

Environmental Emissions Data for Nuclear Sustainability Service - Western

Q1 2022

OVERVIEW

This report summarizes the environmental emissions data for Q1 2022 for OPG's Nuclear Waste Management operations located at the Bruce Nuclear Power Development site in Bruce County. OPG's Nuclear Sustainability Services - Western stores low and intermediate level radioactive waste from the operation of OPG and Bruce Power nuclear reactors. The low level waste is stored as is, compacted or incinerated. The facility also provides used fuel dry storage for the Bruce Power reactors. OPG's Radioactive Waste Operations Site 1 stores low and intermediate level radioactive waste.

This report includes:

- Radioactive Effluents: Releases to air remained well below the regulatory limits.
- Perimeter Dose Rate Monitoring: Results demonstrate radiation exposures were within the regulatory limit.
- Groundwater Monitoring: OPG continued to analyze groundwater results to examine trends.
- Waste Incinerator: Emissions testing results confirmed compliance with air quality standards.
- Spills to the Environment: There were no spills to the environment that were reportable to a regulatory authority.

Note: The contents of this report are consistent with environmental data OPG is required to provide to the Canadian Nuclear Safety Commission (CNSC) on a quarterly basis. These reporting requirements are periodically revised.

ENVIRONMENTAL EMISSIONS MANAGEMENT

OPG has an environmental management program to ensure its activities are conducted in a manner that minimizes any adverse impact on the public and the environment. OPG's environmental program conforms to CNSC requirements for environmental protection and the International Organization for Standardization (ISO) standard for environmental management systems. The quality assurance programs for OPG's chemistry and health physics laboratories conform to the requirements of national and international standards.

As part of OPG's environmental management program, OPG has established an effluent monitoring and control program that is based on the "ALARA" principle. That is, measures are in place to ensure emissions to the environment are kept As Low As Reasonably Achievable while taking social and economic factors into account.

MONITORING OF RADIOACTIVE EFFLUENTS

Release Limits & Action Levels

OPG uses [radiation dose limits](#) specified in federal legislation to derive Release Limits for the radionuclides that may be released to air and water from its nuclear facilities. OPG's Nuclear Sustainability Services – Western must maintain its radiological emissions well below these limits to meet the terms of its operating licence. OPG also sets Action Levels that are much lower than the Release Limits to identify and control emissions before a limit can be reached.

Public Radiation Dose Data

Annual environmental monitoring program results for NSS-W, including an assessment of radiation dose to the public and protection of the environment, are available at:

www.opg.com/news-and-media/Pages/reports.aspx

Annual assessments of environmental radiological data for the Bruce Nuclear Power Development site, including OPG's NSS-W, are available at:

www.brucepower.com/resources-and-publications/reports

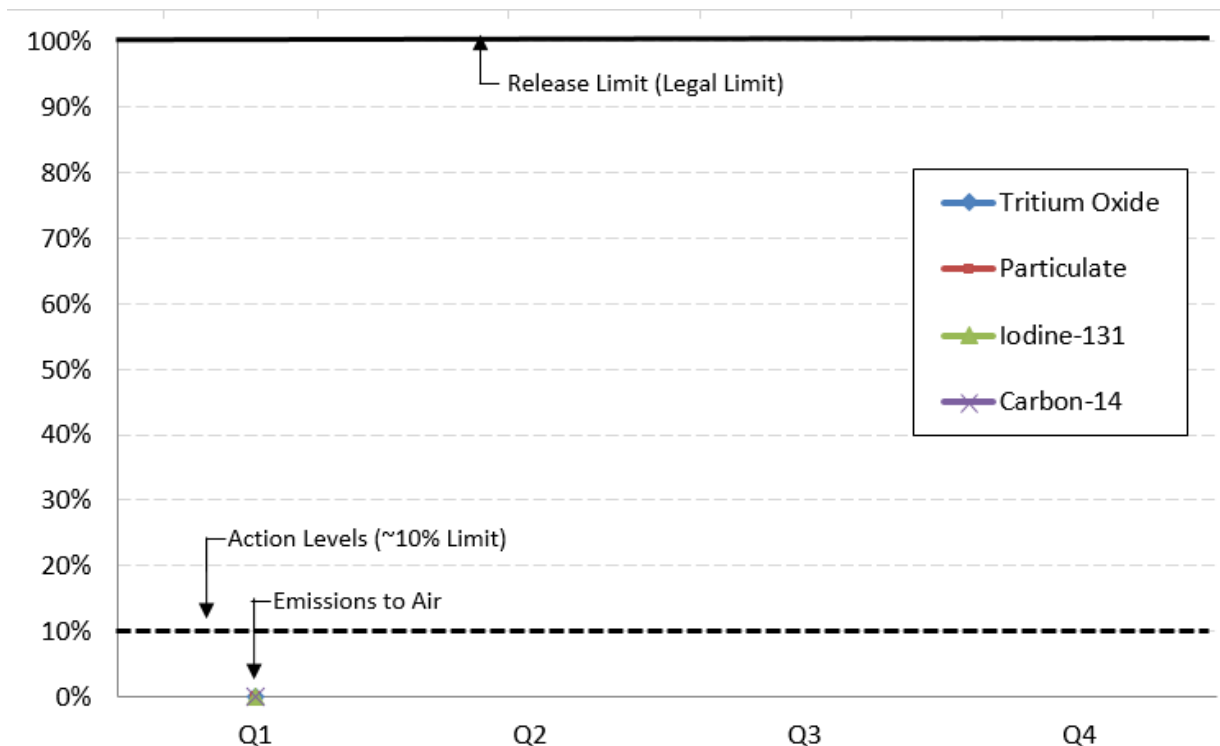
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Performance Results

Emissions from the Nuclear Sustainability Services – Western are monitored to track performance. For Q1 2022, radiological emissions to air remained well below the Release Limits and no Action Levels were exceeded. (Appendix A, Tables A.1) The following graphs show radiological emissions for the year to date as a percentage of the Release Limits.

Air Emissions as a Per Cent of Release Limits



WATER EMISSIONS

Water removed from NSS-W storage structures and building sumps is transferred to Bruce Power Active Liquid Waste (ALW) system, and is accounted for in that station's emissions.

PERIMETER DOSE RATE MONITORING

Average ambient dose rates are measured at perimeter fences by Thermoluminescent Dosimeters to demonstrate that radiation exposures to non-Nuclear Energy Workers and members of the public are as low as reasonably achievable. (Appendix A, Table A.2)

GROUNDWATER MONITORING

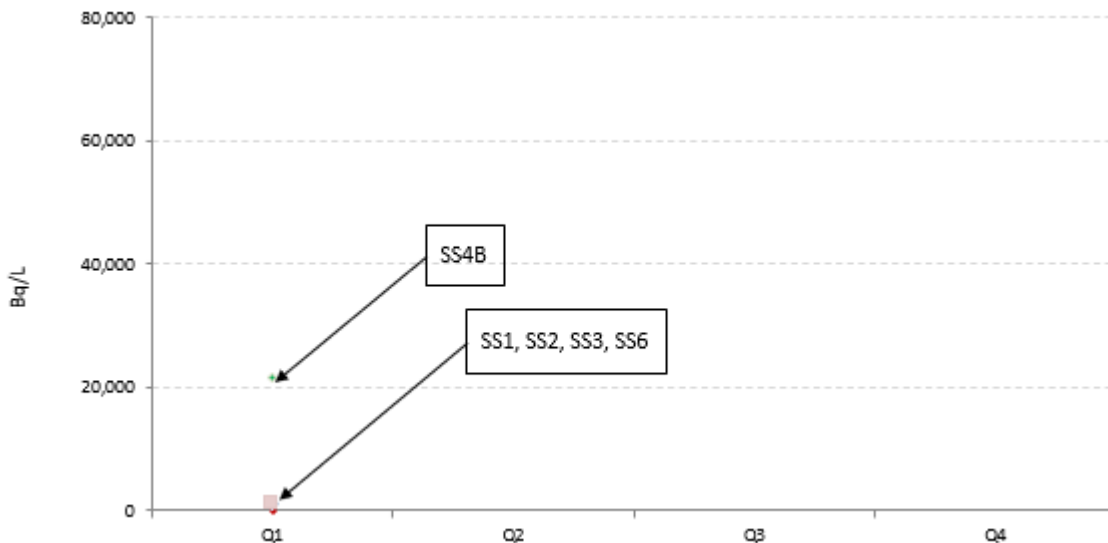
Starting in January 2022, the groundwater monitoring, except for subsurface drainage locations, will be conducted semi-annually in Q2 and Q4 of every year and the respective monitoring data of these sampling locations will be available in the 2022 Q2 and Q4 environmental emissions data report. Groundwater will no longer be sampled for Gross Beta or Carbon-14. Subsurface drainage location monitoring is conducted in and around the

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Nuclear Sustainability Services - Western waste storage structures to analyze water quality (Appendix A, Tables A.3).

Groundwater Monitoring Tritium Concentration Results



WASTE INCINERATOR EMISSIONS TESTING

The results of annual emissions testing performed at the Waste Volume Reduction Facility in 2021 indicated the facility is in compliance with Ontario air quality standards. (Appendix A, Table A.4).

SPILLS TO THE ENVIRONMENT

OPG has extensive programs to ensure the risk of spills to the environment is effectively assessed and managed. All spills are reported by OPG to the appropriate federal, provincial and municipal authorities as required.

OPG classifies its reportable spills as Category A, B or C spills based on the actual or potential impacts. Category A spills are considered very serious due to the scale of injury or damage, health effects, or safety impairment. Category B spills are considered serious due to localized injury or impacts to property. Category C spills are all other reportable spills that are less serious than Category A and B spills.

There were no reportable spills at Nuclear Sustainability Services – W in Q1 2022.

APPENDIX A

ENVIRONMENTAL EMISSIONS DATA

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Table A.1: Airborne Radionuclide Releases^(a)

	Tritium Oxide (Bq)	Particulate (Bq)	Iodine-131 (Bq)	Carbon-14^(b) (Bq)
SUMMARY: ANNUAL				
Release Limit (Bq/year)^(c)	3.45×10^{17}	6.65×10^{11}	1.99×10^{12}	2.41×10^{15}
Total Releases As of Q1 2022	3.0×10^{12}	0	1.9×10^3	8.0×10^8
DETAILS: QUARTERLY^(d)				
Action Level (Bq/week)^(e)	6.91×10^{14}	1.33×10^9	3.98×10^9	4.82×10^{12}
Q1	3.0×10^{12}	0	1.9×10^3	8.0×10^8

- (a) The Waste Volume Reduction Building radioactive waste incinerator stack and ventilation exhaust stack are monitored for tritium, particulate, and iodine-131 emissions. The incinerator stack is also monitored for carbon-14 emissions. The Transportation Package Maintenance Building ventilation stack is monitored for tritium and particulate emissions. The Used Fuel Dry Storage Facility ventilation stack is monitored for particulate emissions.
- (b) Carbon-14 emissions are impacted by the in-service time of the incinerator. OPG has completed the effluent monitoring assessment project and is in the process of reviewing the impact on C-14 emission data.
- (c) The derived Release Limit for a given radionuclide is the release rate of that radionuclide to air during normal operation of a nuclear facility over the period of a calendar year, which would result in an individual receiving a dose equal to the regulatory annual dose limit for a member of the public. New Release Limits have been implemented for Nuclear Sustainability Services – Western starting in 2020.
- (d) Releases have been summarized by quarter for this report.
- (e) Exceedances of Action Levels must be reported by OPG to the CNSC. To prevent an Action Level from being reached, OPG has set Internal Investigation Levels that require emissions to be reviewed when they reach the high end of the normal range. Corrective actions are taken if necessary. There were no CNSC Action Level exceedance events in the first quarter of 2022. New Action Levels have been implemented for Nuclear Sustainability Services – Western starting in 2020.

A becquerel (Bq) is the standard international unit for measuring radioactive decay or radioactivity. One becquerel is the decay of one atom of a radioisotope per second, and is an extremely small amount of radioactivity. Becquerel is a measure of the rate (not energy) of radiation emission from a source.

Another unit of measuring radioactivity is the curie (Ci). $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$.

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Table A.2: Perimeter Fence Dose Rates

As per regulatory requirements, Section 4 of CNSC REGDOCS-3.1.3, *Reporting Requirements for Waste Nuclear Substance Licensees, Class II Nuclear Facilities and Users of Prescribed Equipment, Nuclear Substances and Radiation Devices*, RWOS-1 data will now be reported annually in Q4 in the Annual Compliance Monitoring Report.

		Average Air Kerma Rate ($\mu\text{Gy}/\text{hour}$) ^(a)
Location		Q1
Western Low and Intermediate Level Waste Storage Facility	5	0.049
	8	0.059
	10	0.051
	11	0.061
	12	0.060
	15	0.058
	16	0.060
	17	0.056
	18	0.056
	19	0.059
	20	0.057
	21	0.052
	22	0.050
	23	0.067
	24	0.065
	25	0.080
	26	0.070
	27	0.066
	28	0.081
	29	0.063
Western Used Fuel Dry Storage Facility	DFSN-1	0.082
	DFSN-2	0.085
	DFSN-3	0.086
	DFSN-4	0.062
	DFSS-1	0.064
	DFSS-2	0.067
	DFSS-3	0.069
	DFSS-4	0.064
	DFSE-1	0.064
	DFSE-2	0.084
	DFSE-3	0.084
	DFSE-4	0.060
	DFSW-1	0.082
	DFSW-2	0.081
	DFSW-3	0.078
	DFSW-4	0.059

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- (a) Average ambient dose rates are measured at perimeter fences by Thermoluminescent Dosimeters to demonstrate that potential doses due to radiation fields from waste management facility operations are well within allowable limits and pose a negligible risk for the public, the workers and the environment. Dose rate monitoring results are compared to an internal target dose rate standard of 0.5 µGy/hour. This target is derived from the 1 mSv/year dose limit specified in federal legislation for a member of the public and assumes exposure for a working year (2,000 hours).

Table A.3: Nuclear Sustainability Services – Western Groundwater and Subsurface Monitoring Results

As per regulatory requirements, Section 4 of CNSC REGDOCS-3.1.3, *Reporting Requirements for Waste Nuclear Substance Licensees, Class II Nuclear Facilities and Users of Prescribed Equipment, Nuclear Substances and Radiation Devices*, RWOS-1 data will now be reported annually in Q4 in the Annual Compliance Monitoring Report.

		Tritium (Bq/L)
		Q1
WWMF SS1 ^(a)	January	1.26 x 10 ³
	February	1.29 x 10 ³
	March	7.94 x 10 ²
WWMF SS2 ^(a)	January	1.09 x 10 ³
	February	1.01 x 10 ³
	March	1.09 x 10 ³
WWMF SS3 ^(a)	January	1.42 x 10 ³
	February	1.41 x 10 ³
	March	1.83 x 10 ³
WWMF SS4B ^(a)	January	1.74 x 10 ⁴
	February	2.44 x 10 ⁴
	March	2.28 x 10 ⁴
WWMF SS6 ^(a)	January	4.33 x 10 ³
	February	1.27 x 10 ³
	March	3.69 x 10 ³

- (a) Water Sampling Holes are sampled on a semi-annual basis, except for subsurface drainage locations SS1, SS2, SS3, SS4B, SS6 which are sampled monthly.

Table A.4: NSS – Western Incinerator Facility Point of Impingement (POI) Assessment Summary ^(a)

Compound of Concern	Emission Rate	Calculated POI Concentration	Applicable POI Standard	Compliance Assessment
		24 hour basis (except where noted)	24 hour basis (except where noted)	% of Limit
		µg/m ³	µg/m ³	
PM	5.36E-04	0.031	120	0.026
Mercury	1.90E-07	1.11E-05	2	5.57E-04
Arsenic	1.60E-07	9.39E-06	0.3	3.13E-03

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Compound of Concern	Emission Rate	Calculated POI Concentration	Applicable POI Standard	Compliance Assessment
		24 hour basis (except where noted)	24 hour basis (except where noted)	% of Limit
	g/s	µg/m ³	µg/m ³	
Barium	2.66E-06	1.56E-04	10	1.56E-03
Beryllium	3.60E-08	2.11E-06	0.01	0.021
Cadmium	2.20E-07	1.29E-05	0.025	0.052
Chromium	1.15E-06	6.77E-05	0.5	0.014
Copper	6.62E-06	3.89E-04	50	7.77E-04
Lead	3.40E-06	2.00E-04	0.5	0.040
Manganese	1.64E-06	9.63E-05	0.4	0.024
Nickel	1.96E-06	2.05E-05 (annual)	0.04 (annual)	0.051 (annual)
Silver	6.71E-08	3.94E-06	1	3.49E-04
Zinc	5.47E-06	3.21E-04	120	2.67E-04
D&F (TEQ)	1.27E-11	2.28E-09 (1/2-hour)	15 (1/2-hour)	1.52E-08 (1/2-hour)
		7.47E-10	1.00E-07	0.75
Total PCB's	1.81E-09	1.06E-07	0.15	9.42E-05
HCB	5.36E-04	0.031	120	0.026
Naphthalene	1.90E-07	1.11E-05	2	5.57E-04
	1.60E-07	9.39E-06	0.3	3.13E-03
Benzo(a)pyrene	5.04E-08	9.03E-06 (1/2-hour)	0.015 (1/2-hour)	0.060 (1/2-hour)
		2.96E-06	0.005	0.059
		5.28E-07 (annual)	0.00001 (annual)	5.28 (annual)
HCl	4.81E-03	0.28	20	1.41
Phenol	5.50E-03	0.323	30	1.08
Acetaldehyde	7.62E-05	0.014 (1/2-hour)	500 (1/2-hour)	2.73E-03 (1/2-hour)
		4.47E-03	500	8.94E-04
Formaldehyde	2.04E-04	0.012	65	0.018
Acrolein	7.62E-05	0.011 (1 – hour)	4.5 (1-hour)	0.25 (1-hour)
		4.47E-03	0.4	1.12
Benzene	2.41E-05	2.52E-04 (annual)	0.45 (annual)	0.056
Ethylbenzene	1.76E-06	1.04E-04	1,000	1.04E-05
Methyl Ethyl Ketone (2-Butanone)	1.76E-06	1.04E-04	1,000	1.04E-05
Styrene	1.76E-06	1.04E-04	400	2.59E-05
Tetrachloro-Ethylene	1.76E-06	1.04E-04	360	2.88E-05
Toluene	1.76E-06	1.04E-04	2,000	5.18E-06
Trichloroethane, 1,1,1	1.76E-06	1.04E-04	115,000	9.00E-08
Vinyl Chloride (chloroethene)	1.76E-06	1.04E-04	1	0.010
Xylene, m&p	3.53E-06	2.07E-04	730 (sum of all xylenes)	4.26E-05
Xylene,o	1.76E-06	1.04E-04		

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		24 hour basis (except where noted)	24 hour basis (except where noted)	% of Limit
	<i>g/s</i>	<i>µg/m³</i>	<i>µg/m³</i>	
Carbon Monoxide	9.49E-05	0.017 (1/2-hour)	6,000 (1/2-hour)	2.83E-04 (1/2-hour)
Nitrogen Oxides	0.072	10.73 (1-hour)	400 (1-hour)	2.68 (1-hour)
		4.22	200	2.11
Sulphur Dioxide	2.51E-04	0.038 (1-hour)	690 (1-hour)	5.44E-03 (1-hour)
		0.015	275	5.36E-03

Bold text indicates ECA prescribed limits.

Underlined italics indicate compound emissions less than reporting limits.

*Shaded italics indicate **Guideline** POI concentrations.*

- (a) The results of an emission testing program performed in October 2021 indicated the Nuclear Sustainability Services - Western Waste Volume Reduction Facility was operating well within compliance for all Ontario Environmental Protection Act, Ontario Regulation 419/05 standards and point of impingement guidelines based on ground level point of impingement concentrations. This testing is required annually to meet Ontario Ministry of the Environment, Conservation and Parks Environmental Compliance Approval requirements.