Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

UNRESTRICTED

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SUMMARY OF EFFLUENT AND ENVIRONMENTAL MONITORING AT THE NUCLEAR POWER DEMONSTRATION WASTE FACILITY.

This summary describes the results of the effluent and environmental monitoring activities at the Nuclear Power Demonstration Waste Facility (NPDWF) for calendar year 2016.

The NPDWF contains the decommissioned NPD Nuclear Generating Station located just east of Rolphton, Ontario. Under a target cost agreement with Atomic Energy of Canada Ltd. (AECL), Canadian Nuclear Laboratories (CNL) is planning to advance the decommissioning of the NPDWF and has committed to complete the decommissioning activities required to close the site by 2020. CNL continues to maintain the NPDWF in a safe, secure shut down state during Storage with Surveillance (SWS) until such time that final decommissioning is undertaken.

In terms of environmental performance, there were no abrupt changes in the nature or magnitude of releases to the environment during 2016. All environmental releases were a small fraction of their respective Derived Release Limits (DRLs).

CNL is committed to achieving high standards of operational safety. The information and data presented in this report support the conclusion that safe performance is being achieved at the NPDWF.

ACRONYMS

AECL	Atomic Energy of Canada Limited
CNL	Canadian Nuclear Laboratories
DRL	Derived Release Limit
HEPA	High-Efficiency Particulate Air
MDA	Minimum Detectable Activity
NPDWF	Nuclear Power Demonstration Waste Facility
NPRI	National Pollutant Release Inventory
OCM	Operational Control Monitoring
SWS	Storage With Surveillance
WAS	Wells Area Sump
VKT	Vehicle Kilometers Travelled

EFFLUENT MONITORING PROGRAM

The Effluent Monitoring Program at the NPDWF consists of:

- An annual check against the National Pollutant Release Inventory (NPRI) reporting requirements;
- An annual check against the Greenhouse Gas Emissions reporting requirements;
- Monitoring and reporting any losses of halocarbon refrigerants and fire suppressants over 10 kg, in compliance with the Federal Halocarbon Regulations;
- Airborne release monitoring through tritium and gross beta-gamma analysis of the ventilation stack emissions (Table 1); and
- Waterborne release monitoring through tritium, gross beta-gamma, and non-radiological parameter monitoring of the Wells Area Sump (WAS), as well as tritium and gross beta-gamma monitoring of Manhole #2 (Table 2).

National Pollutant Release Inventory

Additional work was completed at the NPDWF in 2016 (compared to 2015) with over 20,000 hours worked during the calendar year, thereby meeting the need to consider activities and emissions against NRPI reporting thresholds.

The sources of NPRI emissions at the NPDWF in 2016 were not different from those in 2015 and include:

- The burning of diesel fuel in emergency diesel generator (i.e., Class III backup);
- Unpaved road dust; and,
- Solvent use.

All three sources are minimal; therefore, formal calculations were not warranted for NPDWF. More specifically, there is a minimal amount of diesel fuel burned on site in contractors equipment; virtually no unpaved road travel (does not meet the 10,000 VKT reporting limit); and there is a small volume of chemicals containing solvent in storage.

Greenhouse Gas Emissions

The NPDWF would be required to report releases under the *Greenhouse Gas Emissions Notice* provided that the facility emitted over the 50 000 tons of CO_2 equivalent (CO_2e) or more within 2016. Since the source of greenhouse gas emissions at the NPDWF is minimal (i.e., fuel emissions from site vehicle fleets with <100 vehicle kilometers travelled per year, and minor emissions from a former landfill), reporting thresholds were not met in 2016.

Halocarbons

In compliance with the *Federal Halocarbon Regulations*, losses of halocarbon refrigerants and fire suppressants over 10 kg are reported to Environment and Climate Change Canada. In 2016, there were no reportable losses.

Radiological Airborne Releases

The High-Efficiency Particulate Air (HEPA)-filtered ventilation system at NPDWF was operated for a total of 742.9 hours in 2016. This was a reduced fan run time from 2015 since the fans were run only during the dayshift in 2016 whereas the fans were run 24 hrs/day during asbestos abatement activities in 2015.

Results of airborne release monitoring of the ventilation stack emissions in 2016 is shown in Table 1 below.

Table 1
NPDWF Annual Airborne Effluent Monitoring Report for 2016

Radionuclide	Release for Period (Bq)	DRL (Bq/a)	% DRL	Average (Bq) 2011-2015
Tritium	2.53E+11[1]	4.52E+16	<0.01	1.32E+11
Gross Beta [2]	<4.30+04 [3]*	3.83E+12	<0.01	<4.09E+04*

[1] Samples from the January sub-period were compromised due to operator error and an average of all other monthly analysis results was used for the January data point.
[2] Gross Beta results were determined using Canberra Packard Gross Alpha-Beta counter and the radioactivity is based on Cs-137.
[3] Gross Beta DRL is based on Cs-137, the most restrictive radionuclide.
* Based on values that were at the MDA.

The total airborne tritium release in 2016 was 2.53 E+11 Bq compared with a DRL of 4.52E+16 Bq/a (<0.01% of the DRL). The average airborne release for 2011 to 2015 for tritium is 1.32E+11 Bq. Airborne tritium releases are stable and very low as shown in Figure 1.

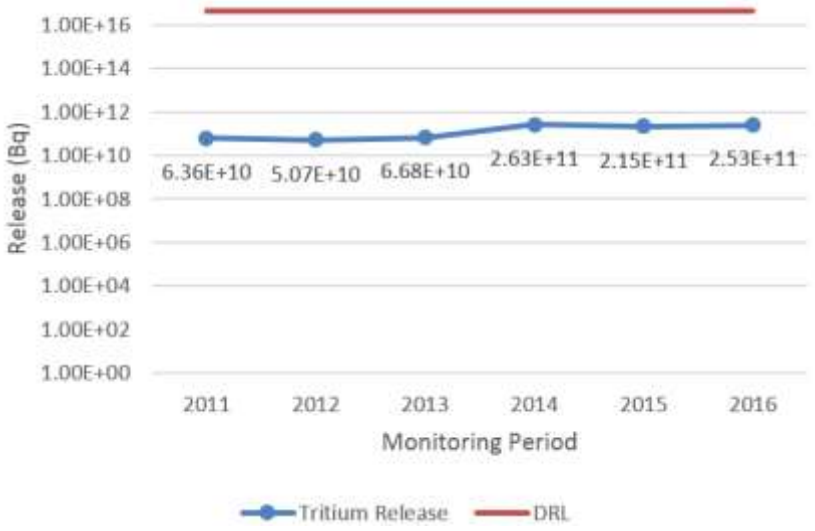

Figure 1: NPDWF Airborne Releases: Tritium

The total airborne gross beta release in 2016 was <4.30E+04 Bq (based on values at the MDA) compared with a DRL of 3.83E+12 Bq/a (<0.01% of the DRL). Average airborne release for 2011 to 2015 for gross beta was <4.09 E+04 Bq. Airborne gross beta releases are stable and very low as shown in Figure 2.

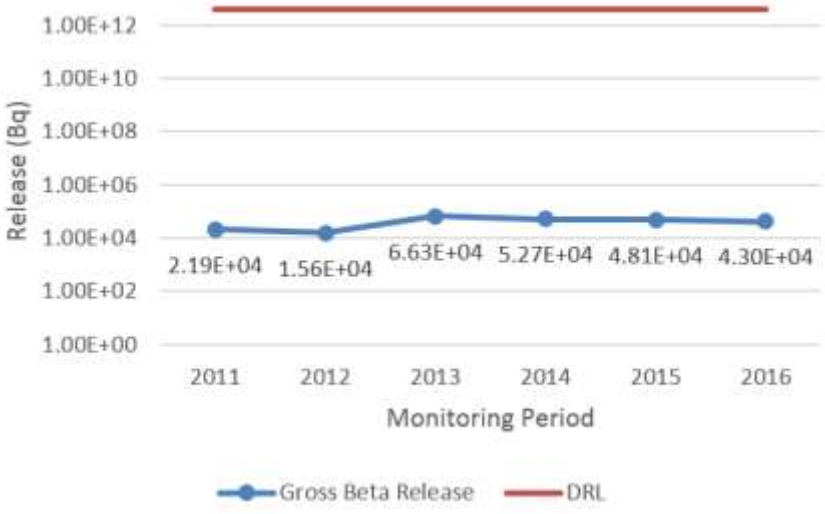

Figure 2: NPDWF Airborne Releases: Gross Beta

Note: 2012, 2015, and 2016 results were based on values that were at the MDA.

Liquid Releases

Liquid radioactive effluents accumulate mainly in the facility Wells Area Sump. When the sump is near full, controlled batch discharges occur from this sump to the Ottawa River via the process drain (Figure 3). Prior to discharge representative liquid effluent samples are collected by facility operating personnel, analyzed, and verified to be below the DRL. The total volume of liquid effluent discharged from the WAS in 2016 was 16,000 L.

Groundwater flowing towards the facility is intercepted by a subsurface drainage system and diverted around the Main Building and into the Ottawa River as a continuous discharge (i.e., Drain 1 and Drain 2). Manhole #2 (MH-2) and Manhole #3 (MH-3) act as observation and sampling points in these subsurface drain systems (Figure 3). The volumetric flowrate from the manholes are measured annually, while tritium and gross beta are measured semi-annually in May and November. In 2016 no flow was observed in Drain 2 as it is likely above the groundwater elevation, thus no samples were collected from Manhole #3. An estimated 191,260,000 L of groundwater was diverted via Manhole #2 in 2016.

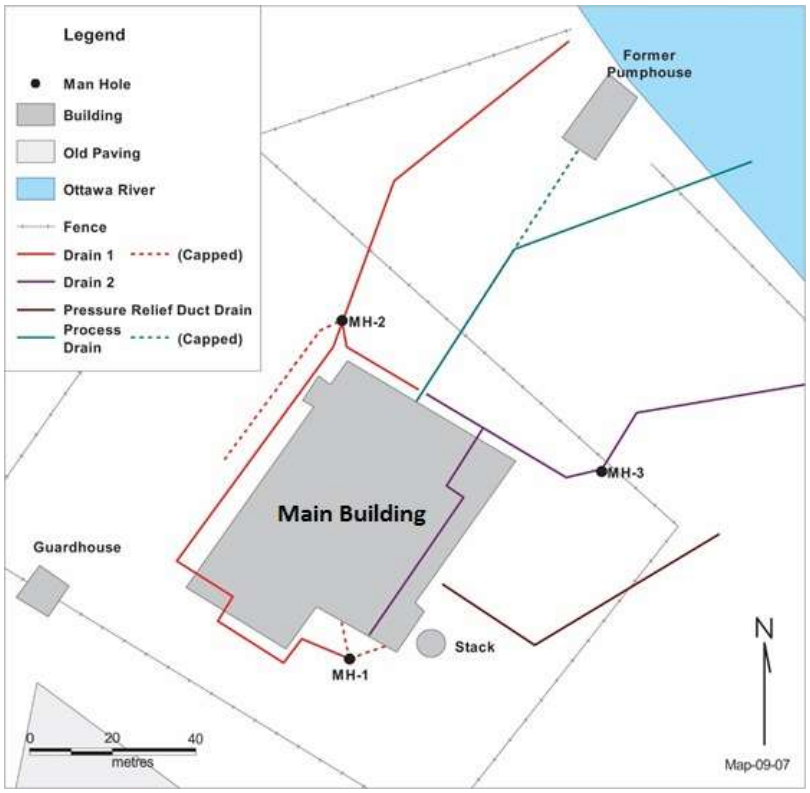

Figure 3: Active and inactive drainage systems around the NPDWF

As shown in Table 2, the total liquid tritium release from the WAS in 2016 was 6.57E+10 Bq compared with a DRL of 4.33E+17 Bq/a (<0.01%). The average liquid release from the WAS for 2011 to 2015 for tritium is 1.12E+11 Bq. Waterborne tritium releases from the WAS are stable and very low as shown in Figure 4.

The total liquid tritium in the effluent from Manhole #2, as a result of the external groundwater diversion system is reported in Table 2 as "ND", indicating that the sample results were below the analysis critical level and are therefore reported as "Not Detected". A graph has not been presented for this data since 2016 is the first year this parameter has been monitored.

The total liquid gross beta release from the WAS in 2016 was 2.35E+06 Bq compared with a DRL of 2.56E+13 Bq/a (<0.01%). The average liquid release from the WAS for 2011 to 2015 for gross beta is 3.39 E+06 Bq. Waterborne gross beta releases from the WAS are stable and very low as shown in Figure 5.

The total liquid gross beta in the effluent from Manhole #2, which is reflective of the groundwater diversion system external of the facility, was <3.33E+07 Bq (based on values at the MDA) compared with a DRL of 2.56E+13 Bq/a (<0.01%). A graph has not been presented for this data since 2016 is the first year this parameter has been monitored.

Table 2
NPDWF Annual Liquid Effluent Monitoring Report for 2016 (WAS)

Location	Radionuclide	Release for Period (Bq)	DRL (Bq/a)	% DRL	Average (Bq) 2011-2015
Wells Area Sump	Tritium	6.57E+10	4.33E+17	<0.01	1.12E+11
	Gross Beta	2.35E+06	2.56E+13 [1]	<0.01	3.39E+06
Manhole #2	Tritium	ND	4.33E+17	<0.01	N/A
	Gross Beta	<3.33E+07*	2.56E+13 [1]	<0.01	N/A

[2] Gross Beta DRL based on Cs-137, the most restrictive radionuclide.

* Based on values that were at the MDA.

ND Results are below the critical level and are reported as not detected.

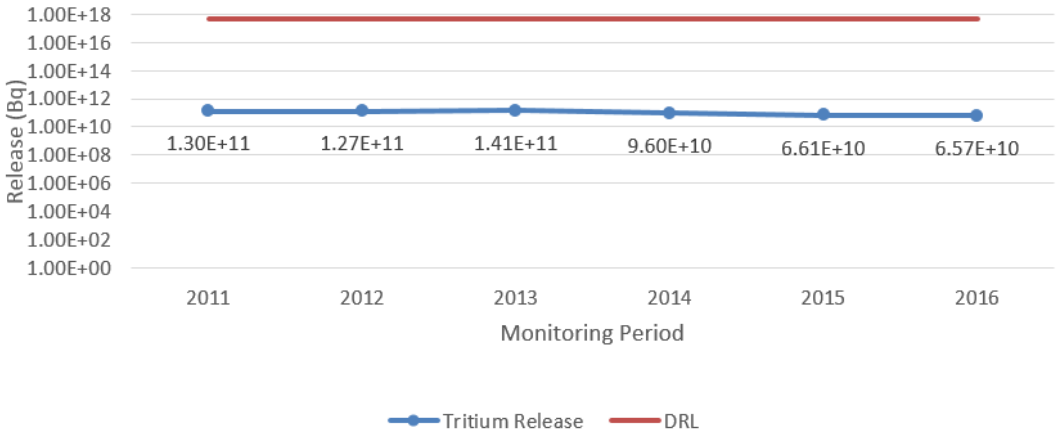

Figure 4: NPDWF Liquid Releases (WAS): Tritium

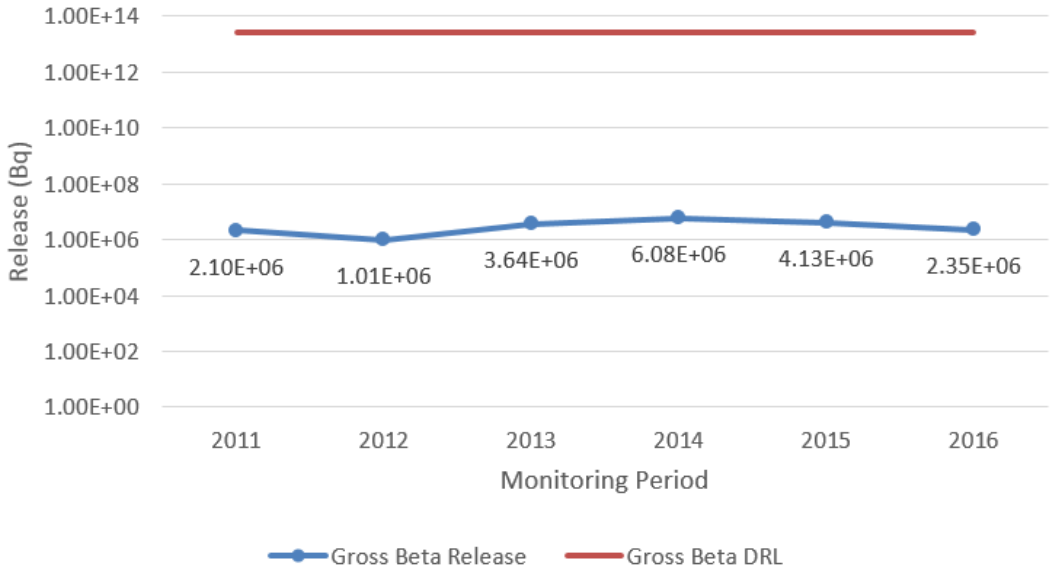

Figure 5: NPDWF Liquid Releases (WAS): Gross Beta

There is only one liquid effluent monitoring point at NPDWF which reports non-radiological parameters. This reporting period was the first year for monitoring the potential for metals, mercury, dioxins/furans and PCBs in the WAS. The results for metals analyses included 320 µg/L for iron and 46 µg /L for lead. Other non-radiological results included 0.31 µg /L for mercury, 0.2 µg /L for PCBs and 5.85 pg/L of dioxins/furans. CNL will continue to monitor these non-radiological parameters during future monitoring periods in order to evaluate the environmental performance further.

NPD SITE MONITORING

Additional monitoring at the NPD site consists of tritium, gross beta, gross alpha, total strontium and cesium-137 analyses of the Ottawa River. Results of monitoring of radioactivity in the Ottawa River upstream (Rolphton) and downstream (Deep River) of NPDWF from 2011 to 2016 is shown in Table 3. The difference between concentrations at these two monitoring stations is not significant. The observed concentrations are at natural background levels, and far below the Maximum Acceptable Concentrations specified by Health Canada.

Table 3: Radioactivity (Bq/L in Ottawa River Water – 2010-2015

Location & Parameter	2011	2012	2013	2014	2015	5-Year Average	2016 Average	2016 Maximum[a]
Rolphton								
Tritium (Bq/L)	< 3	< 4	V 1	< 1.2 ± 0.6	V 1.7 ± 0.1	2.2 ± 1.3	2.1 ± 0.1	2.9 ± 0.6 (Jan)
Gross Beta (Bq/L)	0.045	0.056 ± 0.006	V 0.039 ± 0.002	0.042 ± 0.001	0.04 ± 0.001	0.044 ± 0.007	0.046 ± 0.012	0.1 ± 0.1 (May)
Gross Alpha (Bq/L)	0.0064	0.0056 ± 0.0005	0.0046 ± 0.0001	0.0115 ± 0.0004	0.0091 ± 0.0003	0.0074 ± 0.0028	0.0072 ± 0.0006	0.01 ± 0.0025 (Nov)
Total Strontium (Bq/L)	0.0034	< 0.0037	V 0.0017 ± 0.0005	0.0048 ± 0.0006	0.0019 ± 0.0017	0.0031 ± 0.0013	NA	NA
^{137}Cesium (Bq/L)	0.0010	< 0.0009	V 0.0010 ± 0.0003	V 0.0016 ± 0.0005	V 0.0012 ± 0.0008	0.001 ± 0.0001	V 0.0006 ± 0.0001	0.001 ± 0.0001 (Q4)
Deep River								
Tritium (Bq/L)	< 3	< 3	V 1 ± 1	< 1 ± 1	V 1.4 ± 0.1	V 2 ± 1.2	2.2 ± 0.1	3.2 ± 0.6 (Jan)
Gross Beta (Bq/L)	0.042	0.061 ± 0.007	0.042 ± 0.002	0.046 ± 0.001	0.039 ± 0.001	0.046 ± 0.009	0.052 ± 0.013	0.08 ± 0.0.06 (Apr)
Gross Alpha (Bq/L)	0.0046	0.0056 ± 0.0005	0.0045 ± 0.0001	0.0095 ± 0.0003	0.0079 ± 0.0003	0.0064 ± 0.0022	0.0065 ± 0.0006	0.009 ± 0.0026 (Jan)
Total Strontium (Bq/L)	0.0039	< 0.0027	0.0026 ± 0.0005	V 0.0052 ± 0.0007	V 0.0027 ± 0.0012	V 0.0034 ± 0.0012	NA	NA
^{137}Cesium (Bq/L)	< 0.0008	0.0011 ± 0.0003	V 0.0009 ± 0.0003	V 0.0007	V 0.002	V 0.0015 ± 0.0009	V 0.0006 ± 0.0001	0.0007 ± 0.0001 (Jan)

± Represents the uncertainty in the counting statistics, except for the 5-year averages, where it represents the uncertainty in the result population (i.e. one standard deviation of the annual averages).

< Indicates that the result is below the detection level (L_D). Results that fall below the L_D are reported as less than the numerical value of the L_D.

V Indicates that one or more of the values used to calculate the result is below the critical level (L_C) and/or the detection level (L_D).

Note: In 2016 the CNL EMP moved from reporting a ±1 sigma uncertainty to a method (described in the CSA N288.4) that more accurately represents the uncertainty associated with the measured value. This has, in general, resulted in a higher reported uncertainty than what has been seen in previous years.

MONITORING PROGRAM CHANGES

A “need-for-monitoring assessment” for non-radiological parameters was completed in 2016 and determined that there is a need to monitor for iron, mercury, lead, PCBs, dioxins and furans in the WAS. Additionally Manhole #2 is acknowledged as a liquid effluent discharge point from the NPDWF and is monitored for tritium and gross beta.