



2020 Results of OPG's Pickering and Darlington Environmental Monitoring Programs

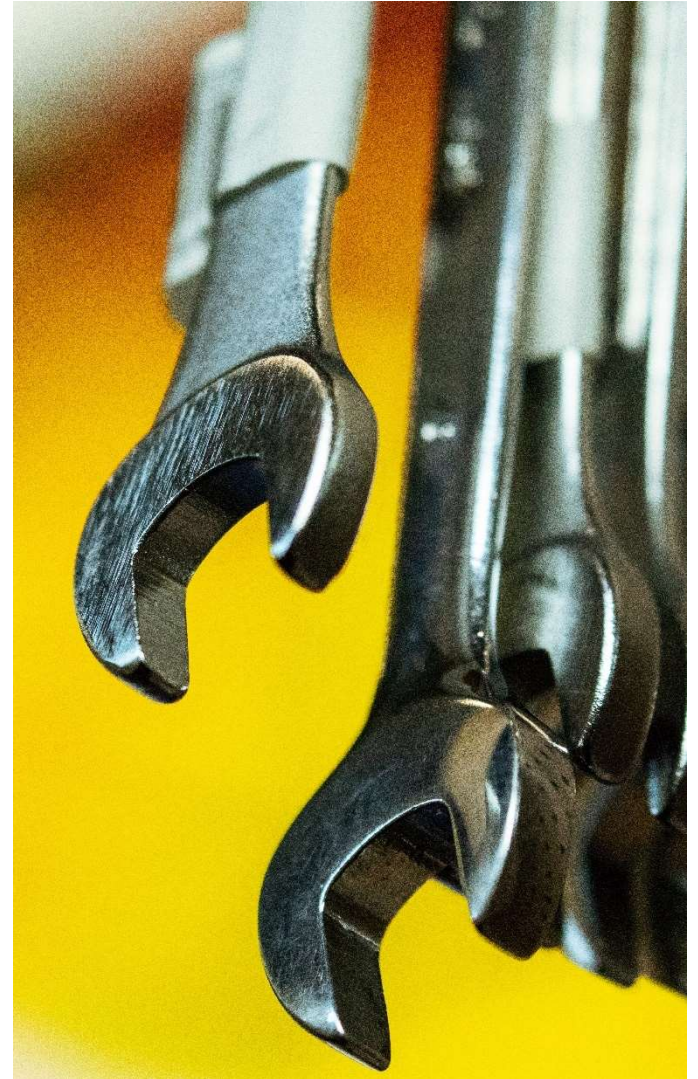
CAC Update September 21, 2021

ONTARIOPOWER
GENERATION

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Environmental Monitoring Programs

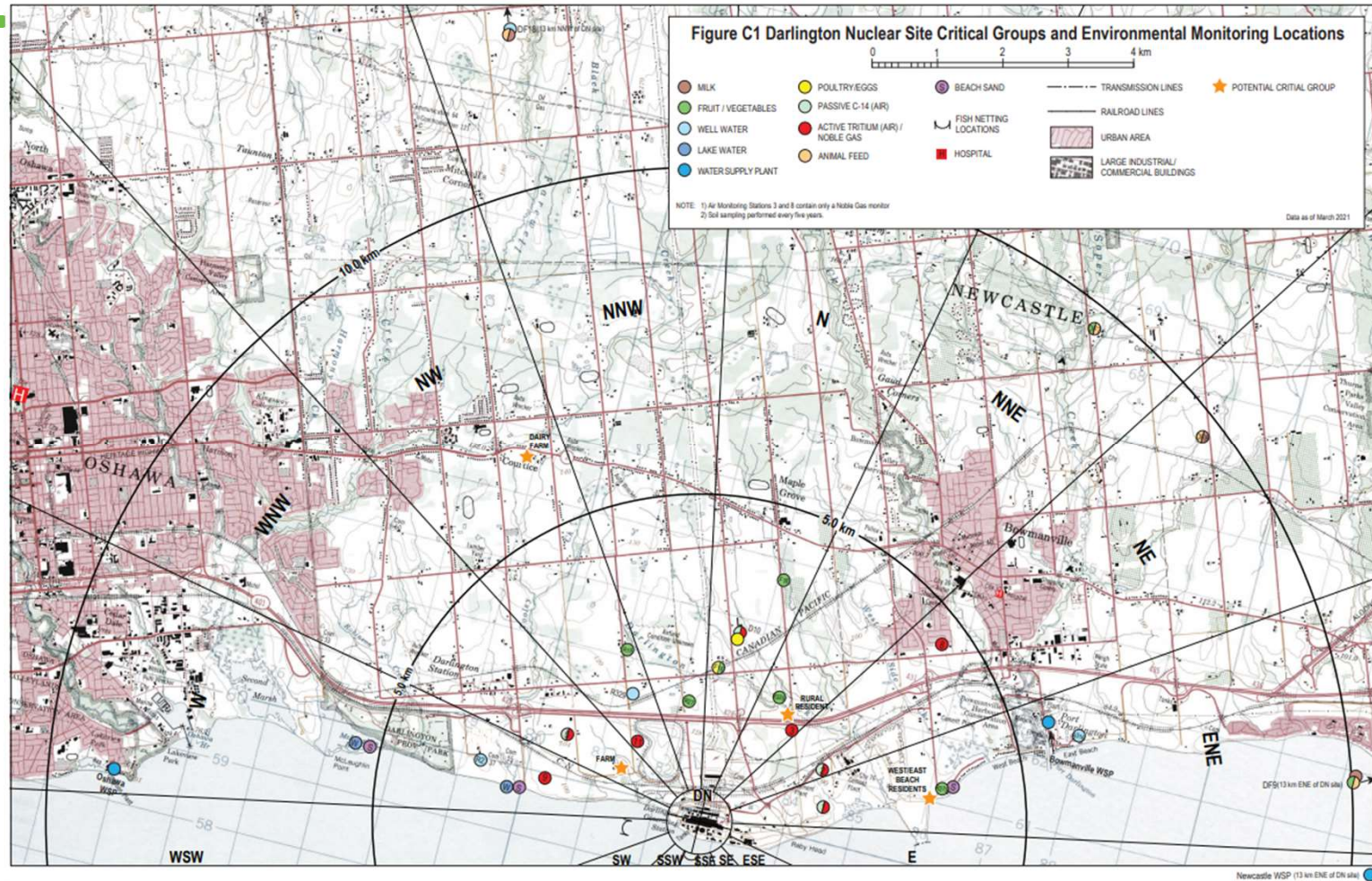
Key Objectives

- Demonstrate, independent of effluent monitoring, the effectiveness of containment and effluent control
- Demonstrate compliance with limits on the concentration/intensity of contaminants/physical stressors in the environment
- Provide data to assess the level of risk on human health and the environment and/or to confirm predictions made by environmental risk assessments

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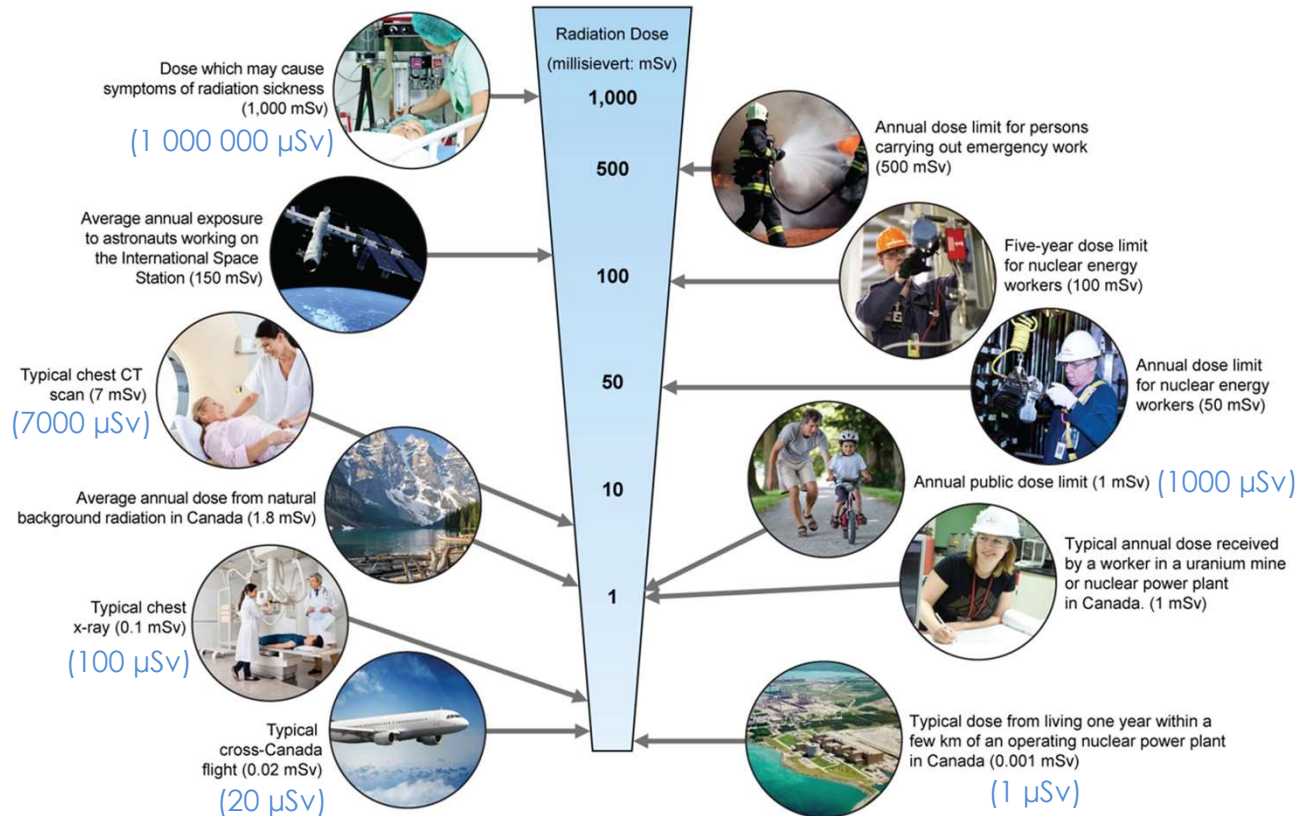
DN Critical Groups and Sampling Locations





Note: 1 mSv = 1000 μ Sv

Radiation Dose Examples



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Taken from <http://www.cnsccsn.gc.ca/eng/resources/radiation/introduction-to-radiation/radiation-doses.cfm>

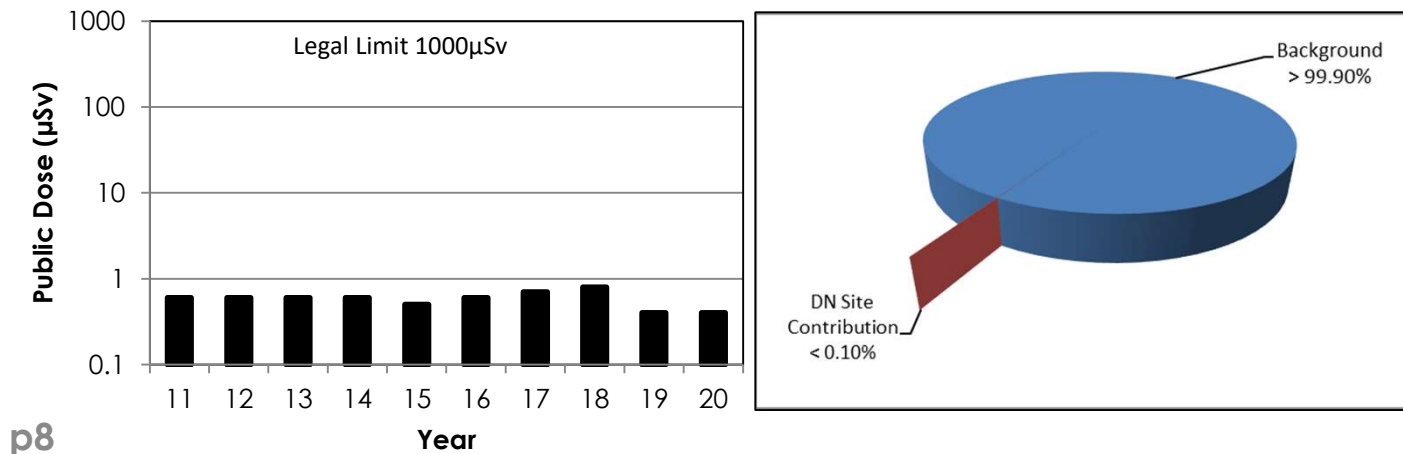


2020 EMP Summary

- Annual public doses resulting from PN and DN operations were 1.2 μSv and 0.4 μSv respectively; < 0.1% of the annual regulatory limit
- Station radiological emissions remained at very small fractions of their respective Derived Release Limits (DRLs)
- Dose calculations and annual report were reviewed and verified by an independent third party
- 2020 EMP report was submitted to CNSC on April 23, 2021 and is available on www.opg.com since June 28, 2021

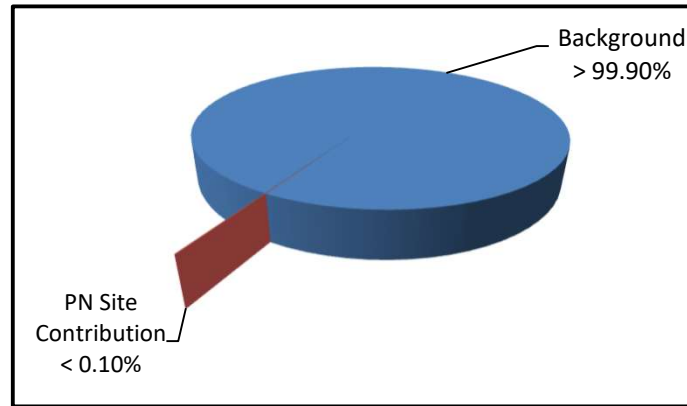
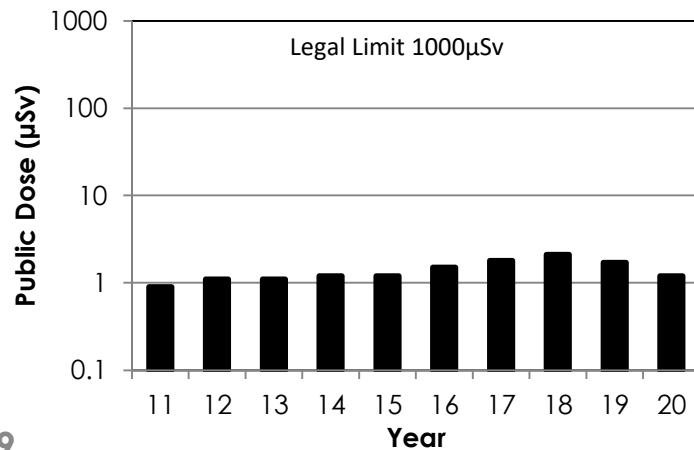
Darlington Station 2020 Public Dose

- 2020 public dose was 0.4 μSv , represented by the Farm adult
- Darlington public dose continues to be very low and is consistent with the 2019 dose
- HTO, C-14, and noble gases are the main dose contributors
- < 0.1% of annual regulatory limit of 1000 μSv and < 0.1% of annual natural background radiation of 1,400 μSv



Pickering Station 2020 Public Dose

- 2020 public dose was 1.2 μSv , represented by the Urban Resident adult
- Pickering public dose continues to be very low and is consistent with the 2019 dose
- HTO and noble gases are the main dose contributors
- < 0.1% of annual regulatory limit of 1000 μSv and < 0.1% of annual natural background radiation of 1,400 μSv



2020 Results of Radioactive Emissions Monitoring

Site Emissions ^(d)	DN		PNA & PNB (Units 1-8) ^(e)	
	Bq	% DRL	Bq	% DRL
AIR				
Tritium Oxide	1.9E+14	0.38	6.5E+14	0.64
Elemental Tritium ^(a)	1.5E+13	<0.01	NA	NA
Noble Gas ^(b)	2.4E+13	0.06	4.5E+13	0.17
I-131 ^(c)	1.5E+08	<0.01	1.0E+07	<0.01
Particulate	3.1E+07	<0.01	5.8E+06	<0.01
C-14	8.3E+11	0.07	2.3E+12	0.10
WATER				
Tritium Oxide	1.2E+14	<0.01	4.3E+14	0.05
Gross Beta/Gamma	2.5E+10	0.07	3.2E+11	17.11
C-14	3.8E+08	<0.01	1.8E+09	<0.01

NOTES: NA = Not Applicable, Bq = Bequerels

(a) Emissions from Darlington Tritium Removal Facility

(b) Units for noble gas emissions are Bq-MeV

(c) Weekly samples are usually < Method Detection Limit (MDL)

(d) Annual air emissions are the sum of continuous samples analysed weekly.

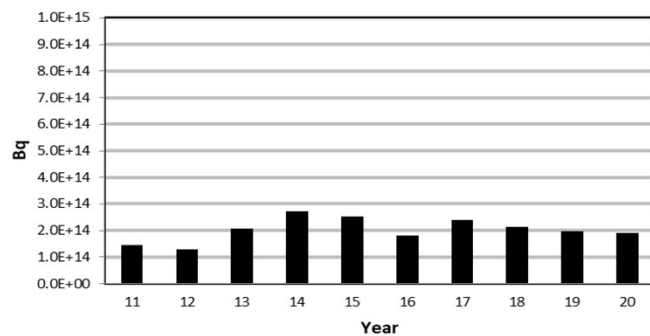
Note that if interim Noble Gas sampling is in place, samples may not be continuous.

Annual water emissions are the sum of monthly composite samples for C-14, and weekly composite samples for tritium oxide and gross beta/gamma.

(e) As of 2019 PN DRLs and emissions are for PNA and PNB combined rather than separate as in the past.

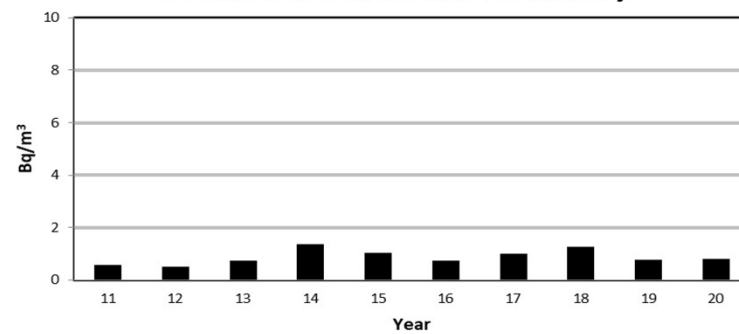
Emissions and EMP Data

DN HTO to Air Emissions



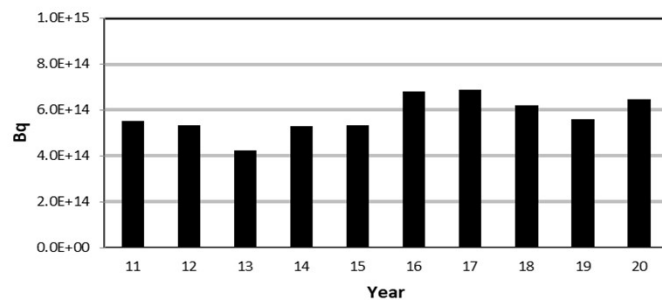
2020 = 1.9×10^{14} Bq

DN HTO to Air at Site Boundary



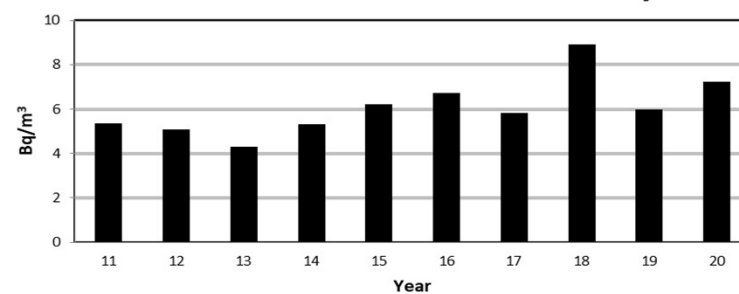
2020 = 0.54 Bq/m³

PN HTO to Air Emissions



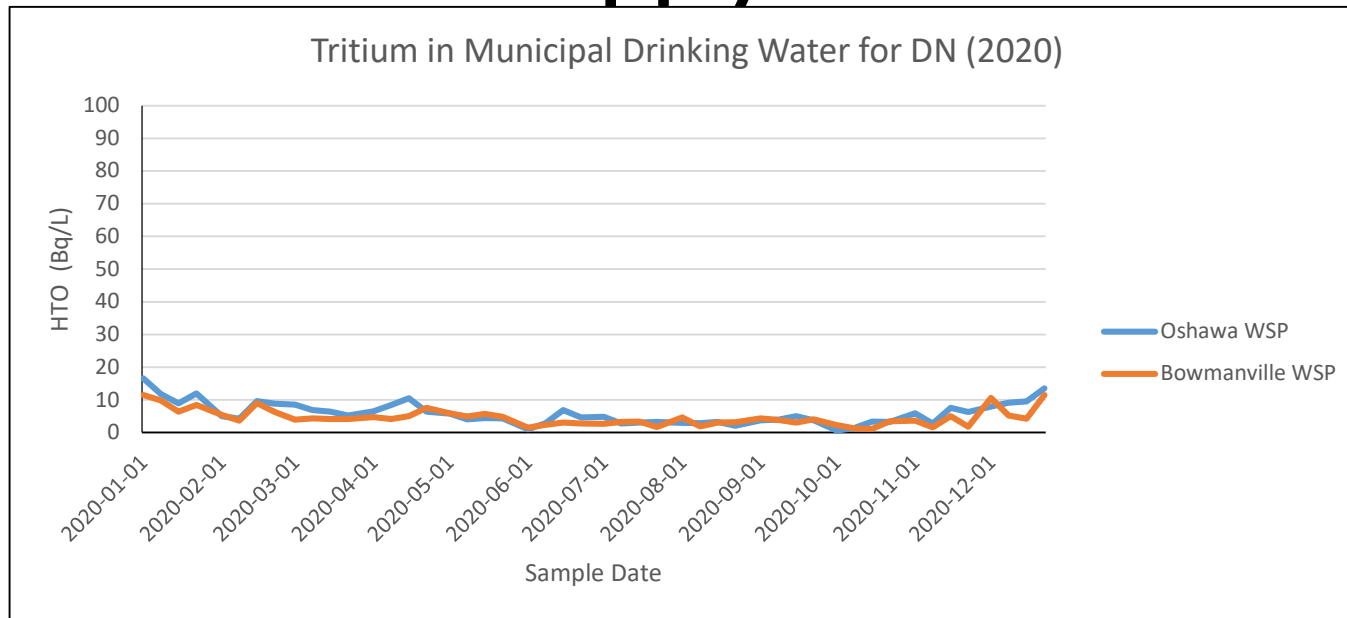
2020 = 6.5×10^{14} Bq

PN HTO to Air at Site Boundary



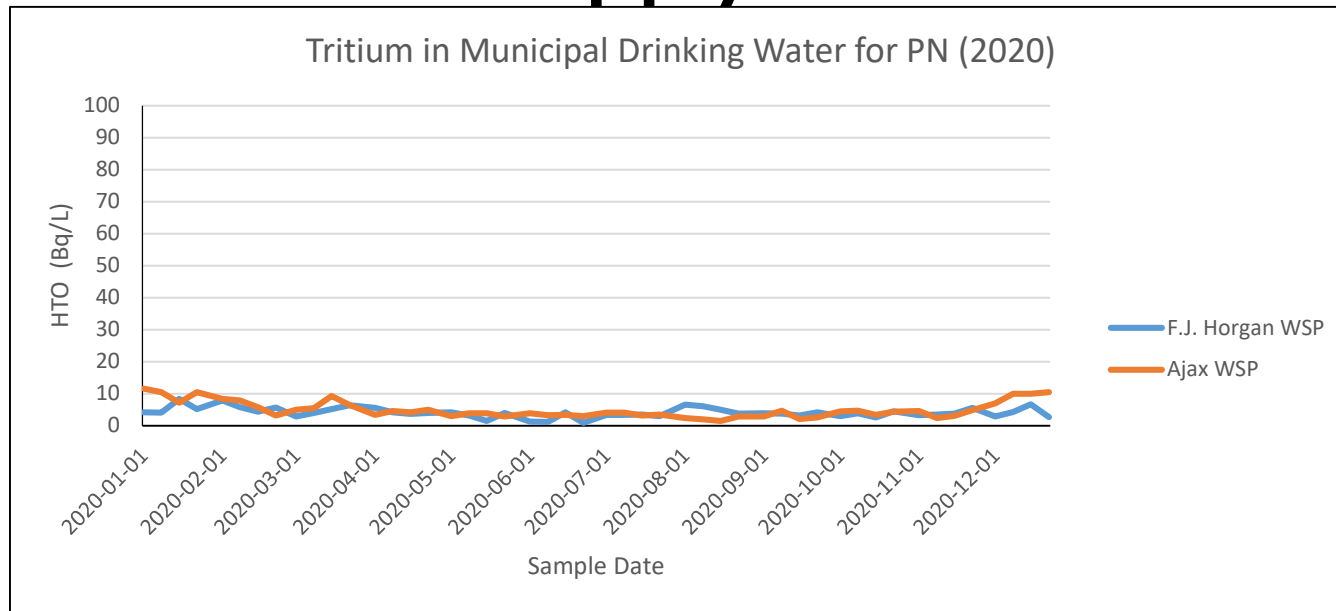
2020 = 7.2 Bq/m³

Tritium at Water Supply Plants near DN



- Average HTO Concentrations: Oshawa = 5.9 Bq/L , Bowmanville = 4.6 Bq/L
- Ontario Drinking Water Quality Standard is 7000 Bq/L
- Water Supply Plant annual average concentrations far below OPG's commitment of < 100 Bq/L

Tritium at Water Supply Plants Near PN



- Average HTO Concentrations: F.J. Horgan = 4.1 Bq/L, Ajax = 5.0 Bq/L
- Ontario Drinking Water Quality Standard is 7000 Bq/L
- Water Supply Plant annual average concentrations far below OPG's commitment of < 100 Bq/L

Results of Non-Radiological Emissions Monitoring

Hazardous Material ^(a)	DN	PN
	Mg	Mg
AIR		
SO ₂ to Air ^{(b)(c)}	9.5E-01	3.3E-01
NO ₂ to Air ^(c)	2.6E+01	9.0E+00
CO ₂ to Air ^{(b)(c)}	4.7E+03	1.6E+03
Ammonia to Air	1.1E+01	7.1E+00
Hydrazine to Air ^(d)	3.8E+01	5.3E-03
Ozone Depleting Substances (ODS) Releases ^(e)	9.9E-02	0.0E+00
WATER		
Ammonia to Water	2.7E+00	3.4E-01
Hydrazine to Water ^(d)	2.5E-01	2.0E-01

- 2020 emissions continue to be reported through 2021, therefore the 2020 EMP Report summarized the complete set of emissions for 2019
- In 2019, there was one ODS release of R134a (tetrafluoroethane) refrigerant at DN, in excess of 100kg. The spill was reported to the Spills Action Centre and regulatory authorities.

NOTES:

Mg = Megagrams

(a) Hazardous Materials as calculated for NPRI reporting requirements

(b) Reported in OPG Sustainable Development Report as an OPGN aggregate value.

(c) Based on annual fuel consumption.

(d) Based on annual consumption.

(e) Based on estimated quantity when a release occurs.

2020 Environmental Monitoring Program Results

- Site emissions remained at a very small fraction of their respective DRLs.
- 916 laboratory analyses performed for the 2020 dose calculation.
- The 2020 site public doses remains a small fraction of both the annual legal dose limit and the annual natural background radiation in the area.
- Tritium in drinking water measured at local water supply plants remained at a small fraction of the Ontario Drinking Water Quality Standard of 7000 Bq/L and OPG's voluntary commitment of 100 Bq/L.
- The overall EMPs encompass other programs that are reported separately.



Other Monitoring Programs

Thermal Monitoring

- Discharge of warm water through condenser cooling water system has potential to impact spawning success and larvae development of fish species.
- OPG records and reports Ambient Lake Water Temperature to assess potential impacts from the Pickering and Darlington Stations.
- The average lake temperature at the Darlington Lake Current Monitor between December 1st 2019 and March 31st 2020 was 2.7°C, compared to a no effects threshold of < 6.0° C.
- There is no indication of a warming trend which would approach the threshold in the near term.



Other Monitoring Programs

Impingement and Entrainment Monitoring Program

- Pickering Fisheries Act Authorization authorizes the impingement and entrainment of fish resulting from the operation of the CANDU reactors.
- The biomass impinged in 2019 was estimated to be 15,114.5 kg, or 2.87 kg/million m³ of station flow.
- The 2020 Impingement Report was submitted to the CNSC in May 2021.



Looking Ahead

- The updated DN Environmental Risk Assessment (ERA) has been completed and will be publicly available in Q4 of 2021. The results of the following are included in the DN ERA:
 - A 2019 supplementary study on hydrazine concentrations in lake water at the outlet of the DN diffuser to analyze the result using a lower detection limit. This study was designed to remove uncertainty surrounding human exposure to hydrazine through drinking water and fish ingestion.
 - A 2019 supplementary study on the filtered and unfiltered concentrations of aluminum in the DN CCW to clarify the risk to ecological receptors in Lake Ontario.
- The Ministry of the Environment, Conservation and Parks performed audits of the Health Physics Laboratory in January and September, 2020. There were no non-compliant findings for either audit. Overall, the Inspection rating for both audits was 100%.

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