

Environmental Emissions Data for Nuclear Waste Management - Bruce Site

Q3 2019

OVERVIEW

This report summarizes the environmental emissions data for Q3 2019 for OPG’s Nuclear Waste Management operations located at the Bruce Nuclear Power Development site in Bruce County. OPG’s Western Waste Management Facility 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 and water 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 was 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.

Public Radiation Dose Data

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

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 Western Waste Management Facility 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.

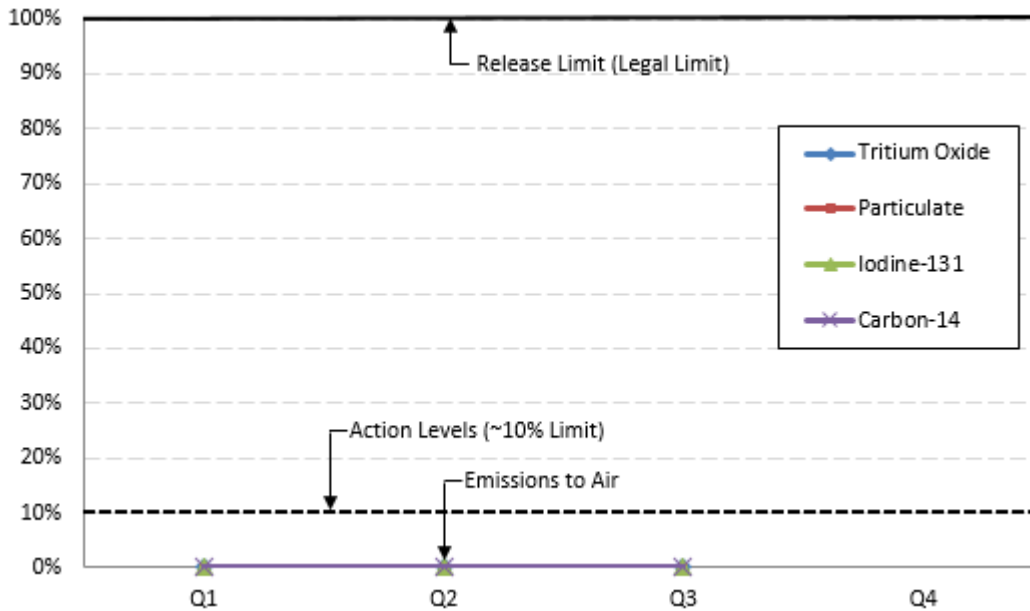
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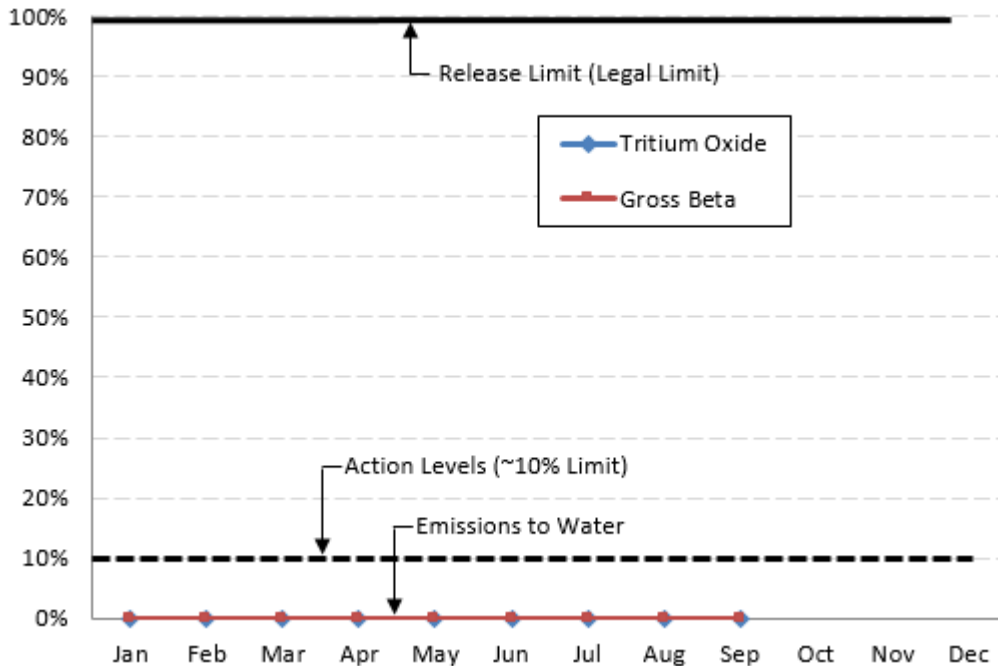
Performance Results

Emissions from the Western Waste Management Facility are monitored to track performance. For Q3 2019, radiological emissions to air and water remained well below the Release Limits and no Action Levels were exceeded. (Appendix A, Tables A.1 and A.2) 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 as a Per Cent of Release Limits



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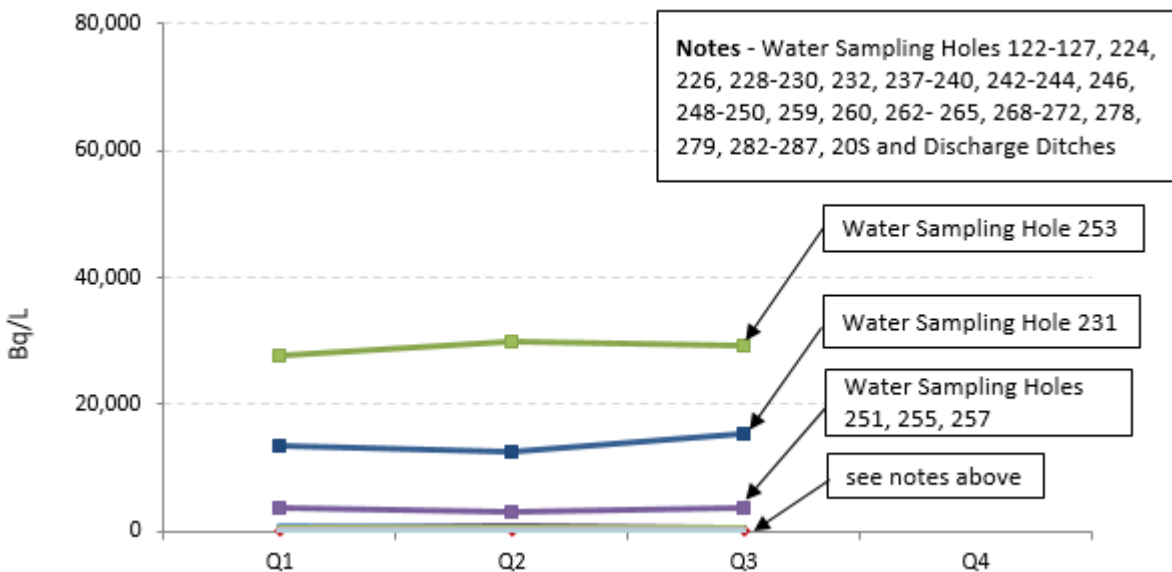
PERIMETER DOSE RATE MONITORING

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.3)

GROUNDWATER MONITORING

Groundwater monitoring is conducted in and around the Western Waste Management Facility and the Radioactive Waste Operations Site 1 waste storage structures to analyze water quality. (Appendix A, Tables A.4, A.5 and A.6) The following graph shows average quarterly and annual tritium concentration results for the year to date. Tritium concentrations at Water Sampling Hole (WSH) 231 remained elevated but shows a decreasing trend since 2010. Elevated tritium concentrations at WSH 253 is expected as it is located up-gradient of WSH 231 and is closer to the tritium source.

Groundwater Monitoring Tritium Concentration Results



WASTE INCINERATOR EMISSIONS TESTING

The results of annual emissions testing performed at the Waste Volume Reduction Facility in 2017 indicated the facility is in compliance with Ontario air quality standards. (Appendix A, Table A.7). The Ontario Ministry of the Environment, Conservation and Parks exempted OPG from testing the facility in 2018 due to the extended incinerator outage schedule during the year. Testing to resume in Q4 2019.

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 the Nuclear Waste Management site in Q3 2019.

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) | 2.96 x 10 ¹⁷ | 2.34 x 10 ¹² | 1.90 x 10 ¹² | 1.09 x 10 ¹⁵ |
| Total Releases As of Q3 2019 | 9.25 x 10 ¹² | 6.52 x 10 ² | 0 | 2.50 x 10 ⁹ |
| DETAILS: QUARTERLY^(d) | | | | |
| Action Level (Bq/week)^(e) | 5.9 x 10 ¹⁴ | 4.7 x 10 ⁹ | 3.79 x 10 ⁹ | 2.17 x 10 ¹² |
| Q1 | 1.06 x 10 ¹⁰ | 6.52 x 10 ² | 0 | 4.61 x 10 ⁷ |
| Q2 | 3.87 x 10 ¹¹ | 0 | 0 | 9.48 x 10 ⁸ |
| Q3 | 8.85 x 10 ¹² | 0 | 0 | 1.51 x 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.
- (c) The derived Release Limit for a given radionuclide is the release rate of that radionuclide to air or surface water 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 third quarter of 2019.

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 Ci = 3.7 x 10¹⁰ Bq.

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Table A.2: Waterborne Radionuclide Releases^(a)

| | Tritium Oxide (Bq) | Gross Beta-Gamma (Bq)^(b) |
|--|-------------------------------|--|
| SUMMARY: ANNUAL | | |
| Release Limit (Bq/year)^(c) | 7.70 x 10 ¹⁵ | 4.56 x 10 ¹¹ |
| Total Releases as of Q3 2019 | 1.24 x 10 ¹¹ | 5.57 x 10 ⁷ |
| DETAILS: MONTHLY | | |
| Action Level (Bq/month)^(d) | 6.2 x 10 ¹³ | 3.6 x 10 ⁹ |
| January | 1.37 x 10 ¹⁰ | 6.37 x 10 ⁶ |
| February | 1.11 x 10 ¹⁰ | 1.25 x 10 ⁷ |
| March | 1.25 x 10 ¹⁰ | 1.64 x 10 ⁷ |
| April | 2.27 x 10 ¹⁰ | 8.05 x 10 ⁶ |
| May | 1.33 x 10 ¹⁰ | 2.48 x 10 ⁶ |
| June | 1.27 x 10 ¹⁰ | 2.99 x 10 ⁶ |
| July | 1.42 x 10 ¹⁰ | 2.89 x 10 ⁶ |
| August | 1.05 x 10 ¹⁰ | 1.84 x 10 ⁶ |
| September | 1.33 x 10 ¹⁰ | 2.17 x 10 ⁶ |

- (a) Various surface and sub-surface water drainage systems service the Western Waste Management Facility. Water is collected at sample stations and is monitored for radioactivity before the water is released to surface water drainage. The weekly samples taken from each sample station are analyzed for tritium and gross beta activity. The results of the individual sample stations are combined and reported as a total emission from the Western Waste Management Facility.
- (b) Monthly release data is gross beta.
- (c) The derived Release Limit for a given radionuclide is the release rate of that radionuclide to air or surface water 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) 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 third quarter of 2019.

Table A.3: Perimeter Fence Dose Rates

| Location | | Average Air Kerma Rate (μGy/hour)^(a) |
|-------------------------------------|----|--|
| | | Q3 |
| Radioactive Waste Operations Site 1 | 1 | 0.056 |
| | 1A | 0.060 |
| | 2 | 0.060 |
| | 2A | 0.058 |
| | 3 | 0.054 |
| | 4 | 0.054 |

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| Location | | Average Air Kerma Rate ($\mu\text{Gy}/\text{hour}$) ^(a) |
|---|--------|---|
| | | Q3 |
| Western Low and Intermediate Level Waste Storage Facility | 4A | 0.059 |
| | 5 | 0.055 |
| | 8 | 0.063 |
| | 10 | 0.056 |
| | 11 | 0.058 |
| | 12 | 0.062 |
| | 15 | 0.064 |
| | 16 | 0.071 |
| | 17 | 0.063 |
| | 18 | 0.065 |
| | 19 | 0.065 |
| | 20 | 0.064 |
| | 21 | 0.062 |
| | 22 | 0.058 |
| | 23 | 0.071 |
| | 24 | 0.068 |
| | 25 | 0.074 |
| | 26 | 0.078 |
| | 27 | 0.077 |
| 28 | 0.097 | |
| 29 | 0.070 | |
| Western Used Fuel Dry Storage Facility | DFSN-1 | 0.091 |
| | DFSN-2 | 0.095 |
| | DFSN-3 | 0.088 |
| | DFSN-4 | 0.066 |
| | DFSS-1 | 0.072 |
| | DFSS-2 | 0.072 |
| | DFSS-3 | 0.074 |
| | DFSS-4 | 0.072 |
| | DFSE-1 | 0.071 |
| | DFSE-2 | 0.092 |
| | DFSE-3 | 0.088 |
| | DFSE-4 | 0.067 |
| | DFSW-1 | 0.089 |
| | DFSW-2 | 0.079 |
| DFSW-3 | 0.079 | |
| DFSW-4 | 0.060 | |

(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 to the public, the workers, and the environment. Dose rate monitoring results are compared to an internal target dose rate standard of 0.5 $\mu\text{Gy}/\text{hour}$. 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).

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Table A.4: Radioactive Waste Operations Site 1 Groundwater Monitoring Results

| | | Tritium (Bq/L) | Gross Beta (Bq/L) | Carbon 14 (Bq/L) ^(a) |
|-----------------------|-----------|--------------------|-----------------------|---------------------------------|
| | | Q3 | Q3 | Q3 |
| WSH 122 | | 2.07×10^2 | 6.64×10^{-2} | <0.1 |
| WSH 123 | | 4.58×10^2 | 5.99×10^{-2} | 1.5 |
| WSH 205 | | 2.68×10^2 | 1.13×10^{-1} | <0.1 |
| WSH 124 | | 2.19×10^2 | 6.79×10^{-2} | <0.1 |
| WSH 125 | | 1.84×10^2 | 7.14×10^{-2} | <0.1 |
| WSH 126 | | 1.86×10^2 | 7.49×10^{-2} | <0.1 |
| WSH 127 | | 1.23×10^2 | 6.19×10^{-2} | <0.1 |
| DD (N) ^(b) | July | 2.50×10^2 | 1.45×10^{-1} | N/A |
| | August | 2.02×10^2 | 2.05×10^{-1} | N/A |
| | September | 2.78×10^2 | 1.70×10^{-1} | N/A |
| DD (S) ^(b) | July | 2.07×10^2 | 8.78×10^{-2} | N/A |
| | August | 1.73×10^2 | 2.07×10^{-1} | N/A |
| | September | 7.01×10^1 | 7.80×10^{-2} | N/A |

(a) Values prefixed by an “<” indicate that reported results were less than the minimum detectable limit.

(b) Discharge Ditches (DD) are surface water sampling points and are sampled monthly.

Table A.5: Western Waste Management Facility Groundwater Monitoring Results

| | | Tritium (Bq/L) | Gross Beta (Bq/L) | Carbon 14 (Bq/L) ^(a) |
|------------------------|-----------|--------------------|-----------------------|---------------------------------|
| | | Q3 | Q3 | Q3 |
| WSH 226 | | 1.02×10^1 | 1.81×10^{-1} | <0.1 |
| WSH 228 | | 1.44×10^2 | 1.30×10^{-1} | <0.1 |
| WSH 229 ^(b) | | 5.51×10^2 | 1.34×10^{-1} | 14.9 |
| WSH 230 | | 5.09×10^2 | 7.59×10^{-2} | <0.1 |
| WSH 231 ^(c) | July | 1.41×10^4 | 1.69×10^{-1} | N/A |
| | August | 1.53×10^4 | 1.97×10^{-1} | N/A |
| | September | 1.69×10^4 | 1.30×10^{-1} | N/A |
| WSH 240 ^(b) | | 9.52 | 1.44×10^{-1} | 8.7 |
| WSH 242 | | 4.59×10^1 | 1.84×10^{-1} | N/A |
| WSH 243 | | 4.04×10^2 | 2.50×10^{-1} | <0.1 |
| WSH 253 ^(c) | | 2.93×10^4 | 2.36×10^{-1} | N/A |
| WSH 255 ^(c) | | 3.60×10^3 | 2.83×10^{-1} | N/A |
| WSH 264 | | 3.00×10^1 | 3.87×10^{-1} | <0.1 |
| WSH 265 | | 5.17×10^2 | 3.47×10^{-1} | <0.1 |
| WSH 269 | | 3.15×10^2 | 3.59×10^{-1} | N/A |
| WSH 282 | | 5.86×10^2 | 2.39×10^{-1} | <0.1 |
| WSH 283 | | 1.61×10^2 | 2.87×10^{-1} | <0.1 |
| WSH 284 | | 4.73×10^2 | 3.40×10^{-1} | <0.1 |

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| | Tritium (Bq/L) | Gross Beta (Bq/L) | Carbon 14 (Bq/L) ^(a) |
|---------|--------------------|-----------------------|---------------------------------|
| | Q3 | Q3 | Q3 |
| WSH 285 | 2.99×10^2 | 2.65×10^{-1} | <0.1 |
| WSH 286 | 2.57×10^2 | 3.46×10^{-1} | <0.1 |
| WSH 287 | 2.63×10^2 | 5.40×10^{-1} | 0.14 |

- (a) Values prefixed by an “<” indicate that reported results were less than the minimum detectable limit.
- (b) Elevated Carbon-14 levels found in samples from WSH229 and WSH240 are believed to be erroneous. The migration mechanism (i.e. C-14 migration in groundwater) does not support the rapid increase and sharp return to normal levels the following quarter in Q4 2019.
- (c) Water Sampling Holes are sampled on a quarterly basis, except for WSH 231 which is sampled monthly. It has been determined the source of the tritium at WSH 231 is evaporated water from waste in the Low Level Storage Buildings, which has likely migrated as condensate via underground electrical infrastructure. Various mitigating measures have been taken and the tritium concentration at WSH 231 shows a decreasing trend, with seasonal variations. WSH 251, WSH 253, WSH 255 and WSH 257 were incorporated into the groundwater monitoring program in 2017 and are used to monitor the extent of the tritium migration.

Table A.6: Western Waste Management Facility Annual Groundwater Monitoring Results^(a)

| | Tritium (Bq/L) | Gross Beta (Bq/L) | Carbon 14 (Bq/L) ^(b) |
|------------------------|--------------------|-----------------------|---------------------------------|
| WSH 224 | 5.42×10^1 | 1.37×10^{-1} | <0.1 |
| WSH 232 | 9.56 | 1.90×10^{-1} | <0.1 |
| WSH 237 | 1.09×10^1 | 3.18×10^{-1} | <0.1 |
| WSH 238 | 1.05×10^1 | 6.49×10^{-1} | 0.21 |
| WSH 239 | 1.04×10^1 | 6.23×10^{-1} | <0.1 |
| WSH 244 | 1.54×10^1 | 3.54×10^{-1} | N/A |
| WSH 246 | 9.40 | 1.99×10^{-1} | N/A |
| WSH 248 | 9.31 | 1.96×10^{-1} | N/A |
| WSH 249 | 9.40 | 2.29×10^{-1} | N/A |
| WSH 250 | 1.80×10^2 | 2.11×10^{-1} | <0.1 |
| WSH 251 ^(c) | 2.57×10^3 | 1.37×10^{-1} | N/A |
| WSH 257 ^(c) | 1.93×10^3 | 2.69×10^{-1} | N/A |
| WSH 259 | 7.86×10^2 | 1.90×10^{-1} | N/A |
| WSH 260 | 1.79×10^1 | 1.85×10^{-1} | N/A |
| WSH 262 | 2.95×10^1 | 2.05×10^{-1} | <0.1 |
| WSH 263 | 7.60×10^1 | 1.94×10^{-1} | N/A |
| WSH 268 | 9.55 | 1.69×10^{-1} | N/A |
| WSH 270 | 9.51 | 1.79×10^{-1} | N/A |
| WSH 271 | 5.61 | 1.99×10^{-1} | N/A |
| WSH 272 | 2.62×10^2 | 1.81×10^{-1} | N/A |

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| | Tritium (Bq/L) | Gross Beta (Bq/L) | Carbon 14 (Bq/L) ^(b) |
|---------|--------------------|-----------------------|---------------------------------|
| WSH 278 | 3.95×10^1 | 1.91×10^{-1} | N/A |
| WSH 279 | 2.41×10^2 | 1.84×10^{-1} | N/A |

- (a) Annual samples were taken in Q3 of 2019.
- (b) Values prefixed by an “<” indicate that reported results were less than the minimum detectable limit.
- (c) Refer to footnote (c) in Table A.5.

Table A.7: Annual Waste Incinerator Emission Test Results and Emission Criteria^(a)

| Stack Gas Concentration Criterion | Maximum Allowable Value | 2017 Test Average Value |
|--|---------------------------|--|
| Total Hydrocarbons (as CH ₄) | 50 ppm | 0.8 ppm |
| Particulate Matter | 14 mg/Rm ³ | 0.95 mg/Rm ³ |
| Mercury | 20 µg/Rm ³ | <0.22 µg/Rm ³ |
| Isomers of Dioxins and Furans | 80 pg TEQ/Rm ³ | 2.04 pg TEQ/Rm ³ / 2.33 (including dioxin-like PCBs) |
| Hydrogen Chloride | 27 mg/Rm ³ | 20.91 mg/Rm ³ |
| Nitrogen Oxides (as NO ₂) | 198 mg/Rm ³ | 126.06 mg/Rm ³ |
| Carbon Monoxide | 25 ppm | 2.5 ppm |

- (a) The results of an emission testing program performed in October 2017 indicated the Western Waste Management Facility 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. The Ministry granted OPG an exemption from source testing in 2018 due to the extended incinerator outage schedule. Annual testing is to resume in Q4 2019.