

Although the waste rock inventory is provided for the Cluff Lake and Beaverlodge sites and included in table 6 for the Rabbit Lake and Key Lake sites, it is generally not available for the inactive and decommissioned sites. Also, operations at the sites in table 7 predated current waste segregation practices. As a result, the breakdown between mineralized and non-mineralized waste rock is not available.

Table 7: Uranium tailings and waste rock at decommissioned and inactive tailings sites as of December 31, 2016

Site name or location	Company name or responsible party	Storage method	Onsite waste inventory as of December 31, 2016	
			Tailings	Waste rock
			Mass (tonnes)	Mass (tonnes)
Decommissioning tailings sites				
Cluff Lake	AREVA	Tailings management area – surface	3,230,000	18,400,000
Inactive tailings sites				
Key Lake	Cameco	Above-ground TMF	3,579,781 ^[1]	reported in table 6
Rabbit Lake	Cameco	Above-ground TMF	6,500,000	reported in table 6
Beaverlodge	Cameco	Above-ground tailings and mine backfill	5,700,000 ^[2]	4,800,000
Gunnar	Saskatchewan Research Council	Above-ground tailings	4,400,000	N/A
Lorado	Saskatchewan Research Council	Above-ground tailings	360,000	N/A
Port Radium	Indigenous and Northern Affairs Canada	Above-ground tailings in four areas	907,000	N/A
Rayrock	Indigenous and Northern Affairs Canada	Above-ground tailings in north and south tailings piles	71,000	N/A
Quirke 1 and 2	Rio Algom Ltd.	Flooded, above-ground tailings	46,000,000	N/A
Panel	Rio Algom Ltd.	Flooded, above-ground tailings	16,000,000	N/A
Denison	Denison Mines Inc.	Flooded, above-ground tailings in two areas	63,800,000	N/A

Site name or location	Company name or responsible party	Storage method	Onsite waste inventory as of December 31, 2016	
			Tailings	Waste rock
			Mass (tonnes)	Mass (tonnes)
Spanish American	Rio Algom Ltd.	Flooded, above-ground tailings	450,000	N/A
Stanrock/Can-Met	Denison Mines Inc.	Above-ground tailings	5,750,000	N/A
Stanleigh	Rio Algom Ltd.	Flooded, above-ground tailings	19,953,000	N/A
Lacnor	Rio Algom Ltd.	Above-ground tailings	2,700,000	N/A
Nordic	Rio Algom Ltd.	Above-ground tailings	12,000,000	N/A
Milliken	Rio Algom Ltd.	Tailings management area	150,000	N/A
Pronto	Rio Algom Ltd.	Above-ground tailings	2,100,000	N/A
Agnew Lake	Ontario Ministry of Northern Development and Mines	Lake-vegetated, above-ground tailings	510,000	N/A
Dyno	EWL Management Ltd.	Above-ground tailings	600,000	N/A
Bicroft	Barrick Gold Corporation	Above-ground tailings in two areas	2,000,000	N/A
Madawaska	EWL Management Ltd.	Above-ground tailings in two areas	4,000,000	N/A

Note: N/A means “not available.”

^[1] Based on monthly production reports between 1983 and 1996. In 1996, tailings placement switched to the Deilmann TMF.

^[2] Tailings volume does not include 4,300,000 tonnes that have been used as backfill.

List of Acronyms and Abbreviation

AECL	Atomic Energy of Canada Limited
ASDR	l'aire de stockage des déchets radioactifs (radioactive waste storage area)
Bq	becquerel
CRL	Chalk River Laboratories
EMS	environmental management system
ERA	environmental risk assessment
EWL	EnCana West Limited
ILW	intermediate-level radioactive waste
L&ILW	low- and intermediate-level radioactive waste
LLW	low-level radioactive waste
MAGS	modular above-ground storage
N/A	not available
NB Power	New Brunswick Power Corporation
OPG	Ontario Power Generation
POST	post-closure analysis
SMAGS	shielded modular above-ground storage
SRWMF	Solid Radioactive Waste Management Facility
TBq	terabecquerel
TMF	tailings management facility
WMA	waste management area
WMF	waste management facility
WWMF	Western Waste Management Facility