ONTARIO POWER GENERATION

Environmental Emissions Data for Pickering Nuclear

Q3 2021

OVERVIEW

This report summarizes Pickering Nuclear's environmental emissions data for Q3 2021. Pickering Nuclear Generating Station has six operating reactor units and a total generation capacity of 3,094 megawatts. The station is located in the City of Pickering in Durham Region.

This report includes:

- Radioactive Effluents: Releases to air and water remained well below the regulatory limits.
- Pickering Waste Management Facility: Monitoring results for air emissions, water, and perimeter dose rate confirmed the integrity of the facility.
- Groundwater Monitoring: OPG continued to analyze groundwater results to examine trends.
- 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.

MONITORING OF RADIOACTIVE EFFLUENTS

Release Limits & Action Levels

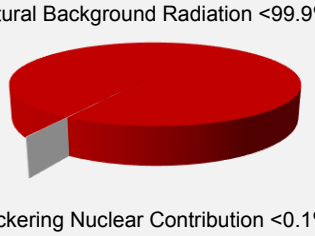
OPG uses radiation dose limits specified in federal legislation to derive Release Limits for the radionuclides that may be released to air and water from its nuclear facilities. Pickering Nuclear must maintain its radiological emissions well below these limits to meet the terms of its operating licence.

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

The radiation dose to the public resulting from the operation of Pickering Nuclear is a very small fraction of the estimated annual average background radiation dose around the station.

Annual environmental monitoring program results for Pickering Nuclear, including an assessment of radiation dose to the public, are available at: www.opg.com/news-and-media/Pages/reports.aspx



Environmental Emissions Data for Pickering Nuclear

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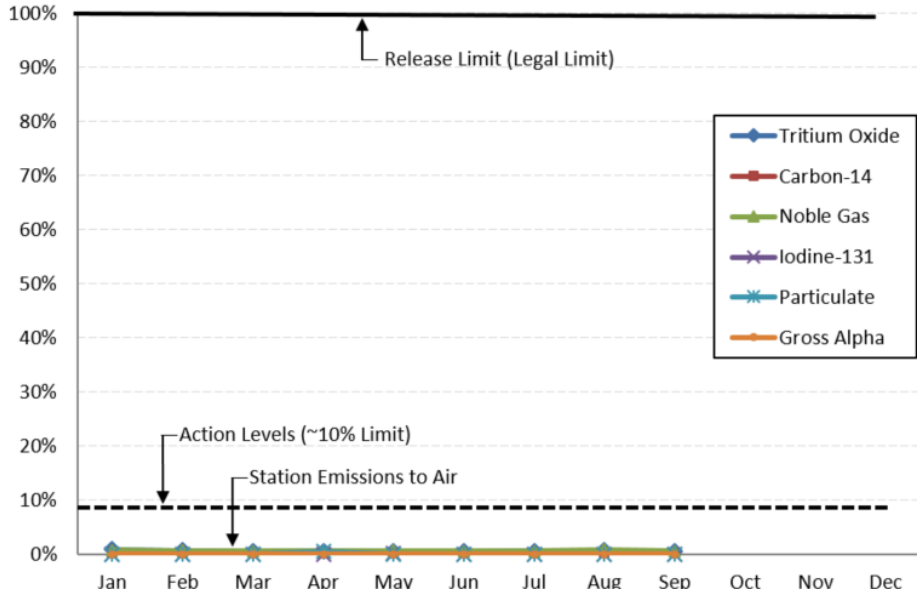
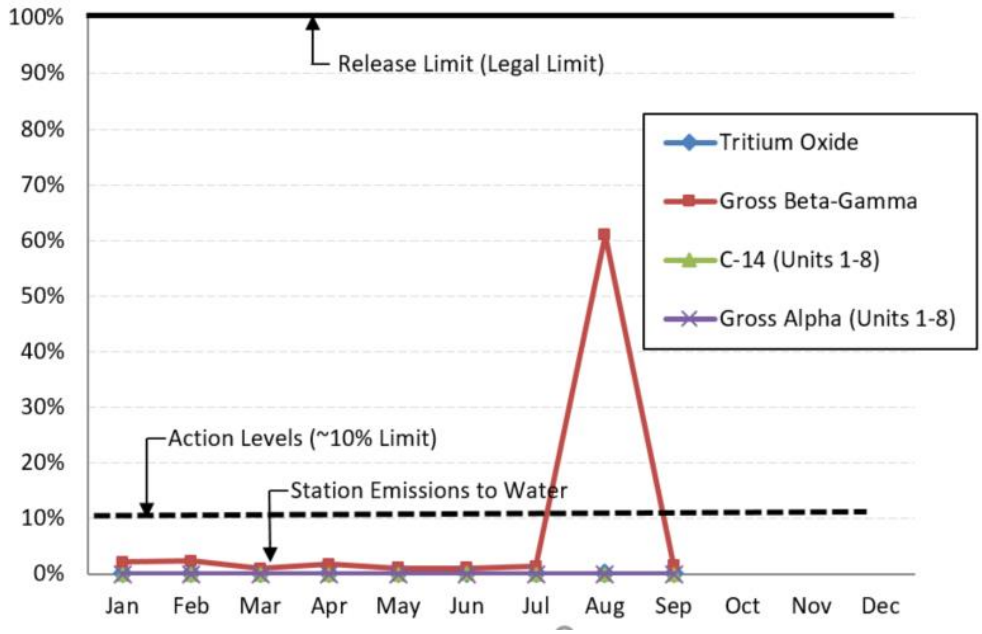
Performance Results

Pickering Nuclear's emissions to the environment are monitored to track performance. For Q3 2021, Pickering Nuclear's 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 Pickering Nuclear's radiological emissions for the year to date as a percentage of the Release Limits. Note: Units 2 and 3 are in a safe shutdown state.

Air Emissions as a Per Cent of Release Limits for Pickering Nuclear Generating Station (A and B)



Water Emissions as a Per Cent of Release Limits for Pickering Nuclear Generating Station (A and B)



Environmental Emissions Data for Pickering Nuclear

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PICKERING WASTE MANAGEMENT FACILITY

Radiological air emissions, water, and radiation dose monitoring requirements for the Pickering Waste Management Facility were met in Q3 2021 and no issues were identified. (Appendix A, Tables A.3, A.4 and A.5)

GROUNDWATER MONITORING

Groundwater monitoring is conducted at monitoring wells around the Pickering site perimeter, including along the Lake Ontario shoreline, to confirm that there are no adverse off-site impacts from tritium in groundwater. 2020 groundwater monitoring report is available at: *https://www.opg.com/reporting/regulatory-reporting/*

RELEASES OF HAZARDOUS SUBSTANCES (NON-RADIOACTIVE)

Pickering Nuclear complies with numerous regulatory requirements for controlling and monitoring releases of hazardous substances to the environment. Pickering Nuclear reports releases of hazardous substances to Environment Canada's National Pollutant Release Inventory (NPRI). Tools and resources for accessing, analyzing and interpreting NPRI data are available on the NPRI website. Pickering Nuclear's carbon dioxide emissions are well below the threshold for mandatory reporting to federal and provincial authorities. Greenhouse gas data and information for reporting facilities are available on the Greenhouse Gas Emissions Reporting Program (GHGRP) website.

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 Pickering Nuclear in Q3 2021.

APPENDIX A

ENVIRONMENTAL EMISSIONS DATA

Environmental Emissions Data for Pickering Nuclear

Q3 2021

Table A.1: Airborne Radionuclide Releases for Pickering Nuclear Generating Station (A and B)

		Tritium (Bq)	Carbon-14 (Bq)	Noble Gas (Bq-MeV)	Iodine-131 (Bq)	Particulate (Bq)	Gross Alpha (Bq)
SUMMARY: ANNUAL							
Release Limit (Bq/year)[a]		1.02×10^{17}	2.69×10^{15}	2.66×10^{16}	2.82×10^{12}	4.28×10^{11}	7.49×10^{10}
Total Releases as of Q3 2021		4.1×10^{14}	2.1×10^{12}	$< 1.1 \times 10^{14}$	$< 7.3 \times 10^{6}$	$< 8.5 \times 10^{6}$	$< 7.5 \times 10^{5}$
DETAILS: WEEKLY[b]							
Action Level (Bq/week)[c]		2.03×10^{14}	5.38×10^{12}	5.32×10^{13}	5.65×10^{9}	8.57×10^{8}	Not Applicable [d]
Jan.	Week 1	2.2×10^{13}	3.3×10^{10}	$<2.5 \times 10^{12}$	$<1.7 \times 10^{5}$	$<7.7 \times 10^{4}$	$<1.9 \times 10^{4}$
	Week 2	1.5×10^{13}	3.4×10^{10}	$<3.2 \times 10^{12}$	$<1.7 \times 10^{5}$	$<8.3 \times 10^{4}$	$<1.9 \times 10^{4}$
	Week 3	9.7×10^{12}	4.7×10^{10}	$<7.4 \times 10^{12}$	$<1.7 \times 10^{5}$	$<8.6 \times 10^{4}$	$<1.9 \times 10^{4}$
	Week 4	1.8×10^{13}	7.4×10^{10}	$<2.3 \times 10^{12}$	$<1.7 \times 10^{5}$	$<7.8 \times 10^{4}$	$<1.9 \times 10^{4}$
Feb.	Week 5	1.3×10^{13}	4.6×10^{10}	$<3.2 \times 10^{12}$	$<1.7 \times 10^{5}$	$<8.5 \times 10^{4}$	$<1.9 \times 10^{4}$
	Week 6	1.2×10^{13}	5.2×10^{10}	$<2.4 \times 10^{12}$	$<1.9 \times 10^{5}$	$<1.2 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 7	1.0×10^{13}	4.9×10^{10}	$<3.1 \times 10^{12}$	$<1.9 \times 10^{5}$	$<2.1 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 8	1.2×10^{13}	3.7×10^{10}	$<1.1 \times 10^{12}$	$<1.8 \times 10^{5}$	$<1.2 \times 10^{5}$	$<1.9x\ 10^{4}$
	Week 9	9.9×10^{12}	9.2×10^{10}	$<2.4 \times 10^{12}$	$<2.1 \times 10^{5}$	$<1.2 \times 10^{5}$	$<1.9 \times 10^{4}$
Mar.	Week 10	7.3×10^{12}	3.3×10^{10}	$<2.2 \times 10^{12}$	$<1.7 \times 10^{5}$	$<9.0 \times 10^{4}$	$<1.9 \times 10^{4}$
	Week 11	7.8×10^{12}	4.1×10^{10}	$<2.4 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.5x\ 10^{5}$	$<1.9 \times 10^{4}$
	Week 12	7.7×10^{12}	5.9×10^{10}	$<2.2 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.0 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 13	8.7×10^{12}	6.2×10^{10}	$<2.4 \times 10^{12}$	$<1.7 \times 10^{5}$	$<2.3 \times 10^{5}$	$<1.9 \times 10^{4}$
April.	Week 14	7.3×10^{12}	5.3×10^{10}	$<2.3 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.0 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 15	1.1×10^{13}	6.2×10^{10}	$<4.3 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.2 \times 10^{6}$	$<2.0 \times 10^{4}$
	Week 16	1.4×10^{13}	4.7×10^{10}	$<1.6 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.1 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 17	7.9×10^{12}	5.6×10^{10}	$<1.9 \times 10^{12}$	$<2.0 \times 10^{5}$	$<1.9 \times 10^{5}$	$<2.0 \times 10^{4}$
May.	Week 18	8.1×10^{12}	5.1×10^{10}	$<2.9 \times 10^{12}$	$<2.3 \times 10^{5}$	$<1.8 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 19	7.2×10^{12}	7.5×10^{10}	$<3.0 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.3 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 20	7.8×10^{12}	8.3×10^{10}	$<2.9 \times 10^{12}$	$<1.7 \times 10^{5}$	$<2.1 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 21	8.5×10^{12}	1.3×10^{11}	$<3.1 \times 10^{12}$	$<1.7 \times 10^{5}$	$<2.5 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 22	1.3×10^{13}	6.1×10^{10}	$<3.1 \times 10^{12}$	$<1.7 \times 10^{5}$	$<2.6 \times 10^{5}$	$<2.0 \times 10^{4}$
June.	Week 23	7.6×10^{12}	6.8×10^{10}	$<3.1 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.2 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 24	7.6×10^{12}	$6.0x\ 10^{10}$	$<3.2 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.6x\ 10^{5}$	$<2.0 \times 10^{4}$
	Week 25	6.7×10^{12}	6.2×10^{10}	$<1.9 \times 10^{12}$	$<1.7 \times 10^{5}$	$<1.5 \times 10^{5}$	$<2.0 \times 10^{4}$
	Week 26	9.3×10^{12}	6.6×10^{10}	$<2.1 \times 10^{12}$	$<1.7 \times 10^{5}$	$<2.3 \times 10^{5}$	$<2.0 \times 10^{4}$
July.	Week 27	7.7×10^{12}	4.4×10^{10}	$<2.8 \times 10^{12}$	$<1.8 \times 10^{5}$	$<2.9 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 28	9.0×10^{12}	5.0×10^{10}	$<2.7 \times 10^{12}$	$<2.6 \times 10^{5}$	$<2.2 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 29	1.1×10^{13}	3.4×10^{10}	$<2.8 \times 10^{12}$	$<2.8 \times 10^{5}$	$<2.8 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 30	1.2×10^{13}	4.0×10^{10}	$<1.6 \times 10^{12}$	$<2.2 \times 10^{5}$	$<3.6 \times 10^{5}$	$<1.9 \times 10^{4}$
Aug.	Week 31	1.0×10^{13}	3.7×10^{10}	$<3.1 \times 10^{12}$	$<2.0 \times 10^{5}$	$<3.7 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 32	1.3×10^{13}	5.5×10^{10}	$<4.2 \times 10^{12}$	$<1.7 \times 10^{5}$	$<3.4 \times 10^{5}$	$<1.9 \times 10^{4}$

		Tritium (Bq)	Carbon-14 (Bq)	Noble Gas (Bq-MeV)	Iodine-131 (Bq)	Particulate (Bq)	Gross Alpha (Bq)
	Week 33	9.1×10^{12}	4.0×10^{10}	$<2.0 \times 10^{12}$	$<1.7 \times 10^{5}$	$<3.2 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 34	1.3×10^{13}	7.7×10^{10}	$<5.9 \times 10^{12}$	$<2.9 \times 10^{5}$	$<3.6 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 35	1.7×10^{13}	6.1×10^{10}	$<5.6 \times 10^{12}$	$<2.6 \times 10^{5}$	$<2.9 \times 10^{5}$	$<1.9 \times 10^{4}$
Sep.	Week 36	1.3×10^{13}	3.9×10^{10}	$<2.8 \times 10^{12}$	$<1.9 \times 10^{5}$	$<2.0 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 37	7.4×10^{12}	3.7×10^{10}	$<2.8 \times 10^{12}$	$<1.9 \times 10^{5}$	$<2.5 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 38	9.9×10^{12}	4.0×10^{10}	$<1.5 \times 10^{12}$	$<1.7 \times 10^{5}$	$<2.1 \times 10^{5}$	$<1.9 \times 10^{4}$
	Week 39	1.1×10^{13}	4.2×10^{10}	$<1.7 \times 10^{12}$	$<1.7 \times 10^{5}$	$<2.5 \times 10^{5}$	$<1.9 \times 10^{4}$

(a) 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.

(b) Analysis of air emissions is conducted weekly to monitor against internal performance targets. Emissions are reported using the fiscal calendar and months contain either four or five weeks. Values prefixed by an "<" indicate that reported results were less than the instrument detection limits.

(c) 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 event in the third quarter of 2021.

(d) Action Level for gross alpha is not specified because it is not a routinely monitored radionuclide group at Pickering Nuclear as the activity is below the threshold value for monitoring.

Table A.2: Waterborne Radionuclide Releases to Lake Ontario for Pickering Nuclear Generating Station (A and B)

	Pickering Nuclear Generating Station (A and B)			
	Tritium (Bq)	Gross Beta-Gamma (Bq)	Carbon-14 (Bq)	Gross Alpha (Bq)
SUMMARY: ANNUAL				
Release Limit (Bq/year)[(a)]	7.87×10^{17}	1.87×10^{12}	3.75×10^{13}	2.36×10^{10}
Total Releases as of Q3 2021	3.7×10^{14}	1.1×10^{11}	4.3×10^{9}	$<1.9 \times 10^{6}$
DETAILS: MONTHLY[(b)]				
Action Level (Bq/month)[(c)]	6.29×10^{15}	1.49×10^{10}	3.00×10^{11}	Not Applicable[(d)]
January	5.7×10^{13}	3.2×10^{9}	2.7×10^{7}	$<2.4 \times 10^{5}$
February	4.1×10^{13}	3.6×10^{9}	3.8×10^{7}	$<3.2 \times 10^{5}$
March	3.2×10^{13}	1.6×10^{9}	3.1×10^{8}	$<2.4 \times 10^{5}$
April	3.3×10^{13}	2.7×10^{9}	1.9×10^{8}	$<1.9 \times 10^{5}$
May	4.2×10^{13}	1.7×10^{9}	8.1×10^{8}	$<2.2 \times 10^{5}$
June	3.6×10^{13}	1.7×10^{9}	1.4×10^{9}	$<1.7 \times 10^{5}$
July	4.5×10^{13}	2.0×10^{9}	5.6×10^{8}	$<1.6 \times 10^{5}$
August [(e)]	5.3×10^{13}	9.5×10^{10}	1.4×10^{8}	$<2.1 \times 10^{5}$
September	3.5×10^{13}	2.3×10^{9}	8.5×10^{8}	$<1.5 \times 10^{5}$

(a) 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.
(b) Analysis of water emissions is conducted monthly to monitor against internal performance targets. Monthly emissions are reported using the fiscal calendar and months contain either four or five weeks. Months with five weeks typically report higher releases relative to months with four weeks. For 2021, February, May, August and November have five weeks.
(c) 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 was one CNSC Action Level exceedance event in the third quarter of 2021.
(d) Action Level for gross alpha is not specified since it is not a routinely monitored radionuclide group because its activity is below the threshold value for monitoring.
(e) The higher gross beta gamma result in August 2021 was further assessed. Additional analysis showed that the sample results were not representative and also confirmed the most limiting radionuclide was not present. Emissions returned to expected range in September 2021.

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 10^{10} Bq.

While station emissions typically remain at consistently low levels, small fluctuations do occur because of changing operating conditions (e.g. unit outages), work activities, and equipment issues.

Table A.3: Pickering Waste Management Facility Air Sample Results

	Particulate (weekly average Bq)[(a)]
July	< 2.2 x 10^3 (for two weeks) 7.5 x 10^3 (for one week) 7.1 x 10^3 (for one week)
August	< 2.2 x 10^3 (for four weeks) 6. 6 x 10^3 (for one week)
September	< 2.2 x 10^3 (for three weeks) 6.1 x 10^3 (for one week)

(a) Values prefixed by an "<" indicate that reported results were less than the instrument detection limits. Pickering Waste Management Facility particulate results are included in Pickering Nuclear's airborne radionuclide release data.

Table A.4: Pickering Waste Management Facility Water Sample Results

		Gross Beta-Gamma (Bq/mL)[a]
Sample Point		**Q3**
Retube Component Storage Facility	Catch Basin 111	$<1.51 \times 10^{-2}$
	Catch Basin 112	$< 1.51 \times 10^{-2}$
	Catch Basin 77	$< 1.51 \times 10^{-2}$
	Catch Basin 78	$< 1.51 \times 10^{-2}$
	Catch Basin 82	$< 1.51 \times 10^{-2}$
	Catch Basin 83	$< 1.51 \times 10^{-2}$
Storage Building #3 and 4.	Sample Point 01	$< 1.51 \times 10^{-2}$
	Sample Point 02	$< 1.51 \times 10^{-2}$

(a) Values prefixed by an "<" indicate that reported results were less than the instrument detection limits.

Table A.5: Pickering Waste Management Facility Perimeter Fence Dose Rates

		Average Air Kerma Rate (µGy/hour)[a]
Location		**Q3**
Retube Component Storage Facility (RCSF)	Pi2, RCSF South	0.073
	Pi3, RCSF East	0.074
Storage Building #3	PW1, North - West	0.067
	PW2, North - Middle	0.078
	PW3, North - East	0.066
	PW4, East - North	0.069
	PW5, East - Middle	0.080
	PW6, East - South	0.174
	PW7, South - East	0.086
	PW8, South - West	0.078
	PW9, West - South	0.066
	PW10, West - Middle	0.119
	PW11, West - North	0.066
Used Fuel Dry Storage Facility (UFDSF)[b]	Pu3, UFDSF East Outside	0.241
	Pu4, UFDSF Stage II East1	0.256
	Pu5, UFDSF Stage II East2	0.256

(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).

(b) The dosimeters for the Used Fuel Dry Storage Facility are located on facility perimeter wall and have target dose rate of <1.75 µGy/hour. This rate was derived from the target standard of 0.5 µGy/hour for the perimeter fence, taking into account the location of the dosimeters.