

**OVERVIEW**

This report summarizes the environmental emissions data for Q4 2023 for OPG’s Nuclear Sustainability Services – Western Waste Management Facility (NSS-WWMF) located at the Bruce Nuclear Power Development site in Bruce County. OPG’s NSS-WWMF 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 (RWOS 1) stores low and intermediate level radioactive waste.

This report includes:

- Radioactive Effluents: Releases to air and water remained well below the regulatory limits.
- 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 that OPG is required to provide to the Canadian Nuclear Safety Commission (CNSC). 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 NSS-WWMF 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-WWMF, 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](http://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 waste facilities, are available at:*

[www.brucepower.com/resources-and-publications/reports](http://www.brucepower.com/resources-and-publications/reports)

**AIR EMISSIONS**

Emissions from the NSS-WWMF are monitored to track performance. For Q4 2023, radiological emissions to air remained well below the Release Limits and no Action Levels were exceeded (Appendix A, Table A.1).

Past monitoring results from the radiological particulate emissions monitoring of the ventilation system at the Dry Storage Container (DSC) Processing Building at NSS-WWMF have consistently demonstrated negligible particulate emissions from this building. As approved by the CNSC, this particulate emissions monitoring will be discontinued in 2024. Emissions monitoring will be unchanged for the Waste Volume Reduction Building radioactive waste incinerator stack, and the Transportation Package Maintenance Building ventilation stack.

**WATER EMISSIONS**

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

**GROUNDWATER MONITORING**

Groundwater monitoring wells are sampled semi-annually in Q2 and Q4 of every year, and the subsurface drainage is monitored monthly. The monitoring data of these sampling locations are available in the environmental emissions data reports (Appendix A, Tables A.2, A.3. and A.4). The Annual Groundwater Monitoring Report is available at: <https://www.opg.com/reporting/regulatory-reporting/>

**WASTE INCINERATOR EMISSIONS TESTING**

The results of annual emissions testing performed at the Waste Volume Reduction Facility's radioactive incinerator in 2023 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.

There were no reportable spills at the NSS-WWMF site in Q4 2023.

## APPENDIX A

# ENVIRONMENTAL EMISSIONS DATA

Table A.1: WWMF Airborne Radionuclide Releases<sup>(a)</sup>

	Tritium Oxide (Bq)	Particulate (Bq)	Iodine-131 (Bq)	Carbon-14 <sup>(b)</sup> (Bq)
<b>SUMMARY: ANNUAL</b>				
<b>Release Limit (Bq/year)<sup>(c)</sup></b>	$3.45 \times 10^{17}$	$6.65 \times 10^{11}$	$1.99 \times 10^{12}$	$2.41 \times 10^{15}$
Total Releases As of Q4 2023	$1.2 \times 10^{13}$	$5.1 \times 10^5$	$1.3 \times 10^5$	$2.1 \times 10^{10}$
<b>DETAILS: QUARTERLY<sup>(d)</sup></b>				
<b>Action Level (Bq/week)<sup>(e)</sup></b>	$6.91 \times 10^{14}$	$1.33 \times 10^9$	$3.98 \times 10^9$	$4.82 \times 10^{12}$
Q1	$4.4 \times 10^{12}$	0	$1.3 \times 10^4$	$8.9 \times 10^9$
Q2	$1.6 \times 10^9$	$4.8 \times 10^5$	$8.4 \times 10^3$	$8.8 \times 10^9$
Q3	$3.0 \times 10^{12}$	$2.6 \times 10^4$	$4.3 \times 10^3$	$1.3 \times 10^9$
Q4	$4.6 \times 10^{12}$	$4.9 \times 10^3$	$9.9 \times 10^4$	$2.2 \times 10^9$

- (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 of C-14 emissions waste storage 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.
- (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 fourth quarter of 2023.

*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).  $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$ .*

Table A.2: Radioactive Waste Operations Site 1 Groundwater Monitoring Results

		Tritium (Bq/L)	Gross Beta (Bq/L)
WSH 122	Q1	$1.95 \times 10^2$	N/A
	Q2	$1.71 \times 10^2$	N/A
	Q3	$9.22 \times 10^2$	N/A
	Q4	$9.77 \times 10^2$	N/A
WSH 123	Q1	$3.20 \times 10^2$	N/A
	Q2	$6.40 \times 10^2$	N/A
	Q3	$2.11 \times 10^2$	N/A
	Q4	$3.95 \times 10^2$	N/A
WSH124	Q1	$1.93 \times 10^2$	N/A
	Q2	$2.05 \times 10^2$	N/A
	Q3	$1.82 \times 10^2$	N/A
	Q4	$1.90 \times 10^2$	N/A
WSH125	Q1	$1.96 \times 10^2$	N/A
	Q2	$1.79 \times 10^2$	N/A
	Q3	$1.48 \times 10^2$	N/A
	Q4	$1.83 \times 10^2$	N/A
WSH126	Q1	$1.61 \times 10^2$	N/A
	Q2	$1.89 \times 10^2$	N/A
	Q3	$1.51 \times 10^2$	N/A
	Q4	$1.91 \times 10^2$	N/A
Discharge Ditch (N)	Jan	$2.04 \times 10^2$	$9.74 \times 10^{-2}$
	Feb	$2.70 \times 10^2$	$1.33 \times 10^{-1}$
	Mar	$2.45 \times 10^2$	$1.33 \times 10^{-1}$
	Apr	$2.93 \times 10^2$	$1.38 \times 10^{-1}$
	May	$2.58 \times 10^2$	$9.78 \times 10^{-2}$
	Jun	$2.38 \times 10^2$	$8.53 \times 10^{-2}$
	Jul	$2.31 \times 10^2$	$1.12 \times 10^{-1}$
	Aug	$2.14 \times 10^2$	$1.02 \times 10^{-1}$
	Sep	$2.18 \times 10^2$	$1.36 \times 10^{-1}$
	Oct	$2.31 \times 10^2$	$1.64 \times 10^{-1}$
	Nov	$3.05 \times 10^2$	$1.30 \times 10^{-1}$
	Dec	$2.43 \times 10^2$	$1.09 \times 10^{-1}$
Discharge Ditch (S)	Jan	$1.31 \times 10^2$	$5.40 \times 10^{-2}$
	Feb	$1.72 \times 10^2$	$1.09 \times 10^{-1}$
	Mar	$1.56 \times 10^2$	$9.38 \times 10^{-1}$
	Apr	$1.33 \times 10^2$	$8.09 \times 10^{-2}$
	May	$3.02 \times 10^2$	$9.62 \times 10^{-2}$
	Jun	$3.29 \times 10^2$	$1.10 \times 10^{-1}$
	Jul	No sample-ditch was dry	No sample-ditch was dry
	Aug	$2.19 \times 10^2$	$1.71 \times 10^{-1}$

Environmental Emissions Data for  
Nuclear Sustainability Services – Western Waste Management Facility

		Tritium (Bq/L)	Gross Beta (Bq/L)
	Sep	$2.03 \times 10^2$	$1.40 \times 10^{-1}$
	Oct	$1.83 \times 10^2$	$1.94 \times 10^{-1}$
	Nov	$2.12 \times 10^2$	$1.15 \times 10^{-1}$
	Dec	$1.51 \times 10^2$	$8.82 \times 10^{-2}$

(a)

\* Discharge Ditch N and S are surface water sampling points

- (b) † Sampling program change starting January 2023: Although only programmatically required to be sampled semi-annually, WSHs 122, 123, 124, 125, and 126 are now sampled quarterly (for tritium only)
- (c) Note: Carbon-14 and Gross Beta sampling in groundwater were discontinued in Q1 2022 based on the results of the Conceptual Site Model and the Groundwater Protection and Monitoring Program development per CSA N288.7.

**Table A.3:** WWMF Groundwater Monitoring Results

Year to date results for the WWMF are provided below. RWOS-1 results are reported annually and will be included in the Q4 report.

	Tritium (Bq/L)	
	Q2	Q4
WSH 224	$5.79 \times 10^1$	N/A
WSH 226	$7.23 \times 10^0$	$7.51 \times 10^0$
WSH 228	$1.79 \times 10^2$	$1.72 \times 10^2$
WSH 229	$7.83 \times 10^2$	$7.82 \times 10^2$
WSH 230	$6.96 \times 10^2$	$7.48 \times 10^2$
WSH 231	$8.66 \times 10^3$	$9.39 \times 10^3$
WSH 232	$1.15 \times 10^1$	N/A
WSH 237	$9.43 \times 10^0$	N/A
WSH 238	$6.67 \times 10^0$	N/A
WSH 239	$9.80 \times 10^0$	N/A
WSH 240	$8.62 \times 10^0$	$8.2 \times 10^0$
WSH 242	$4.21 \times 10^1$	$5.42 \times 10^1$
WSH 243	$2.63 \times 10^2$	$3.21 \times 10^2$
WSH 244	$4.99 \times 10^1$	N/A
WSH 245	$8.20 \times 10^0$	N/A
WSH 249	$7.40 \times 10^0$	N/A
WSH 252	$6.25 \times 10^3$	N/A
WSH 253	$1.99 \times 10^4$	$2.07 \times 10^4$
WSH 255	$3.13 \times 10^3$	$3.52 \times 10^3$
WSH 256	$2.85 \times 10^3$	N/A
WSH 257	$3.57 \times 10^3$	N/A
WSH 259	$1.18 \times 10^3$	N/A
WSH 263	$5.26 \times 10^1$	N/A
WSH 265	$4.66 \times 10^2$	$5.14 \times 10^2$
WSH 267	$8.17 \times 10^0$	N/A

	Tritium (Bq/L)	
	Q2	Q4
WSH 269	$4.84 \times 10^2$	$4.35 \times 10^2$
WSH 270	$8.10 \times 10^0$	N/A
WSH 272	$2.97 \times 10^2$	N/A
WSH 275	$7.61 \times 10^0$	N/A
WSH 276	$2.90 \times 10^1$	$1.66 \times 10^1$
WSH 277	$4.51 \times 10^2$	$3.01 \times 10^2$
WSH 278	$1.36 \times 10^1$	N/A
WSH 279	$1.91 \times 10^2$	$2.63 \times 10^2$
WSH 282	$5.92 \times 10^2$	$6.52 \times 10^2$
WSH 283	$1.48 \times 10^2$	$1.88 \times 10^2$
WSH 284	$3.79 \times 10^2$	$4.28 \times 10^2$
WSH 285	$3.85 \times 10^2$	$4.08 \times 10^2$
WSH 286	$3.85 \times 10^2$	$3.00 \times 10^2$
WSH 287	$2.86 \times 10^2$	$3.03 \times 10^2$
WSH 301	$7.79 \times 10^0$	N/A
WSH 307	$7.74 \times 10^0$	N/A
DGRB12	$8.64 \times 10^1$	$9.65 \times 10^1$
DGRB12A	$7.80 \times 10^0$	N/A
DGRB14	$4.42 \times 10^1$	N/A

Table A.3: NSS-WWMF Subsurface Monitoring Results

Month	Tritium (Bq/L)				
	WWMF SS1	WWMF SS2	WWMF SS3	WWMF SS4B	WWMF SS6
January	$1.45 \times 10^3$	$1.22 \times 10^3$	$1.88 \times 10^3$	$6.66 \times 10^4$ (a)	$5.04 \times 10^3$
February	$1.57 \times 10^3$	$8.70 \times 10^2$	$1.87 \times 10^3$	$1.39 \times 10^4$	$3.96 \times 10^3$
March	$1.24 \times 10^3$	$7.87 \times 10^2$	$2.71 \times 10^3$	$1.39 \times 10^4$	$3.41 \times 10^3$
April	$8.79 \times 10^2$	$8.46 \times 10^3$	$2.47 \times 10^3$	$1.24 \times 10^4$	$4.32 \times 10^3$
May	$8.43 \times 10^2$	$8.62 \times 10^2$	$2.54 \times 10^3$	$1.03 \times 10^4$	$3.76 \times 10^3$
June	$1.17 \times 10^3$	$8.89 \times 10^2$	$2.80 \times 10^3$	$1.75 \times 10^4$	$3.61 \times 10^3$
July	$9.18 \times 10^2$	$8.54 \times 10^2$	$2.83 \times 10^3$	$1.28 \times 10^4$	$3.85 \times 10^3$
August	$6.96 \times 10^2$	$7.86 \times 10^2$	$2.84 \times 10^3$	$1.12 \times 10^4$	$3.42 \times 10^3$
September	$1.2 \times 10^3$	$8.28 \times 10^2$	$2.83 \times 10^3$	$1.22 \times 10^4$	$4.04 \times 10^3$
October	$1.15 \times 10^3$	$8.93 \times 10^2$	$3.20 \times 10^3$	$8.49 \times 10^3$	$9.02 \times 10^3$
November	$1.31 \times 10^3$	$8.84 \times 10^2$	$3.11 \times 10^3$	$9.70 \times 10^3$	$4.58 \times 10^3$
December	$1.19 \times 10^3$	$8.40 \times 10^2$	$2.93 \times 10^3$	$1.10 \times 10^4$	$5.05 \times 10^3$

(a) Result is considered an outlier. Suspected to be sampling error. Previous and subsequent results were within normal range.

# Environmental Emissions Data for Nuclear Sustainability Services – Western Waste Management Facility

Q4 2023

Table A.4: NSS-WWMF Incinerator Facility Point of Impingement (POI) Assessment Summary <sup>(a)</sup>

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 <sup>3</sup>	µg/m <sup>3</sup>
PM	1.54E-04	8.35E-03	120	7E-3
Carbon Monoxide	5.66E-04	7.21E-02 (1/2-hour)	6,000 (1/2-hour)	1.2E-03 (1/2-hour)
Sulphur Dioxide	0.0	0	275	0
		0 (1-hour)	690 (1-hour)	0 (1-hour)
Nitrogen Oxides	6.21E-02	3.35E0	200	1.68
		6.59E0 (1-hour)	400 (1-hour)	1.65 (1-hour)
HCl	1.25E-03	1.59E-01	20	3.4E-01
D&F (TEQ)	4.18E-12	2.26E-10	1.00E-07	2.0E-02
		5.33E-10 (1/2-hour)	<b>15 (1/2-hour)</b>	3.56E-09 (1/2-hour)
Total PCB's	9.17E-09	8.32E-07	0.15	3.31E-04
Naphthalene	2.365E-07	1.27E-05	22.5	5.67E-05
		3.01E-05 (1/2-hr)	<b>36 (1/2-hour)</b>	8.35E-05 (1/2-hr)
Benzo(a)pyrene	<u>5.862E-08</u>	6.24E-07 (annual)	0.00001 (annual)	<u>6.24</u> (annual)
		3.17E-06	0.005	6.3E-2
Acetaldehyde	1.29E-04	6.95E-03	500	1E-03
		1.64E-02 (1/2-hour)	500 (1/2-hour)	3E-03 (1/2-hour)
Formaldehyde	<u>8.79E-05</u>	4.75E-03	65	7E-03
Phenol	<u>2.43E-04</u>	1.28E-02	30	4.3E-02
Acrolein	<u>8.79E-05</u>	<u>4.75E-03</u>	0.4	1.19
		<u>9.34E-02</u> (1-hour)	4.5 (1-hour)	4E-01 (1-hour)
Benzene	5.85E-05	6.23E-04 (annual)	0.45 (annual)	14E-02
Methyl Ethyl Ketone (2-Butanone)	<u>1.02E-05</u>	<u>5.547E-04</u>	1,000	6E-05
Vinyl Chloride (chloroethene)	<u>1.02E-05</u>	<u>5.54E-04</u>	1	6E-02
Ethylbenzene	1.02E-05	5.54E-04	1,000	6E-05
Styrene	1.02E-05	5.54E-04	400	1E-04
Tetrachloro-ethylene	1.02E-05	5.54E-04	360	2E-04
Toluene	1.02E-05	5.54E-04	2,000	3E-05
Trichloroethane, 1,1,1	1.02E-05	5.54E-04	115,000	5E-07
Trichloroethene (trichloroethylene)	1.02E-05	5.54E-04	12	<u>5E-03</u>
Xylene <sup>(b)</sup>	2.01E-05	1.09E-03	730 (sum of all xylenes)	1E-04
Arsenic	<u>1.73E-07</u>	<u>9.36E-06</u>	0.3	3E-03
Barium	5.40E-06	2.92E-04	10	3E-03
Beryllium	<u>3.98E-08</u>	<u>2.11E-06</u>	0.01	2E-02

# Environmental Emissions Data for Nuclear Sustainability Services – Western Waste Management Facility Q4 2023

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
	<i>g/s</i>	<i>µg/m<sup>3</sup></i>	<i>µg/m<sup>3</sup></i>	
Cadmium	5.14E-08	2.78E-06	0.025	1E-02
Chromium	1.28E-06	6.94E-05	0.5	1E-02
Copper	6.15E-07	3.33E-05	50	1E-04
Lead	1.88E-07	1.02E-05	0.5	2E-03
Manganese	6.48E-06	3.51E-04	0.4	9E-02
Mercury	<u>2.05E-07</u>	1.11E-05	2	5E-04
Nickel	9.23E-07	9.83E-06 (annual)	0.04 (annual)	1E-02 (annual)
Silver	<i>6.56E-08</i>	3.55E-04	1	<i>3E-04</i>
Zinc	6.56E-06	3.55E-04	120	3E-04

**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-November 2023 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.
- (b) Only m/p-Xylene was detected in the samples and it was used in this table (o-Xylene was below the detection limit).