Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

UNPROTECTED/NON PROTÉGÉ

ORIGINAL/ORIGINAL

CMD: 19-M24

Date signed/Signé le : 16 AUGUST 2019

Filed on / Déposé le : 5 SEPTEMBER 2019

Annual Program Report

Canadian Nuclear Laboratories

Regulatory Oversight Report for Canadian Nuclear Laboratories Sites: 2018

Public Meeting

Scheduled for:

November 7, 2019

Submitted by:

CNSC Staff

Rapport annuel sur les programmes

Laboratoires Nucléaires Canadiens

Rapport de surveillance réglementaire pour les sites des Laboratoires Nucléaires Canadiens: 2018

Réunion publique

Prévue pour :

Le 7 novembre 2019

Soumise par :

Le personnel de la CCSN

e-Doc 5753144 (WORD)
e-Doc 5926886 (PDF)

Canada

Summary

This Commission member document (CMD) concerns the Regulatory Oversight Report for sites operated by Canadian Nuclear Laboratories (CNL) for the 2018 calendar year. CNL is the licensee for each of these sites.

No actions are required of the Commission. This CMD is for information only.

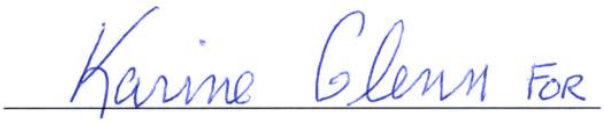
Résumé

Ce document à l'intention des commissaires (CMD) porte sur le Rapport de surveillance réglementaire pour les sites exploités par les Laboratoires Nucléaires Canadiens (LNC). LNC est le titulaire de permis pour chacun de ces sites.

Aucune mesure n'est requise de la Commission. Ce CMD est fourni à titre d'information seulement.

Signed/signé le

August 16, 2019



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EXECUTIVE SUMMARY

The *Regulatory Oversight Report for Canadian Nuclear Laboratories Sites: 2018* is a Commission member document (CMD) which presents the Canadian Nuclear Safety Commission (CNSC) staff's assessment of licensee performance at sites that are licensed to Canadian Nuclear Laboratories (CNL) for the 2018 calendar year. This report also provides an update on CNSC staff's activities related to public information, community engagement and relevant aspects of the CNSC's Independent Environmental Monitoring Program.

CNSC staff use the safety and control area framework to evaluate the performance of each licensee. This report provides performance ratings for all 14 safety and control areas (SCAs); it focuses on radiation protection, environmental protection and conventional health and safety, in particular. Taken together, these SCAs provide a meaningful overview of the safety performance of the facilities addressed in this report. Highlights of the other 11 SCAs are also provided where relevant. The report also includes information on the licensee's public information programs, its engagement with Indigenous groups and communities, reportable events, significant facility modifications and areas of increased regulatory focus, where applicable to the sites. Where possible, trends are shown and information is compared to previous years.

In order to assess the safety performance of licensees, the CNSC conducts regulatory oversight activities consisting of onsite inspections, technical assessments, reviews of reports submitted by licensees, reviews of events and incidents, general communication with licensees and exchanges of information with them. While licensee performance across all SCAs is not explicitly documented in this report, CNSC staff's regulatory oversight activities extend to all SCAs. CNSC staff confirm that in 2018, CNL sites continued to perform licensed activities safely. For this reporting year, CNSC staff rated all SCAs as "satisfactory" with the exception of the security SCA at Whiteshell Laboratories which was rated as "below expectations". This will be elaborated upon during the October 2/3, 2019 Whiteshell relicensing hearings.

Overall, CNSC staff's compliance activities determined that:

- radiation protection programs at all sites adequately controlled radiation exposures, keeping doses as low as reasonably achievable (ALARA)
- environmental protection programs at all sites were effective at protecting people and the environment
- conventional health and safety programs at all sites continued to protect workers

Therefore, CNSC staff conclude that in 2018, the CNL sites covered by this regulatory oversight report made adequate provisions for the health and safety of workers, the protection of the public and the environment, and Canada's international obligations. Documents referenced in this CMD are available to the public upon request.

1 INTRODUCTION

For the purposes of the *Nuclear Safety and Control Act* (NSCA) [1], and its associated Regulations, the Canadian Nuclear Safety Commission (CNSC) regulates Canada's nuclear industry to protect the health, safety, security and the environment; to implement Canada's international commitments on the peaceful use of nuclear energy; and to disseminate objective scientific, technical and regulatory information to the public. Licensees are responsible for operating their facilities safely, and are required to implement programs that make adequate provision for meeting legislative and regulatory requirements.

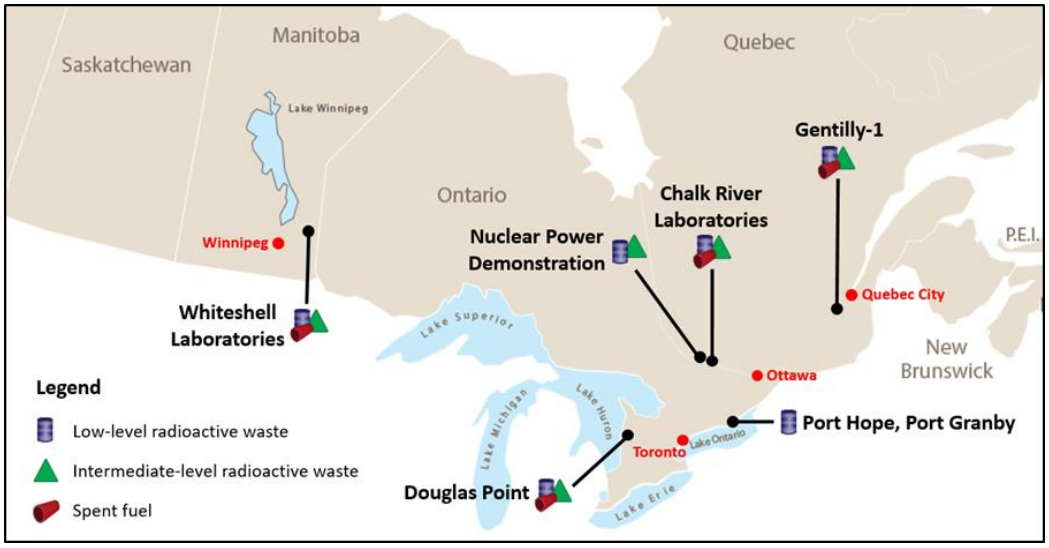
CNSC staff produce regulatory oversight reports (ROR) on various sectors of the Canadian nuclear industry as a means to report to the Commission on CNSC staff oversight activities at those sites and on licensee performance. The Commission has directed CNSC staff to report to the Commission annually on the safety performance of sites operated by Canadian Nuclear Laboratories (CNL) in the form of an ROR. This is the first report to cover all major CNL sites. This ROR includes data for the 2018 calendar year and describes:

- Information on licensee operations, licence changes, major developments at licensed facilities and sites, as well as any significant events;
- The CNSC's regulatory efforts, public information and Indigenous and community engagement activities, and Independent Environmental Monitoring Program (IEMP) results;
- The performance rating for all safety and control areas (SCAs) relevant to each CNL site;
- Performance data on the SCAs of radiation protection, environmental protection, and conventional health and safety for each CNL site; and
- Highlights from other SCAs as applicable.

The sites covered by this report are shown in Figure 1, and the licences are listed in Table 1. These sites were most recently before the Commission in relation to the following Commission member documents (CMD):

- CMD 18-H2 [2], the relicensing of the Chalk River Laboratories site;
- CMD 18-M30 [3], a progress update covering all CNL sites with the exception of CRL;
- CMD 18-H103 [4], the one-year extension of the Whiteshell Laboratories licence;
- CMD 18-H107 [5], the separation of the single licence which previously covered the Douglas Point, Gentilly-1 and Nuclear Power Demonstration sites into three licences, each covering one site; and
- CMD 19-H101 [6], an amendment to the Port Granby Project licence.

Figure 1: Sites covered by this CMD



Within the CNSC, compliance and licensing activities at the sites covered by this report are regulated under the fuel cycle program. The risk classification of these sites within the fuel cycle program is included in Table 1. Each licensed facility or activity under the fuel cycle program is categorized into low, medium and high categories. The appropriate category is determined based on considerations such as the safety of workers and the public (i.e. radiation protection and conventional health and safety), the safety of the environment, and security. For example, a facility's or activity's risk is assessed based on the types of hazards, the consequences of a program failure and the complexity of the operations. This classification is reassessed if licensed activities were to substantially change, or when there are changes to the information and assumptions used for the initial categorization. Each regulatory program within the CNSC establishes the risk considerations most appropriate for the types of facilities and activities being regulated.

Table 1: Licences covered by this CMD

SITE/FACILITY/PROJECT	LICENCE NUMBER	FUEL CYCLE PROGRAM RISK CLASSIFICATION
Chalk River Laboratories (CRL)	NRTEOL-01.00/2028	High
Whiteshell Laboratories (WL)	NRTEDL-W5-8.05/2019	Medium
Port Hope Project (PHP)	WNSL-W1-2310.02/2022	Medium
Port Granby Project (PGP)	WNSL-W1-2311.02/2021	Medium
Douglas Point (DP) Waste Facility	WFDL-W4-332.02/2034	Low
Gentilly-1 (G-1) Waste Facility	WFDL-W4-331.00/2034	Low
Nuclear Power Demonstration (NPD) Waste Facility	WFDL-W4-342.00/2034	Low
Port Hope Pine Street Extension Temporary Storage Site	WNSL-W1-182.0/2021[1]	Low
Port Hope Radioactive Waste Management Facility	WNSL-W1-344-1.8/ind[1]	Low
NRTEOL = Nuclear Research and Test Establishment Operating Licence NRTEDL = Nuclear Research and Test Establishment Decommissioning Licence WNSL = Waste Nuclear Substance Licence WFDL = Waste Facility Decommissioning Licence		

Note that the last four digits of these licence numbers is the year in which they will expire. "ind" stands for "indefinite". Not covered by this ROR are CNL's nuclear substance licences, which are included in the annual *Regulatory Oversight Report on the Use of Nuclear Substances*. In 2018, DP, G-1 and NPD were collectively licensed under WFDL-W4-332.01/2034.

A licence issued under the NSCA contains the period for which the licence is valid, licensed activities and a standard set of licence conditions. A licence conditions handbook (LCH) accompanies each licence in Table 1, with the exception of WNSL-W1-182.0/2021 and WNSL-W1-3441.8/ind, which are small temporary storage sites for low level waste. A LCH contains compliance verification criteria used by CNSC staff to ensure compliance with the conditions of the licence. The risk classifications listed in Table 1 are among the factors used by CNSC staff in determining the frequency and scope of regulatory activities at each of these sites. This approach is part of the CNSC's risk informed considerations for regulating a broad range of facilities and activities.

[1] These licences cover small areas containing low-level waste which will be cleaned up under the PHP. For the remainder of this document, they are included under the PHP unless mentioned separately.

Section 2 of this report includes a brief description of each site and major licensed activities in the period covered by this report.

CNSC staff conduct regular oversight activities to ensure CNL continues to meet the regulatory requirements of these licences, as described in more detail in Sections 3, 4 and 5 of this document. Changes made to licences or LCHs during this review period are described in Section 3.

2 CANADIAN NUCLEAR LABORATORIES

CNL is responsible for the management of nuclear sites owned by Atomic Energy of Canada Limited (AECL). The content in this ROR encompasses the sites listed in Table 1 above, and are described in more detail in the sections below.

CNL took responsibility for operating these sites from AECL in 2014, as part of AECL's transition to a Government-Owned, Contractor-Operated model. In 2015, AECL transferred all shares in CNL to the Canadian National Energy Alliance, a consortium of engineering and technology companies, that manages and operates CNL under a Government-Owned, Contractor-Operated model.

2.1 Chalk River Laboratories

Chalk River Laboratories (CRL) is located in the province of Ontario, 160 kilometers (km) northwest of Ottawa and occupies a total area of 37 km² and a built-up area of approximately 0.4 km^2 (Figure 2). The site is immediately adjacent to the Ottawa River. CRL operates under a single licence, which includes 12 Class I nuclear facilities in an operational state, such as the Zero Energy Deuterium (ZED-2) research reactor, processing facilities, fuel manufacturing facilities, and hot cells. The site also includes 13 different waste management areas (five in operation and eight in long-term monitoring), four Class II nuclear facilities that contain prescribed equipment such as accelerators and irradiators, and more than 50 radioisotope laboratories, support facilities and offices[2].

Figure 2: A view of the CRL built-up area

[2] A detailed description of this site is included in CMD 18-H2, which was presented to the Commission on January 23-25, 2018

CNSC staff have classified CRL as 'high' risk due to the diversity of activities currently carried out on the site, the storage of large quantities of radioactive waste including spent nuclear fuel and legacy liabilities from past activities. The cessation of molybdenum-99 production in 2016 and the permanent shut down of the National Research Universal (NRU) reactor in 2018 have significantly lowered the risk profile of the site. The level of risk at the site will decrease further as CNL's decommissioning work and repatriation of highly enriched uranium (HEU) continues. The public and Indigenous groups in the CRL area continue to show a high level of interest in CNL's current activities at CRL, and in CNL's future plans for the site.

2.1.1 Major Activities at CRL in 2018

The CRL site is undergoing a period of rapid change. Where permitted by the current licensing basis, CNL is shutting down and decommissioning legacy facilities, and constructing and commissioning replacement facilities throughout the site. CNL has also advanced their program to host a Small Modular Reactor at the CRL site, and has further proposed to construct and operate a Near-Surface Disposal Facility at the CRL site; these topics are discussed in more detail in sections 5.4 and 5.5, respectively.

Permanent Shutdown of the NRU Reactor and the Molybdenum-99 Production Facility

The NRU reactor operated until March 31, 2018, when it was permanently shut down. By the end of May 2018, CNSC staff confirmed the reactor had been defueled and CNL had moved all fuel into wet storage in the NRU rod bays. By the end of September 2018, CNSC staff assessed that all heavy water had been drained from the NRU reactor vessel and temporarily stored safely, pending processing and storing in metal drums. CNL is progressively and permanently draining and/or de-energizing systems which are no longer needed so that the NRU facility can be placed in a state of storage with surveillance.

Figure 3: The NRU Reactor Hall

CNL's Molybdenum-99 Production Facility (MPF) had ceased to operate in October 2016, at which time CNL placed it in a standby state in case the decision was made to produce more molybdenum-99. The MPF depended on the NRU reactor for irradiated targets, and with the shutdown of NRU CNSC staff have confirmed it has since transitioned to a safe shutdown state.

Repatriation of Highly Enriched Uranium (HEU)

Under the joint regulatory oversight of the CNSC and the United States Nuclear Regulatory Commission (USNRC), CNL has been safely returning materials which contain HEU to the United States. Both countries have rigorous regulatory requirements in place based on international standards, and shipments take place when both the CNSC and USNRC give approval. The HEU originates from materials imported to Canada for research and medical isotope production at CRL. It consists of spent HEU fuel rods from the National Research Experimental (NRX) and NRU reactors and HEU dissolved in acid, a by-product of CNL's past production of molybdenum-99. As of the end of 2018, CNSC staff conclude that CNL's repatriation work continues safely. To date, CNL has repatriated upwards of 95% of HEU in spent fuel from the CRL site, and upwards of 75% of liquid HEU. The movement of HEU has led to increased monitoring from the International Atomic Energy Agency (IAEA), which will continue for the duration of the repatriation project.

2.2 Whiteshell Laboratories

Whiteshell Laboratories (WL) is a former nuclear research and test facility located near Pinawa, Manitoba that was established by AECL in the early 1960s. The main campus (Figure 4) hosts the 60 megawatt thermal (MWth) Whiteshell Reactor No. 1 (WR-1), a SLOWPOKE demonstration reactor (SDR), and other research and support facilities. Located approximately 2.7 km north-east of the main campus is a waste management area which contains low-level waste (LLW), intermediate-level waste and high-level radioactive waste.[3]

Figure 4: WL Main Campus *(Source: CNL)*

The WR-1 reactor and SDR were permanently shut down in 1985 and 1990 respectively, and in 1997 AECL discontinued most research programs and operations at WL. Decommissioning commenced in 2003. Currently, CNL is carrying out active decommissioning work at the site with the exception of WR-1, which remains in storage with surveillance.

According to CNL's Detailed Decommissioning Plans (DDPs) for WL, decommissioning will be completed by 2050 with plans for a subsequent 200-year period of institutional control.[4] In 2016, the CNSC received an application by CNL to change the decommissioning approach for WR-1 from full dismantlement to in-situ decommissioning. This new approach is currently under review by CNSC staff, and is described further in Section 5.9.

[3] A detailed description of this site is included in CMD 19-H4 [7], which will be presented to the Commission on October 2/3, 2019.
[4] A detailed description of this site is included in CMD 18-M30, which was presented to the Commission on August 22, 2018.

CNSC staff have classified WL as 'medium' risk given the presence of used nuclear fuel and other radioactive wastes at the site, CNL's ongoing decommissioning work, and the legacy of past research operations at the site. The public and Indigenous groups in the WL area continue to show a high level of interest in CNL's current decommissioning activities at WL, and in CNL's future plans for the site.

2.2.1 Major Activities at WL in 2018

As authorized by its current licence, in 2018 CNL carried out hazard reduction and characterization activities at the site in preparation for planned demolition of the active liquid waste treatment centre. These activities included the removal of asbestos, application of fixatives on the interior of tanks, and the removal of various equipment. CNL also carried out hazard reduction and characterization activities in preparation for the decommissioning of WR-1, such as the removal of asbestos and the characterization of reactor components.

2.3 Remediation Sites

CNL is the licensee responsible for the implementation of the Port Hope Area Initiative (PHAI), which consists of the Port Hope and Port Granby projects. These projects involve the clean-up of historic low-level radioactive waste contamination found in Port Hope and Port Granby, and its emplacement in new long-term waste management facilities (LTWMFs), one located in each community. The scope of the PHAI is defined by a legal agreement between the municipalities of Port Hope and Clarington and the Government of Canada, originally signed in 2001. The legacy wastes in Port Hope and Port Granby are a federal liability because they ultimately derive from the operations of a former Crown Corporation, Eldorado Nuclear Limited (ENL). ENL became the privately-held Cameco Corporation (Cameco) in 1988 and wastes produced after that time are the responsibility of Cameco.

The Port Hope and Port Granby projects are each divided into three phases, namely:

- Phase 1 – ongoing operation, care and maintenance of existing legacy facilities, and development of design and licensing documentation;
- Phase 2 – implementation, including the construction and operation of new LTWMFs, and the remediation of legacy waste; and
- Phase 3 – long-term monitoring and maintenance of the LTWMFs.

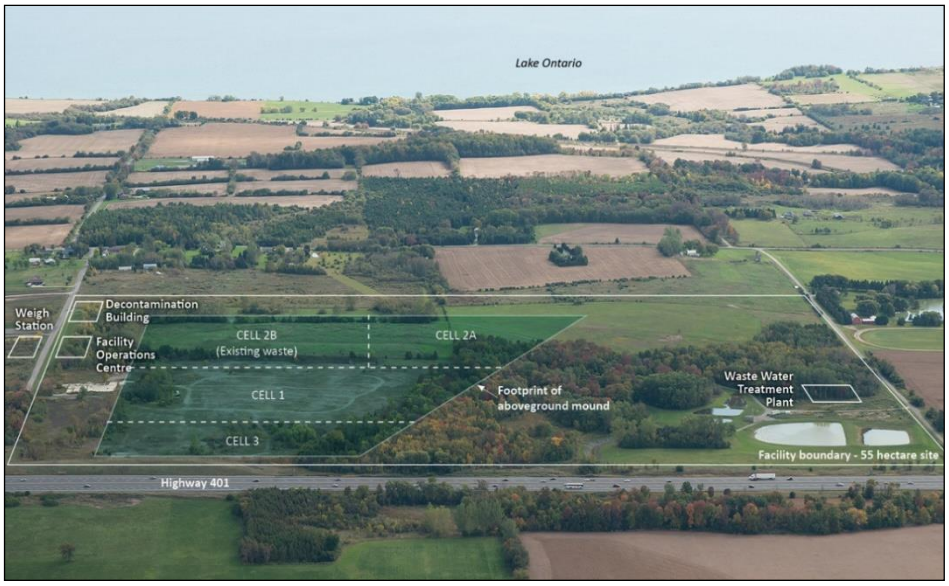
CNSC staff have assessed CNL's work under the PHAI as 'medium' risk. While the radiological and environmental hazards posed by the work are low, the conventional health and safety risks are elevated due to the extensive use of heavy equipment on these sites. CNL's remediation work carried out under the PHAI is also extremely visible to the public, as it takes place in and around the communities of Port Hope and Port Granby. This has led to an elevated level of interest from Indigenous groups and the public.

2.3.1 The Port Hope Project

The Port Hope Project (PHP) involves the construction of an engineered above-ground containment mound, which will safely isolate legacy LLW in the Municipality of Port Hope. The project involves the excavation of roughly 1,500,000 m^3 of uranium and radium refining waste from a legacy waste management facility (WMF) and waste from various sites in the urban area of the municipality, and its emplacement in a LTWMF (Figure 5). The PHP is currently in the implementation phase (Phase 2) of its three phase project. Phase 2 includes the construction and operation of a waste water treatment plant (WWTP); the construction and operation of the LTWMF, including the excavation and emplacement of LLW in cells prepared to accept this waste; site remediation and restoration; and, the capping of the LTWMF once complete. Excavation and emplacement of wastes is expected to continue to 2023. As part of Phase 2 of the PHP, CNL is performing extensive radiological surveys of residential and commercial properties in Port Hope. To date, CNL has identified over 1,000 properties which will need remediation. Remediation work on these small-scale sites began in December 2018 with three properties and is conducted according to CNL procedures reviewed by CNSC staff.

The final phase of the project (Phase 3) will involve long-term monitoring and maintenance of the LTWMF under continued CNSC regulatory oversight.[5]

Figure 5: An overview of the site prior to Port Hope LTWMF construction, overlaid with LTWMF features *(Source: CNL)*



[5] A detailed description of this site is included in CMD 18-M30, which was presented to the Commission on August 22, 2018.

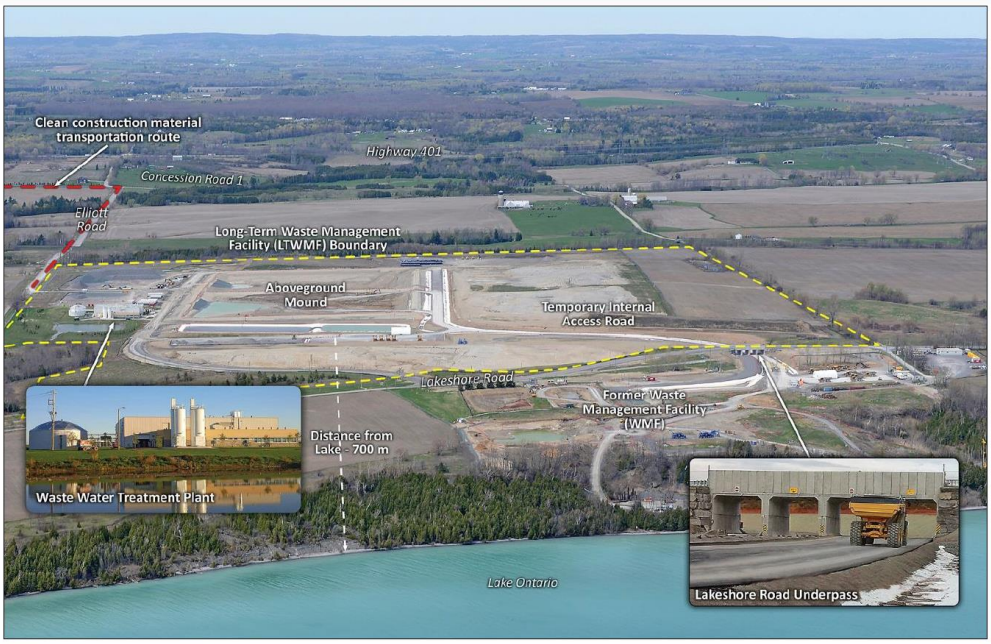
In addition to the main licence for the PHP, CNL holds two other licences for the interim management of legacy LLW in Port Hope, which are associated with and included under the PHP. The Port Hope Pine Street Extension Temporary Storage Site and the Port Hope Radioactive Waste Management Facility will both be remediated under the PHP, with the LLW being transferred to the Port Hope LTWMF.

2.3.2 Port Granby Project

The Port Granby Project (PGP) involves the construction of an engineered above-ground containment mound, which will safely isolate legacy LLW in the Municipality of Clarington. The project involves the excavation of roughly 450,000 m^3 of uranium and radium refining waste from a legacy WMF, and its emplacement in a LTWMF (Figure 6). The PGP is currently in the implementation phase (Phase 2) of a three phase project, which includes the construction and operation of a WWTP; the construction and operation of the LTWMF, including the excavation and emplacement of LLW in cells prepared to accept this waste; the capping of the LTWMF once complete; and site remediation and restoration. The excavation and transfer of LLW has been under way in Port Granby since 2016. The final phase of the project (Phase 3), will involve long-term monitoring and maintenance of the LTWMF under continued CNSC regulatory oversight.[6]

[6] A detailed description of this site is included in CMD 18-M30, which was presented to the Commission on August 22, 2018.

Figure 6: Location of the Port Granby WMF and new LTWMF (LTWMF boundary indicated by dashed yellow line) *(Source: CNL)*



2.3.3 Major Activities at Remediation Sites in 2018

CNSC staff confirmed that CNL has continued with construction, operation and remediation work during 2018 at both the PHP and the PGP. This has included:

- At the PHP, the completion of construction of Cell 3 of the LTWMF, and continued construction work on Cell 2; the ongoing emplacement of LLW into Cell 1; the expansion of the collection pond associated with the WWTP, to allow CNL to better manage impacted water generated at the site; ongoing surveys and the commencement of remediation at small-scale sites (e.g. residential properties) and industrial sites (e.g. the Centre Pier) in Port Hope; the commissioning of an IAEA portal monitor to independently measure safeguarded uranium being transferred from Cameco's Port Hope Conversion Facility; and, significant preparations for the remediation of the Port Hope harbour.
- At the Port Hope Pine Street Extension Temporary Storage Site and the Port Hope Radioactive Waste Management Facility, the removal of all LLW from several of the sites covered by these licences.
- At the PGP, the continued excavation and emplacement of LLW; the verification of large areas of the legacy Port Granby WMF as meeting the clean-up criteria in the licence, and the backfilling of some of those areas; the addition of temporary storage for impacted water via the construction of eight 6,000 m^3 tanks; and, continued preparation for the closure and capping of the PGP LTWMF (the end of Phase II), currently scheduled to begin in 2019.

Figure 7: A remediated section of the old Port Granby Waste Management Facility

2.4 Prototype Power Reactors

The Douglas Point (DP), Gentilly-1 (G-1), and Nuclear Power Demonstration (NPD) waste facilities are three shutdown power reactors which are undergoing decommissioning. For these sites CNL is employing a deferred decommissioning strategy. The three phases of deferred decommissioning are:

- Phase 1 – bring the facility to a safe sustainable shut down state suitable for storage with surveillance;
- Phase 2 – the storage with surveillance period; and
- Phase 3 – final decommissioning where the facility achieves its final end state.

The duration of each phase may vary depending on the decommissioning plan for each of the facilities; these plans are reviewed by CNSC staff prior to implementation. Note that these phases are distinct from the three phases of the remediation projects described in Section 2.3 above.

Currently the DP, G-1 and NPD sites are each in a state of storage with surveillance (Phase 2), as authorized by their licences. All are required to implement and maintain programs such as radiation protection, occupational health and safety, security and fire protection.

CNSC staff have classified the Prototype Power Reactor sites as ‘low’ risk, given that these three sites are all in storage with surveillance. Should CNL begin active decommissioning or otherwise make major changes to operations at these sites, the risk classification would be reevaluated by CNSC staff. The public and Indigenous groups in the area of the DP, G-1 and NPD sites continue to show a high level of interest in CNL’s future plans for these sites, especially in regards to CNL’s proposed accelerated decommissioning activities, discussed further in Section 5.9.

2.4.1 Douglas Point Waste Facility

DP, located in Tiverton, Ontario on the Bruce nuclear site (Figure 8) is a partially decommissioned prototype power reactor. The 200-megawatt electric (MWe) prototype Canada deuterium uranium (CANDU) power reactor was put into service in 1968 and permanently shut down in 1984. At DP, CNL is managing low- and intermediate-level radioactive wastes and used nuclear fuel in concrete dry storage canisters. Additionally, CNL is undertaking decommissioning planning activities for Phase 3 to render the site appropriate for industrial use. CNSC staff have assessed CNL's preliminary decommissioning plans (PDPs), and noted that Phase 3 activities are planned to begin in 2060.[7] In July of 2019, CNL submitted to the CNSC an application for a licence amendment which would allow CNL to begin dismantlement work at DP. Such an amendment will require a separate decision by the Commission with the hearing currently expected to be in 2020.

Figure 8: DP Waste Facility *(Source: CNL)*

[7] A detailed description of this site is included in CMD 18-M30, which was presented to the Commission on August 22, 2018.

2.4.2 Gentilly-1 Waste Facility

G-1, located in Bécancour, Québec within Hydro-Québec's Gentilly-2 site (Figure 9, outlined in yellow and adjacent to Hydro-Québec's Gentilly-2 reactor), is a partially decommissioned prototype power reactor. The 250 MWe boiling water reactor was put into service in 1972 and shut down in 1984. At G-1, CNL is safely managing low- and intermediate-level radioactive wastes and used nuclear fuel in concrete dry storage canisters. Additionally, CNL is undertaking decommissioning planning activities in support of Phase 3 to render the site appropriate for industrial use. According to current decommissioning plans accepted by CNSC staff, Phase 3 activities are planned to begin in 2064, well outside the term of the current licence.[8] The commencement of dismantlement work at G-1 would first require a separate decision by the Commission.

Figure 9: G-1 Waste Facility, outlined in yellow *(Source: CNL)*

[8] A detailed description of this site is included in CMD 18-M30, which was presented to the Commission on August 22, 2018.

2.4.3 Nuclear Power Demonstration Waste Facility

NPD located in Rolphton, Ontario (Figure 10) is a partially decommissioned prototype power reactor. The 20 MWe prototype CANDU power reactor was placed into service in 1962, and operated until 1987. At NPD, CNL is managing low- and intermediate-level radioactive wastes, according to their CNSC assessed and accepted storage with surveillance plan. Additionally, CNL is undertaking decommissioning planning activities in support of Phase 3 to render the licensed site appropriate for industrial use. According to CNL's decommissioning plans, Phase 3 activities are planned to begin in 2030.[9] In 2016 CNL submitted an application to the CNSC to modify the decommissioning approach for NPD from full dismantling to in-situ decommissioning, which could accelerate the decommissioning process. This new approach requires the Commission's approval as outlined in Section 5.9.

Figure 10: NPD Waste Facility *(Source: CNL)*

2.4.4 Major Activities at Prototype Power Reactors in 2018

CNL is currently carrying out a number of hazard reduction and waste characterization activities at DP, G-1 and NPD, in line with decommissioning plans reviewed and accepted by CNSC staff.

[9] A detailed description of this site is included in CMD 18-M30, which was presented to the Commission on August 22, 2018.

Examples of activities carried out by CNL in 2018 include:

- At DP, CNL demolished various ancillary buildings and structures, including the Emergency Cooling Injection System (ECIS) tank and characterized the ECIS bunker; installed a new membrane on the reactor building roof to repair damage caused by seagulls; removed all Moderator Purification System resins and shipped them for processing in the United States; and transferred all low-activity liquid waste (135,000 litres) to CRL's Waste Treatment Centre.
- At G-1, CNL removed and processed various low-level wastes from the reactor building; removed all Heat Transport Purification System and Moderator Purification System resins, which were shipped to CRL for storage; and, shipped Moderator Purification System cover water (20,000 litres) to CRL's Waste Treatment Centre.
- At NPD, CNL conducted geological, structural, and radiological characterization activities in support of their proposed in-situ decommissioning plan; and, ceased routine batch releases of effluent to the Ottawa River. CNL now ships all contaminated water from the NPD sumps to CRL for treatment.

3 THE CNSC'S REGULATORY OVERSIGHT OF CNL

This section of the 2018 CNL ROR contains information on the licensees' compliance with the requirements of the NSCA and associated Regulations made under the NSCA, each site's licence and LCH, and any other applicable standards and regulatory documents.

The information provided in this ROR covers the 2018 calendar year and, where applicable, includes trends and comparisons to previous years. CNSC staff use the SCA framework to assess, evaluate, review, verify and report on licensee performance. The SCA framework includes 14 SCAs, which are subdivided into specific areas that define its key components. Appendix B provides definitions of these SCAs and their specific areas, Appendix C provides information on the CNSC's ratings methodology, and Appendix D contains detailed SCA ratings for each site.

This ROR report largely focuses on three SCAs, namely radiation protection, environmental protection, and conventional health and safety, as they provide a good overview of safety performance at CNL sites. The varied nature of CNL's activities across their different licenses means that not all SCAs apply equally to all sites or activities. Although not explicitly documented in this report, all relevant SCAs are assessed during compliance inspections and reviews of CNL's documents, and a rating is generated for each SCA each year. CNSC staff use RORs to inform the Commission of major findings or topics of interest in all SCAs, as shown in Section 5. The report also includes information on CNL's public information programs, engagement with Indigenous groups and communities, 2018 reportable events, any significant facility modifications, and areas of increased regulatory focus.

In addition, the report includes a list of references, the definitions of acronyms, a glossary and other appendices. Appendix A is a list of CNSC inspections carried out at CNL sites in 2018, Appendices E and F contain information on dose to workers and the public respectively, Appendix G contains health and safety information, Appendix H provides the total annual releases of radionuclides for each CNL site during 2018, and Appendix I lists select relevant websites.

3.1 Regulatory Activities

The CNSC ensures licensee compliance through verification, enforcement and reporting activities. CNSC staff develop compliance plans for each site commensurate with the risk associated with the site. CNSC staff implement the compliance plans by conducting regulatory activities including on-site inspections, desktop reviews and technical assessments of licensee programs, processes and reports. These activities can result in licensees being found in non-compliance with CNSC requirements, at which point CNSC staff will place corrective enforcement actions on the licensee and track those actions to completion.

During the reporting period, CNSC staff spent over 42,000 hours working on compliance and licensing at CNL sites. This included effort from CNSC staff in 36 different divisions spread over nine directorates.

Compliance Activities

In 2018, CNSC staff spent 2,700 hours in the field conducting 28 inspections, and nearly 22,000 hours in the office conducting desktop reviews, technical assessments of licensee documents, and preparing for inspections.

A summary of CNSC staff's inspection activities is shown in Table 2, and a more detailed table of inspections is available in Appendix A. All inspections include verification activities related to the conventional health and safety and radiation protection SCAs. The enforcement actions which resulted from these inspections were provided to CNL via detailed inspection reports and recorded in the CNSC regulatory information bank to ensure they are tracked to completion. CNSC staff verify on an ongoing basis that the licensee has complied with the conditions of enforcement actions and that all actions are closed in the specified timeframes. CNSC staff's assessment of the risk significance of the enforcement actions issued in each inspection are included in Appendix A.

Table 2: Compliance Inspections at CNL Sites during 2018

Site, Facility or Project	Inspections in 2018	Enforcement Actions Issued
Chalk River Laboratories	12	12
Whiteshell Laboratories	2	1
Port Hope Project	5	14
Port Granby Project	6	22
Douglas Point Waste Facility	1	2
Gentilly-1 Waste Facility	1	None
Nuclear Power Demonstration Waste Facility	1	None

The number of inspections carried out at a given site in a year varies with CNSC staff's assessment of the risk of that site and the activities the licensee is carrying out at the site. It is also informed by incidents or situations that may warrant a reactive (unplanned) inspection. For context, compare the number of inspections in 2018 to Table 3 below, which shows the baseline number of inspections CNSC staff expect to carry out over a 10-year period at CNL sites, based on a site's risk categorization. This baseline is augmented as needed to take into account facility- or site-specific information. Annually, the plan is reviewed and the number of inspections increased or the focus areas changed, as justified by changes in licensee activities, or in order to ensure licensee compliance.

Table 3: 10-year Baseline Inspection Plan for CNL sites

Site risk categorization	High	Medium	Low
Minimum number of inspections over a 10-year period	32	15	3

Licensing Activities

In 2018, CNSC staff spent about 17,500 hours on licensing activities, which includes the drafting of new licences, the preparation of Commission Member Documents, the drafting and/or revision of LCHs, and discussions with CNL on all of the above. A summary of changes to CNL's licences and LCHs over the period covered by this ROR is shown in Table 4 below.

Table 4: Changes to CNL Licences and LCHs in 2018

Site, Facility or Project	Licence Changes in 2018	LCH Changes in 2018
Chalk River Laboratories	Issuance of new 10-year licence in March 2018, following public hearings in January 2018.	A new LCH was issued in May 2018, associated with the new licence.
Whiteshell Laboratories	Issuance of 1-year extension to the previous licence in August 2018, valid for the 2019 calendar year and with no change to any authorizations.	No change to the LCH in 2018.
Port Hope Project	No change to the licence in 2018.	No change to the LCH in 2018.
Port Granby Project	No change to the licence in 2018. In 2018, CNL requested a licence amendment to incorporate Release Limits for the new Waste Water Treatment Plant, as described in CMD 19-H101. The Commission granted approval for the revised licence in April 2019.	No change to the LCH in 2018. A new LCH was issued in April 2019, associated with the new licence.
Douglas Point, Gentilly-1 and Nuclear Power Demonstration waste facilities	No change to the licence in 2018. In 2018, CNL requested a separation of the single licence covering these three sites into individual licences for each site, as described in CMD 18-H107. The Commission granted approval for separation of the licence in February, 2019.	No change to the LCH in 2018. Three new LCHs have been issued in 2019, associated with the licence separation.

IAEA Safeguards Activities

Under the terms of the Canada-IAEA safeguards agreements, the IAEA has the right to perform independent verification activities at various types of sites in Canada. The Port Granby Project is the only site covered by this ROR which is not under IAEA safeguards. CNL must submit various types of information to the CNSC and IAEA in order to support the IAEA's verification activities, in addition to providing access to the site to the IAEA. In 2018, CNL provided information and access as required.

In 2018, the IAEA carried out activities at CNL sites as shown in Table 5 below to verify nuclear material inventories and assure the absence of undeclared nuclear material and activities. IAEA activities are not CNSC compliance inspections, but CNSC staff accompany the IAEA in roughly 75% of their activities. They may therefore result in CNSC staff issuing recommendations or enforcement actions to the licensee. In 2018, no enforcement actions resulted from CNSC staff's participation in IAEA activities. Sites which did not host an IAEA activity in 2018 are omitted from the table.

Table 5: Activities carried out by the IAEA at CNL sites during 2018

Site, Facility or Project	Activity					
	PIV	**DIV**	**SNRI**	**IIV**	**UI**	**CA**
Chalk River Laboratories	16	23	9	0	2	1
Whiteshell Laboratories	0	1	0	0	0	0
Port Hope Project	0	1	0	2	0	0
Gentilly-1 Waste Facility	1	1	0	0	0	0
PIV = Physical Inventory Verification DIV = Design Information Verification SNRI = Short Notice Random Inspection	IIV = Interim Inventory Verification UI = Unannounced Inspection CA = Complementary Access					

3.2 Chalk River Laboratories

For 2018, CNSC staff rated all 14 SCAs for CRL as "satisfactory". CNSC staff performed 12 inspections at the CRL site in 2018, and issued 12 enforcement actions, 10 of which remain open at the time of this report. The majority of the open actions are related to an inspection which was conducted in December 2018 and which focused on training at the CRL site. The open actions do not pose any immediate threat to safety, security or the environment, but require CNL to make programmatic changes to address the findings. In order to ensure that these findings are adequately addressed, CNSC staff will be performing further follow-up work on training at CNL in 2019.

During a desk-top review of CRL's safeguards reports in 2018, CNSC staff determined that previously identified issues with timely reporting persisted. In response, CNL submitted and began implementing an action plan in December 2018. During 2019 CNSC staff have continued to monitor the accuracy of the CRL's safeguards reports.

Due to the complexity of the CRL site and the risk level it poses, CNSC staff have a permanent site office at the CRL site which is staffed by CNSC inspectors. These inspectors are allowed unrestricted access to the CRL site, and carry out both scheduled inspections and frequent walk-downs of CRL facilities and activities. This allows them to maintain a more organic level of knowledge of the activities at the site, and to perform compliance verification activities in response to any situations of concern.

3.3 Whiteshell Laboratories

For 2018, CNSC staff rated 13 of 14 SCAs for WL as "satisfactory", the exception being the SCA of Security, discussed further below. CNSC staff performed two inspections at the WL site in 2018, and issued one enforcement action, which has since been closed.

During the period covered by this report, CNSC staff raised concerns regarding ongoing issues with CNL's security program at Whiteshell Laboratories. These concerns led to the CNSC issuing an inspector's Order to CNL, to implement changes to CNL's security posture at the site. CNSC staff have evaluated CNL's 2018 performance at the WL site in the SCA of Security as 'below expectations'. CNL has provided an action plan to CNSC staff, and has made significant progress in addressing the conditions of the Order. In June 2019, CNSC staff and CNL provided an update to the Commission on the progress against the Order in a closed session.

CNSC staff expect CNL's performance in this SCA to improve in 2019. CNSC staff have nonetheless increased regulatory oversight of this SCA at Whiteshell in 2019 as a part of its graduated enforcement strategy.

3.4 The Port Hope Area Initiative

For 2018, CNSC staff rated all 14 SCAs for each of the PHP and PGP sites as "satisfactory". CNSC staff performed 11 inspections at PHAI sites in 2018, and issued 37 enforcement actions, four of which remained open at the time of this report. These open actions relate to CNSC staff's requests for further documentation regarding the installation of the baseliner system in Cell 3 of the Port Hope LTWMF, and so do not pose a threat to safety, security or the environment. These actions are being tracked to completion by CNSC staff.

Due to CNSC staff's verification of specific milestones in CNL's construction and remediation work, such as the installation of baseliner systems at the LTWMF, a relatively high number of inspections were carried out by CNSC staff at PHAI sites in 2018. Similarly, CNSC staff also carried out inspections of CNL's remediation verification at the PGP, that is, CNL's work to ensure that a given area is now clean. Such verifications must be carried out prior to CNL backfilling the remediated area.

Figure 11 - CNSC inspector observes CNL's radiation survey of a residential property in Port Hope

CNSC staff's targeting of these milestones has led to a higher number of inspections than otherwise would be the case, given the risk profile of PHAI sites. The relatively high number of enforcement actions at the PHAI in 2018 is due to the higher number of inspections and the non-routine nature of PHAI operations relative to other CNL sites, which have been in steady operation for decades. Enforcement actions at PHAI sites in 2018 were of low safety significance.

3.5 DP, G-1 and NPD Waste Facilities

For 2018, CNSC staff rated all 14 SCAs for each of the DP, G-1 and NPD sites as "satisfactory". CNSC staff performed one inspection at each of the DP, G-1 and NPD sites in 2018, and issued two enforcement actions (both at DP), which have since been closed. These enforcement actions were of low safety significance such as ensuring that the site-specific emergency phone number is listed on radiation zoning signs. Given that these facilities remained in a state of storage with surveillance in 2018, they continued to be categorized as low risk by CNSC staff and received limited inspection effort.

3.6 Focused Inspections at CNL sites in 2018

The CNSC uses an external complaint process as a method to learn of and address unreported non-compliances associated with its regulatory mandate. In some cases, CNSC staff carry out reactive focused inspections in order to address specific concerns raised through this process. In 2018, CNSC staff carried out two such inspections, one at CRL and one at the PHAI sites. These were carried out in response to information received by CNSC staff which alleged deficiencies in safety culture at those sites, specifically related to the raising issues by CNL staff. As part of these inspections, CNSC staff reviewed CNL documents and records, and interviewed current and former CNL staff.

Neither inspection found evidence that CNL discourages staff from raising safety-related issues, although the team identified some reluctance amongst those workers interviewed on CNL sites with regards to raising other issues in general. CNSC staff have requested that CNL carry out a safety culture self-assessment by the end of December 2019, and communicate the results of that self-assessment to CNSC staff by the end of March, 2020.

4 THE CNSC'S ASSESSMENT OF SAFETY AT CNL SITES

The CNSC regulates all aspects of safety at nuclear sites in Canada, including risks to workers, the public and the environment, among others. Information related to the SCAs of radiation protection, environmental protection and conventional health and safety are presented in this section, as these three SCAs are representative of CNL's overall safety performance. In particular, the SCAs of radiation protection and conventional health and safety are a good measure of the safety of workers at CNL sites, while the SCA of environmental protection is a good measure of the safety of the public and the environment.

For both the radiation protection and environmental protection SCAs, the concept of Action Levels (ALs) are used. ALs are a specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program or environmental protection program. If an AL is exceeded, CNL must establish the cause and, if applicable, take steps to restore the effectiveness of relevant programs. Action level exceedances are reportable to the CNSC under the Radiation Protection Regulations and the timing to report any exceedances is provided in the REGDOC-3.1.2 Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills [8].

4.1 The Environment and the Public

Protection of the environment and the public are linked in the SCA of environmental protection, which covers programs that identify, control and monitor all releases of radioactive and hazardous substances and the effects on the environment from facilities or as a result of licensed activities.

CNSC staff concluded that the environmental protection SCA at CNL sites covered by this ROR met applicable regulatory requirements and was thus "satisfactory" in 2018, unchanged from the previous year.

Table 6: Environmental Protection Ratings for CNL Sites in 2018

Safety and control area	CRL	WL	PHP[10]	PGP	DP	G-1	NPD
Environmental protection	SA	SA	SA	SA	SA	SA	SA

CNSC staff have arrived at this conclusion on the basis of independent assessment of CNL's effluent and emissions monitoring data and environmental monitoring data, ongoing evaluation of CNL's Environmental Management System (EMS, a part of CNL's overall Management System), and also on the basis of activities carried out during inspections at CNL sites in 2018.

[10] Note that WNSL-W1-182.0/2021 and WNSL-W1-344-1.8/ind are included under the PHP in this table

Effluent and Emissions Control at CNL sites

At all CNL sites, airborne and waterborne releases of radioactive and hazardous substances remained below regulatory limits in 2018. As required by the Class I Nuclear Facilities Regulations [9], at CRL, WL, DP, G-1 and NPD, CNL implements effluent and environmental monitoring programs. Although they are not Class I facilities, similar programs are also in place for PHAI sites.

Of note in 2018:

- Releases to the environment from the CRL site have decreased due to the permanent shutdown of the NRU reactor, in addition to the decrease in 2016 from the shutdown of the Molybdenum-99 Production Facility. Releases to the environment from the CRL site are tabulated in Tables H-1 and H-2 of Appendix H.
- Notwithstanding the overall decrease in emissions, CRL exceeded Action Levels for environmental protection three times for releases of radioactive substances to the air. These three exceedances were all associated with work being carried out in the NRU facility. Two of these exceedances were in adjacent weeks and were related to a planned defect-fuel experiment being carried out by CNL, while the third was related to work on the heavy water purification system, after NRU had been permanently shut down. CNSC staff have assessed that there was no impact on workers, the public or the environment as a result of these exceedances.
- Following a recommendation from CNSC staff, CNL ceased direct releases of liquid effluent (both radiological and hazardous) to the environment from the Wells Area Sump in NPD, and began collecting that effluent and shipping it to CRL for treatment prior to release. These former releases of liquid effluent did not exceed any action levels or regulatory limits, but were not a best practice for waste management.

CNL's Environmental Management System

The CNSC requires that licensees develop and maintain EMSs in order to provide a documented framework for integrated activities related to environmental protection. CNL has established a corporate EMS, a part of the overall CNL Management System, which applies to all CNL sites in Canada. CNL's EMSs for CRL and WL conform to, and are registered to, the International Standards Organization 14001:2015 Standard, Environmental Management Systems – Requirements with Guidance for Use [10]. EMSs include activities such as establishing annual environmental objectives, goals and targets. CNSC staff confirmed that CNL meets objectives, goals and targets through regular compliance verification activities.

Assessment and monitoring

CNSC staff confirmed that CNL, in accordance with its environmental protection and monitoring programs, successfully carried out required effluent and environmental monitoring, site inspections, environmental awareness training and program implementation for the sites covered by this ROR. Through compliance activities conducted during 2018, CNSC staff concluded that environmental monitoring conducted at CNL sites and the discharge of treated effluent from CNL sites both met regulatory requirements.

Of note in 2018:

- CNL continued to sample and analyze groundwater for radiological and hazardous contaminants at the PHAI, CRL, and WL. Results in 2018 were consistent with historical data, and in some cases concentrations of contaminants have decreased.
- In 2017 the Commission amended the licence for the PHP with regards to in-situ management of arsenic in groundwater under Cell 1. CNL established a trigger level of 50µg/l in groundwater down-slope from Cell 1, and no results in 2018 were above this level.

Protection of the Public

CNL is required to demonstrate that the health and safety of the public are protected from exposures to hazardous substances released from their licensed operations. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

CNSC receives reports of discharges to the environment through the reporting requirements outlined in CNL's licences and LCHs. The review of hazardous (non-radiological) discharges to the environment from CNL's sites indicates that the public and environment are protected.

Based on CNSC staff reviews of the programs at CNL sites, CNSC staff concluded that the public continues to be protected from CNL operational emissions.

Environmental Risk Assessment

CNSC staff develop monitoring requirements and compliance plans for each site, commensurate with the risk associated with the licensed activities. The Environmental Risk Assessment (ERA) is a systematic process used to identify, quantify and characterize the risk posed by contaminants and physical stressors in the environment to human and non-human (biological) receptors. Currently, all CNL sites covered by this ROR have acceptable environmental protection programs in place to ensure the protection of the public and the environment.

Of note in 2018:

- CNSC staff evaluated the results of CNL's 2018 groundwater monitoring at the PHP and CRL, and concluded that results remain consistent with historic data and in some cases are showing improving results over time.
- CNSC staff continue to monitor CNL's sampling of groundwater seeping through the bluffs overlooking Lake Ontario at the PGP, which contain elevated levels of fluoride, arsenic, uranium and nitrates. The water quality in these seeps is expected to improve over time as CNL continues to excavate and remove the legacy wastes which is the source of these contaminants.
- CNSC staff received an updated ERA covering the entire CRL site, as an update to the previous 2012 ERA. Among other topics, the 2018 ERA covers buildings/facilities/infrastructure constructed or in the process of construction since 2012, as well as buildings demolished, decommissioned or in the process of decommissioning since 2013. CNSC staff are reviewing this document and will provide comments to CNL in 2019.
- CNSC staff reviewed CNL's Environmental and Biophysical Monitoring Plan for both the Port Hope and Port Granby projects. Monitoring data for all environmental media are within or below the predictions made in the previous Environmental Assessments for those projects, demonstrating that the risks from emissions from PHAI sites are very low.

4.1.1 Independent Environmental Monitoring Program (IEMP) Results

In addition to licensees carrying out required monitoring of their operations, the CNSC carries out its Independent Environmental Monitoring Program (IEMP) to verify and confirm that the public and the environment around licensed nuclear facilities remain safe. The IEMP is a regulatory tool that complements the CNSC's ongoing compliance verification program. The IEMP involves CNSC staff taking samples from publicly accessible areas around nuclear sites, and measuring and analyzing the level of relevant contaminants in those samples.

Samples may be taken for air, water, soil, sediment, vegetation, and some food, such as locally-grown produce. Samples are analyzed at the CNSC's laboratory for both radiological and non-radiological contaminants related to the activities of the nuclear site. CNSC staff compare contaminant levels in samples to applicable guidelines and/or natural background levels. All IEMP sample results and associated standards are posted on the CNSC's IEMP website, which is linked in Appendix I.

Figure 12: CNSC staff collect water samples on the St. Lawrence River near G-1 and G-2 in September 2018

In 2018, CNSC staff conducted independent environmental monitoring around the sites covered by this CMD as shown in Table 7. IEMP results for the areas surrounding these sites indicate that the public and the environment in the vicinity of these sites are protected.

Table 7: IEMP Activities Around Sites Covered by this Report in 2018

Site	Date(s)
Nuclear Power Demonstration	August and October 2018
Gentilly-2 Nuclear Facility (including the Gentilly-1 Waste Facility)	September 2018

It is a priority for the CNSC that IEMP sampling reflects Indigenous traditional land use, values and knowledge where possible. As part of the CNSC's ongoing relationship building with Indigenous communities, CNSC staff collaborated with the Algonquins of Ontario (AOO) in the development of the sampling plan for the NPD Waste Facility. CNSC staff included many of AOO requested locations in the sampling plan conducted in August. Additionally, in October, CNSC staff collected a variety of samples with the aid of AOO Knowledge Holders. This included traditional and medicinal plants. The results were provided to the AOO in May 2019.

CNSC staff plan to carry out IEMP sampling campaigns in the vicinity of the CRL, DP, and PHAI sites in 2019.

4.2 Protection of Workers at CNL Sites

The mandate of the CNSC includes consideration of the safety of all workers at licensed sites, including licensee staff, contractors, and sub-contractors, etc. The SCAs of radiation protection and conventional health and safety are considered to be the most direct measure of the licensee's performance in these areas.

Table 8: Radiation Protection and Conventional Health and Safety Ratings for CNL Sites in 2018

Safety and control area	CRL	WL	PHP[11]	PGP	DP	G-1	NPD
Radiation protection	SA	SA	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA	SA	SA

4.2.1 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations* [11]. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained as low as reasonably achievable (ALARA). CNL sites are required to implement and maintain a radiation protection program; this program meets the requirements of the *Radiation Protection Regulations*.

For 2018, CNSC staff rated the radiation protection SCA at all CNL licensed sites as "satisfactory" based on regulatory oversight activities. CNSC staff have come to these conclusions on the basis of inspections performed at CNL sites, along with desktop reviews.

Application of ALARA

In 2018, CNL continued to implement the ALARA program, and the subsidiary site-specific radiation protection plans for the sites covered by this ROR. These site-specific plans contain commitments to apply ALARA measures for all CNL activities.

CNL's application of ALARA within their radiation protection program includes management commitment and oversight, personnel qualification and training, design analyses of facilities and systems, provision of protective equipment and ALARA assessments/reviews of radiological activities.

[11] Note that WNSL-W1-182.0/2021 and WNSL-W1-344-1.8/ind are included under the PHP in this table

The CRL site is the most complex of CNL's sites, with diverse work activities that represent radiological risks to workers. At CRL in 2018, CNL developed 39 radiological work assessments and four radiological work plans/procedures to ensure that work activities at the CRL site were consistent with the ALARA principle. These documents incorporate radiological control hold points and radiological control measures.

Worker dose control

At CNL, workers, including employees and contractors, conducting work activities which present a reasonable probability of receiving an occupational dose greater than 1 millisievert (mSv)/year are considered as Nuclear Energy Workers (NEWs). Workers, whose job function do not present a reasonable probability of receiving an occupational dose greater than 1 mSv/year, are considered non-NEWs. Radiation exposures to NEWs and to non-NEWs are monitored by CNL to ensure compliance with the CNSC's regulatory dose limits and to maintain radiation doses ALARA.

CNL uses CNSC licensed dosimetry for measuring and controlling external doses. Internal exposure is assessed through a routine bioassay program dependent on worker tasks or duties.

In 2018, no worker at a CNL site (whether a NEW or a non-NEW) received a radiation exposure in excess of the CNSC regulatory effective dose limits. More detailed data on doses to NEWs and non-NEWs at CNL sites is available in Appendix E.

Radiation protection program performance

Radiation protection program performance at CNL sites was assessed in 2018 through CNSC staff compliance activities, including inspections and desktop reviews. CNL's compliance with the *Radiation Protection Regulations* and CNSC licence requirements was satisfactory.

Action levels for radiological exposures are established for each of the CNL sites as part of CNL's radiation protection program. In March of 2018, a radiation protection action level exceedance occurred at the PGP. A NEW received a committed effective dose from exposure to radon of 0.70 mSv and a whole body effective dose of 0.46 mSv, for a total of 1.16 mSv effective dose over a 4 week period, exceeding CNL's action level of 1 mSv over a 4 week period. The worker was present in waste excavation areas, where levels of radon gas above natural background are likely. Through an investigation, CNL concluded that this action level exceedance did not represent a loss of control of their radiation protection plan, due to the nature of the work activities being performed by the worker. CNSC staff are satisfied with CNL's reporting and investigation of the action level exceedance. CNL's radiation protection action levels at the PHAI had been in force since before the excavation of waste began at PHAI sites. In February 2019, CNL revised the PHAI radiation protection plan action levels to 3 mSv over a 4 week period, which better aligns with current work activities at the PHAI sites and the likelihood of exposure to radon at levels above natural background.

There were no other radiation protection action level exceedances in 2018 at the other sites covered by this ROR.

Radiological hazard control

Radiation and contamination monitoring programs continued to be implemented at CNL's sites in 2018, to control and minimize radiological hazards and the spread of radioactive contamination. These programs include the use of radiological safety zones to maintain effective management of radiological hazards, along with control measures and monitoring for surface contamination, personnel contamination, radiation dose rates, and airborne radioactivity.

CNL performed routine contamination monitoring of the workplace to identify surface contamination in order to prevent inadvertent transfer of contamination. Dose rate measurements and, where appropriate, in-plant air monitoring were routinely performed in the workplace to confirm that radiation exposures are kept ALARA. The radiological hazard surveys conducted in 2018 by CNL's staff did not identify any adverse trends, and were consistent with expected radiological conditions.

Estimated dose to the public

As part of their annual reporting to the CNSC, CNL provides data on dose to a hypothetical member of the public, who is representative of someone who spends considerable time in proximity to the licensed site. In all cases, CNL's data indicates that doses to the public resulting from CNL's operations are orders of magnitude less than the 1 mSv limit prescribed in the *Radiation Protection Regulations*. This dose data is available in Appendix F.

4.2.2 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and protect workers. CNL licenced sites must develop, implement and maintain effective safety programs to promote safe and healthy workplaces and minimize incidences of occupational injuries and illnesses.

For 2018, CNSC staff rated the conventional health and safety SCA at all CNL licenced sites as "satisfactory" based on regulatory oversight activities. These included inspections, desktop reviews of CNL documentation, and an ongoing review of items raised via CNL's 'improvement action' or ImpAct tool. CNL uses the ImpAct tool to record all incidents at all CNL sites, from relatively minor occurrences such as wildlife on site roads, to events which are reportable to the CNSC. All of CNL's ImpAct data is available to CNSC staff, whether that data relates to events which must be reported to the CNSC or to events of lower significance. Overall, the compliance verification activities conducted by CNSC staff at CNL sites confirmed that CNL continues to view conventional health and safety as an important consideration.

Practices

In addition to the NSCA and its associated regulations, CNL's activities must comply with Part II: Occupational Health and Safety of the Canada Labour Code [12], its Canada Occupational Health and Safety Regulations [13], and other applicable federal and provincial health and safety acts and regulations.

CNL's Occupational Safety and Health program applies to all work performed by CNL employees, and CNL is accountable for ensuring the health and safety of contractors at work places controlled by CNL. When evaluating safety practices at a site, CNSC staff do not distinguish between the licensee's own staff and staff employed by contractors or sub-contractors, considering all to be 'workers' and equally subject to CNSC requirements and to the licensee's policies and procedures for the site. This is relevant for CNL as at many CNL sites there are numerous contractors performing a wide variety of different tasks.

During 2018, CNSC staff verified CNL safety practices during compliance inspections and site walk-downs, all of which incorporated the verification of aspects related to conventional health and safety, as well as during desktop reviews and technical assessments.

Performance

The key performance indicators for conventional health and safety are the number of recordable lost-time injuries (RLTI) that occur per year, RLTI severity and RLTI frequency. An RLTI is defined as a workplace injury that results in the worker being unable to return to work for a period of time. RLTI severity and frequency provide context to the number of RLTIs. RLTI severity quantifies the number of lost work days experienced per 100 employees, while RLTI frequency quantifies the number of lost-time injuries relative to the number of hours worked.

Data on RLTI, RLTI frequency and RLTI severity since 2014 are included in Appendix G for all sites covered by this ROR.

There were no RLTIs at PHAI sites, DP, NPD, and G-1 in 2018. Both CRL and WL had RLTIs in 2018, but these sites also had relatively more hours worked than the sites that had no RLTIs.

For comparison, CNL's reported RLTI frequency is lower than lost time injury rates at most comparable industries in Ontario (for instance, construction and manufacturing) in 2018, as per the Ontario Workplace Safety and Insurance Board (WSIB) data [14] included in Appendix G. CNSC staff consider this to be a conservative comparison because Ontario LTI data includes only injuries for which compensation claims were allowed, rather than all reportable injuries as is included in CNL's data. Ontario numbers are also lower than those for Manitoba, the location of the only CNL site which is both outside of Ontario and reported an LTI in 2018. On the basis of compliance activities carried out in 2018 and a review of CNL's data, CNSC staff are satisfied with CNL's conventional health and safety performance at the sites covered by this ROR.

5 EVENTS AND OTHER MATTERS OF REGULATORY INTEREST

5.1 Reportable Events

Detailed requirements for reporting unplanned situations or events at CNL licensed sites to the CNSC are included in the applicable LCH. CNSC Regulatory Document 3.1.2 *Reporting Requirements for Non-Power Reactor Class I Facilities and Uranium Mines and Mills* came into force for applicable CNL licensees in January 2019. Over the period covered by this report, CNL has complied with the requirements for submission of these reports.

A summary of events reported to the CNSC by CNL in 2018 are presented in Table 9.

Table 9: Number Reportable Events by Site from January 1, 2018 to December 31, 2018

Site	Number of Events
Chalk River Laboratories	35
Douglas Point Waste Facility	0
Gentilly-1 Waste Facility	0
Nuclear Power Demonstration Waste Facility	2
Whiteshell Laboratories	0
Port Hope	5
Port Granby	5

For each event, CNL completed an investigation and established corrective actions, where appropriate. For simpler events, CNL reported on both the event and the corrective actions in one report, while for more complicated events, multiple reports (e.g. initial verbal report, preliminary written and full written reports) may be submitted. In all cases, CNSC staff reviewed this information, came to a consensus determination of qualitative safety significance, and further steps (follow-up questions, incorporation of follow-up activities into subsequent compliance activities, etc.) were taken as appropriate. For reportable events which occurred in 2018, CNSC staff are satisfied with CNL's corrective actions.

Many of these events were of low safety significance, such as the failure to calibrate radiation detectors in unoccupied buildings at the prescribed frequency, and had no impact on the health and safety of workers or the public, the environment, or security.

Eight events at CRL were directly related to the operation of the now shut-down NRU reactor. There were three instances of releases of radioisotopes to the environment which exceeded action levels, therefore necessitating reporting to the CNSC and an internal investigation by CNL. These releases did not exceed regulatory limits. Events related to NRU operation will no longer occur now that it is permanently shut down, although work continues in the NRU building in order to transition that facility into a state of storage with surveillance.

Events which CNSC staff assess as meeting specific risk criteria are the subject of "Event Initial Reports" from CNSC staff to the Commission. In 2018, there were no Event Initial Reports related to events at CNL sites. There have been two Event Initial Reports thus far in 2019, which for completeness are shown in Table 10 below and are available on the CNSC's website. CNSC staff continue to follow up on both events; they will be covered in more detail in the 2019 ROR for CNL sites.

Table 10: Event Initial Reports at CNL Licensed Sites from January 1, 2018 to Present

CMD Number	Event
19-M9	Worker injured on January 9, 2019 at CNL Port Granby Project
19-M10	Power Outage at Chalk River Laboratories

5.2 Public Engagement

The area of public engagement has two aspects, those of activities carried out directly by CNSC staff, and of activities carried out by CNL.

5.2.1 CNSC staff

The NSCA mandates the CNSC to disseminate objective scientific, technical and regulatory information to the public concerning its activities and the activities it regulates. CNSC staff fulfill this mandate in a variety of ways, including the publishing of RORs and through 'Meet the Regulator' sessions. CNSC staff also seek out other opportunities to engage with the public and Indigenous groups, often participating in meetings or events in communities with interest in nuclear sites. These allow CNSC staff to answer questions about the CNSC's mandate and role in regulating the nuclear industry, including CNL's sites.

A list of outreach activities carried out by CNSC staff in 2018 and targeted at, or otherwise relevant to, CNL's activities is presented in Table 11 below. These are separate from CNSC staff's Indigenous engagement activities described in Section 5.3 below

Table 11: CNSC Staff Outreach Related to CNL Sites and Projects in 2018

Date	Event	Location
June, 2018	Meet the Regulator Session – CNL focus	Ottawa, ON
June, 2018	Meet the Regulator Session	Gatineau, QC
September, 2018	Port Hope & District Agricultural Society Fair, Port Hope, ON	Port Hope, ON

Of the events listed, the Port Hope & District Agricultural Society Fair in Port Hope, ON, was considered to be particularly successful by CNSC staff. CNSC staff participated in a pre-existing and well-attended event in the community and were able to discuss the CNSC's role and mandate with a large number of members of the public from the region.

Figure 13 - CNSC staff speaking to members of the public at the 2018 Port Hope & District Agricultural Society Fair

Given the success of that event, and given CNL's many new plans for its various sites, in 2019 CNSC staff have continued to carry out targeted outreach activities at pre-existing events in communities near CNL's sites.

5.2.2 Canadian Nuclear Laboratories

To ensure open and transparent information about nuclear facilities is available to the public, the CNSC requires licensees to implement and maintain a public information program and disclosure protocol (PIDP). All of the CNL sites covered by this ROR are required to have such a program, and CNSC staff consider that CNL's PIDPs for the sites covered by this ROR meet all requirements.

Public Information Program for CRL

CNL's PIDP for the CRL site meets all regulatory requirements for public information and disclosure. CNL provides open and transparent means for the public to obtain desired operational, environmental, and safety information about the facility. CNL has a public website, listed in Appendix I, where members of the public and Indigenous groups can access extensive environmental reporting and information about reportable events at CNL sites. CNL also has regular engagement sessions with the community to update stakeholders on licensed activities and uses multiple communications tools to allow the public access to facility information. CNSC staff consistently oversee CNL's implementation of the PIDP to ensure that CNL continues to meet its obligations regarding dissemination of information.

Public Information Program for PHAI

CNL's public information program for the PHAI has been developed based on CNSC requirements for public information and disclosure, and allows members of the public to obtain plain-language information on all aspects of the PHAI projects. CNL also ensures timely public disclosure following the occurrence of any unplanned events at PHAI sites via its website. CNSC staff confirm through compliance activities that CNL proactively shares project-related information with interested parties and continues to build relationships with its stakeholders. CNL's public information strategies and approaches ensure the Port Hope and Port Granby communities have access to up-to-date information on the PHAI.

Public Information Program for WL, DP, G-1 and NPD

CNL's public information program for WL, DP, G-1 and NPD has been developed in accordance with CNSC regulatory requirements, and allows members of the public to obtain plain language information on all aspects of these projects. CNL maintains up-to-date information on all decommissioning projects on their website, and ensures appropriate public disclosure following the occurrence of unplanned events. CNL also regularly engages with their communities to confirm they are receiving desired information on project activities.

5.3 Indigenous Consultation and Engagement

As an agent of the Government of Canada and as Canada's nuclear regulator, the CNSC recognizes and understands the importance of consulting and building relationships with Indigenous peoples in Canada.

CNSC staff are committed to building long-term relationships with Indigenous groups who have interests in nuclear facilities' regulation within their traditional and/or treaty territories. By pursuing informative and collaborative ongoing interactions, the CNSC's goal is to build partnerships and trust. The CNSC's Indigenous engagement practices, which include information sharing and funding support (through the CNSC's Participant Funding Program (PFP)) for Indigenous peoples to meaningfully participate in Commission proceedings and ongoing regulatory activities, are consistent with the principles of upholding the honour of the Crown and reconciliation.

CNSC staff efforts in 2018 supported the CNSC's ongoing commitment to meeting its consultation obligations and building relationships with Indigenous peoples with interests in the CNL sites covered by this ROR. In particular, CNSC staff continued to work to meet its Duty to Consult obligations with regards to CNL's proposed projects (the NSDF, the NPD Closure Project, and in-situ decommissioning of the WR-1 reactor), topics discussed further in Sections 5.5 and 5.9 below. CNSC staff also continued to identify opportunities for formalized and regular engagement throughout the lifecycle of the other CNL sites, including meetings and workshops. Through this engagement, CNSC staff welcomed the opportunity to discuss and address all topics of interest and concern to the Indigenous communities.

In addition, to ensure that interested Indigenous communities were made aware of this ROR, CNSC staff provided interested communities with notice of the PFP opportunity to review and comment on the report and the opportunity to submit a written intervention and/or appear before the Commission as part of the Commission meeting. As well, copies of the report will be sent to all Indigenous communities and organizations who have requested to be kept informed of activities at the CNL sites.

To ensure licensees engage Indigenous communities, in February 2016 the CNSC published REGDOC-3.2.2, *Aboriginal Engagement*, which sets out requirements and guidance for licensees proposing projects that may raise the Crown's duty to consult. CNSC staff continued to monitor the engagement work conducted by CNL to ensure that they continue to actively engage and communicate with Indigenous groups who have interest in their facilities, and that they are following the guidance of REGDOC 3.2.2 when appropriate. Below is a summary of the engagement activities specific to each facility in this report conducted by CNSC and CNL during the reporting period.

5.3.1 Chalk River Laboratories and Nuclear Power Demonstration

The CRL and NPD sites fall within the traditional territories of the Algonquins of Ontario (AOO), Algonquins of Quebec, the Métis Nation of Ontario and the Williams Treaties First Nations. The Indigenous groups and organizations who have expressed a direct interest in the CRL and NPD sites include: the Algonquins of Ontario, Algonquins of Pikwàkanagàn, Métis Nation of Ontario (MNO), the Algonquin Anishinabeg Nation Tribal Council, Kebaowek First Nation, Kitigan Zibi Anishinabeg First Nation, Anishinabek Nation, the Algonquin Nation Secretariat, and Williams Treaties First Nations: Alderville First Nation, Beausoleil First Nation, the Chippewas of Georgina Island First Nation, Chippewas of Rama First Nation, Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island First Nation.

CNSC consultation and engagement activities

In 2018 the focus of CNSC staff's consultation and engagement activities with regards to the CRL and NPD sites has been on the proposed NSDF for low level waste at CRL and the proposed NPD closure project. CNSC staff have continued to send letters with key project information updates, conduct phone calls, and engage in meetings with the above mentioned groups to discuss their areas of interest related to the proposed NSDF and NPD closure projects and how the CNSC will be incorporating their comments and addressing their concerns as part of the regulatory process, including the ongoing environmental assessments being conducted under the *Canadian Environmental Assessment Act*, 2012 (CEAA 2012, [15]) for each project. In addition, through its PFP, the CNSC has funded two Indigenous Knowledge (IK) studies for AOO and MNO in relation to the two projects. The CNSC also continued to offer funding under the PFP to interested Indigenous groups to help them participate in the remainder of the regulatory process, including for additional meetings with CNSC staff. The CNSC will continue to consult with Indigenous groups who have interests or concerns in relation to the NSDF and NPD closure projects, as well as on other areas of interest related to CRL.

CNL engagement activities

CNSC staff observed that CNL has a dedicated Indigenous engagement program that covers their operations and activities at the CRL and NPD sites.

Consistent with the requirements and guidance of CNSC REGDOC 3.2.2: *Aboriginal Engagement* [16], throughout 2018, CNL met and shared information with interested Indigenous communities and organizations. These efforts have included emails, letters, meetings, site visits and tours, community visits, and workshops among others with a major focus being on the NSDF and NPD Closure projects. CNL is also in the process of negotiating Memorandums of Understanding with AOO and MNO, and has contributed funding to above-mentioned IK studies conducted in relation to NSDF and NPD closure by AOO and MNO.

CNSC staff continue to be satisfied with the level and quality of Indigenous engagement conducted by CNL with regards to their operations and proposed projects at the CRL and NPD sites and continue to adhere to the guidance of REGDOC 3.2.2.

5.3.2 Whiteshell Laboratories

The WL site falls within the traditional territories of Sagkeeng First Nation, Manitoba Métis Federation (MMF), Brokenhead Ojibway Nation, Black River First Nation, Hollow Water First Nation, and the First Nations represented by Grand Council of Treaty 3 and Chiefs of Ontario: Northwest Angle #33, Shoal Lake #40 First Nation, Wabaseemoong Independent Nations, and Iskatewizaagegan #39 Independent First Nation. These Indigenous groups and organizations have all expressed interest in the WL site.

CNSC consultation and engagement activities

In 2018 the focus of CNSC staff's consultation and engagement activities with regards to the WL site has been on the proposed in-situ decommissioning of WR-1 and the proposed licence renewal for the WL site. CNSC staff have continued to send letters with key project information updates, conduct phone calls, and engagement meetings with the above mentioned groups to discuss their areas of interest related to WR-1 and WL relicensing. CNSC staff have continued to discuss with interested Indigenous groups how their comments and concerns will be incorporated and addressed as part of the regulatory process, including the ongoing environmental assessment being conducted under CEAA 2012 for WR-1.

In addition, through its PFP the CNSC has funded three IK studies in relation to the WR-1 project, including for Sagkeeng First Nation, MMF, and one for Black River First Nation, Brokenhead Ojibway Nation, and Hollow Water First Nation. The CNSC also continued to offer funding under the PFP to interested Indigenous groups to help them participate in the remainder of the regulatory process including additional meetings with CNSC staff. The CNSC will continue to consult with Indigenous groups who have interests or concerns in relation to WR-1, the WL licence, as well as on other areas of interest related to WL.

CNL engagement activities

CNSC staff observed that CNL has a dedicated Indigenous engagement program that covers their operations and activities at the WL site.

Consistent with the requirements and guidance of CNSC REGDOC 3.2.2: *Aboriginal Engagement*, throughout 2018, CNL met and shared information with interested Indigenous communities and organizations. These efforts have included emails, letters, meetings, site visits and tours, community visits, and workshops among others with a major focus being on WR-1. CNL has also contributed funding to the above-mentioned IK study conducted in relation to WR-1 by Sagkeeng First Nation. CNSC staff continue to be satisfied with the level and quality of Indigenous engagement conducted by CNL with regards to their operations and proposed projects at WL and continue to adhere to the guidance of REGDOC 3.2.2.

5.3.3 The Port Hope Area Initiative

The PHAI falls within the traditional territories of the Williams Treaties First Nations and the MNO. The Indigenous groups and organizations who have expressed a direct interest in the Port Hope and Port Granby Projects include: Mohawks of the Bay of Quinte, MNO, and the Williams Treaties First Nations: Alderville First Nation, Beausoleil First Nation, the Chippewas of Georgina Island First Nation, Chippewas of Rama First Nation, Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island First Nation.

CNSC consultation and engagement activities

CNSC staff regularly engage with Indigenous groups with interest in the Port Hope Project and the Port Granby Project. In 2018, CNSC staff met with the Williams Treaties First Nations, and MNO Region 8 in order to provide updates on a number of CNSC regulated facilities and activities in their traditional territories, including the Port Hope and Port Granby projects. As part of these meetings the interested Indigenous groups did not raise any issues or concerns with regards to these CNL projects. However, CNSC staff welcome the opportunity to continue to provide project updates and discuss any areas of interest and concern with Indigenous groups in relation to the Port Hope and Port Granby projects.

CNL engagement activities

CNSC staff observed that CNL has a dedicated Indigenous engagement program that covers their remediation sites. CNSC staff confirm that CNL invited representatives from Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island, and Alderville First Nation for an in-person engagement in November 2018 for an update on the Port Hope Area Initiative and a tour of the project sites. CNL also continues to send information about Port Hope and Port Granby and their potential impacts on the environment to interested Indigenous groups, as well as invitations to participate in events and public information sessions.

5.3.4 DP and G-1 Waste Facilities

The Douglas Point reactor falls within the Traditional Territory of the Chippewas of Nawash Unceded First Nation and Saugeen First Nation, who together form the Saugeen Ojibway Nation (SON). The Douglas Point reactor also falls within the asserted traditional harvesting territory of the Métis Nation of Ontario (MNO). In addition, the Douglas Point reactor falls within the asserted traditional harvesting territory of the Historic Saugeen Métis (HSM). The Indigenous groups and organizations who have expressed a direct interest in Douglas Point include SON, MNO, and HSM. The G-1 site lies within the traditional territory of the Abénakis of Wôlinak and Odanak, represented by the Grand Conseil de la Nation Waban-Aki (GCNWA) as well as the Nation huronne-wendat.

CNSC consultation and engagement activities

CNSC staff regularly engage with Indigenous groups with an interest in the Douglas Point reactor. In 2018, CNSC staff met with SON, HSM and MNO Region 7 on multiple occasions in order to provide updates on a number of CNSC regulated facilities and activities of interest. Although the discussions during 2018 focused on the Bruce Nuclear Generating Station licence renewal, CNSC staff welcome the opportunity to discuss any areas of interest with Indigenous groups in relation to Douglas Point as they arise.

More recently in May 2019, CNSC staff signed a Terms of Reference with SON to formalize the engagement on numerous items regarding nuclear activities in SON Traditional Territory. CNSC staff are open to including updates related to the Douglas Point reactor as a part of their formalized engagement with SON, should SON express an interest. CNSC staff are also in the process of signing a Terms of Reference with MNO to formalize engagement. CNSC staff are open to including activities related to the Douglas Point reactor as part of their formalized engagement with MNO Region 7, should they express an interest. CNSC staff have also signed a Terms of Reference with HSM to formalize engagement. CNSC staff are open to discussing the Douglas Point reactor as part of their formalized engagement with HSM, should they express an interest.

In 2018, CNSC staff have not received any questions, comments or feedback from Indigenous groups with an interest in the Gentilly site regarding issues or concerns they may have in relation to the Gentilly-1 reactor. However, CNSC staff welcome the opportunity to discuss any areas of interest with Indigenous groups in relation to Gentilly-1 upon request.

CNL engagement activities

CNSC staff observed that CNL has a corporate wide program dedicated to Indigenous engagement. In 2018, CNL has not received any questions or communications from Indigenous groups expressing interest in DP or G-1. CNL has informed CNSC staff that they welcome the opportunity to engage with Indigenous groups on these facilities should they express an interest.

5.4 Possible Small Modular Reactors at CNL sites

In April of 2018, CNL extended an invitation to proponents of Small Modular Reactor (SMR) demonstration projects to be considered in CNL's evaluation process for the possible construction and operation of an SMR at a site owned by AECL. In March of 2019, Global First Power (GFP), the proponent of a 5MWe high-temperature gas cooled reactor, submitted to the CNSC an application for a licence to prepare a site for an SMR at the CRL site. In June of 2019, CNSC staff received updated documents from GFP in support of the application, and in July of 2019, the Project Description was posted on the Canadian Environmental Assessment Agency's website for comment by the public, Indigenous groups, and other interested stakeholders.

Decisions on the environmental assessment pursuant to CEAA 2012 and the application for the licence to prepare a site will be made by the Commission at a future public hearing.

5.5 CNL's Proposed Near Surface Disposal Facility

CNL is currently proposing to construct and operate a low-level radioactive waste disposal facility known as the Near Surface Disposal Facility (NSDF) on a portion of the CRL site. The construction and operation of such a facility is not included in the current licensing basis for the CRL site.

The NSDF is intended to accept low-level radioactive waste, predominantly that generated by CNL's decommissioning work, contaminated soil, and legacy waste from past operations. The waste CNL proposes to accept into the NSDF will largely be from the CRL site, but will also include a small amount of waste from other CNL sites. CNL submitted a draft Environmental Impact Statement (EIS) in March of 2017 for comment by the public, the CNSC and other provincial and federal departments, and submitted a licence application to the CNSC at the same time. CNL received extensive comments on the draft EIS, and CNSC staff further provided extensive comments on technical documentation related to the licence application. CNL expects to submit a revised EIS and licence application in October of 2019.

The NSDF proposal requires an EA decision under CEAA 2012 by the Commission affirming that the project will not cause significant adverse environmental effects. Should the Commission decide favourably, the proposal requires approval by the Commission to proceed with the construction of the facility. The possible construction and operation of the NSDF is out of the scope of this ROR.

5.6 Certified Staff at CRL

Condition 2.3 of the CRL licence requires that persons appointed to the positions of Senior Reactor Shift Engineer and NRU Health Physicist be certified by the CNSC. This licence condition was put in place when NRU was still an operating reactor. The position of Senior Reactor Shift Engineer became obsolete once NRU was permanently defueled and dewatered.

At present, CNSC staff confirm that CNL retains an adequate complement of certified NRU Health Physicists to support radiological work in NRU. CNSC staff continue to evaluate the conditions under which the requirement for certified NRU Health Physicists will no longer apply.

5.7 Fitness for Duty at High Security Sites

In January of 2018, the CNSC published REGDOC-2.2.4 *Fitness for Duty, Volume II: Managing Alcohol and Drug Use*, version 2 [17]. This REGDOC "…sets out requirements and guidance for managing fitness for duty of workers in relation to alcohol and drug use and abuse at all high-security sites, as defined in the *Nuclear Security Regulations*." REGDOC-2.2.4 Volume II, version 2, will apply to the CRL and WL sites, and requires that licensees use a urine drug-testing process to test staff in safety-critical and safety-sensitive positions for the presence of drugs above specified limits.

Licensees have requested that their implementation dates for this REGDOC be delayed to allow consideration of industry-proposed amendments regarding the use of oral fluid testing. CNSC staff have agreed to this delay and are assessing the industry-proposed amendments. Should the REGDOC be amended, the revised draft will be subject to Commission approval at a future date.

5.8 Updates to CNL's Corporate Programs

During 2018 CNL has continued its work to transition its management system away from the older suite of AECL documentation and towards a modern CNL-specific set of documentation. The most visible aspect of this work for CNSC staff is CNL's creation and revision of their Corporate-level program documentation, which can apply to all sites under the control of CNL and as such are the keystone of their management system.

Key Corporate-level documents are listed in the LCHs for multiple CNL sites, and form part of the licensing basis for those sites. CNSC staff consider that including these high-level documents in LCHs renders all relevant subsidiary CNL documents in the licensing basis. This provides CNSC staff with access on request to the documentation necessary to verify CNL's compliance with CNSC requirements.

During 2018, CNSC staff received 52 Corporate-level documents from CNL for technical review. These reviews often resulted in comment being returned to CNL for action or for consideration, which in turn can lead to revised documents being provided by CNL to CNSC staff for comment.

5.9 Waste and Decommissioning

CNL's activities at each of the sites covered by this report involve the generation, storage and managing of radioactive wastes. CNL has pursued accelerated decommissioning strategies at many of its sites, resulting in an actual or planned increase in the rate of generation of radioactive wastes. CNSC staff maintain oversight of CNL's current and future management of radioactive wastes via inspections, desktop reviews, and technical assessments.

Radioactive wastes stored on the sites covered by this report consist of high, intermediate and low-level radioactive waste. The inventory of wastes stored at CNL sites is included in *Canada's Sixth National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (October 2017)* [18]. The report can be found on the CNSC's website.

During 2018, CNL continued to employ effective programs for the characterization, minimization, segregation, handling, storage, monitoring, and processing (where applicable) of radioactive and hazardous wastes. CNL sorts and compacts wastes where possible in order to minimize the volume which must be stored.

CNL participated in "Waste Reduction Week in Canada" during October of 2018. The goal of this annual program is to educate, engage, and empower Canadians to reduce, reuse, and recycle waste. During the waste reduction week, CNL conducted various promotional activities to engage employees to learn about waste reduction and environmental sustainability.

The Chalk River Site

Two major activities related to radioactive waste were underway at CRL in 2018. Firstly, CNL continued to retrieve fuel from legacy tile holes for transfer to the Fuel Packaging and Storage facility. CNL also began to store sea containers of radioactive waste generated through decommissioning work; this work began once CNSC staff determined that it was within the licensing basis for the CRL site. CNL intends to eventually transfer much of this material to the proposed NSDF, should that facility receive Commission approval. CNSC staff carried out inspections of CRL's Waste Management and Decommissioning program in 2018 to ensure the ongoing safety of these activities. CNSC staff also reviewed three Detailed Decommissioning Plans for buildings at CRL, and CNL's Comprehensive Preliminary Decommission Plan for the CRL site. CNSC staff have assessed and concluded that these documents met regulatory requirements. During 2018, CRL continued to accept radioactive waste from locations across Canada, and continued to use off-site contractors for volume reduction work on select wastes.

CNL continued decommissioning work in various facilities on the CRL site in 2018, including in ancillary buildings associated with the NRX reactor and the Plutonium Recovery Laboratory, among others.

Accelerated Decommissioning Proposals for WL and NPD

Decommissioning at CNSC licensed sites must be carried out according to decommissioning plans which are reviewed and accepted by the CNSC. CNL has such plans in place, but for the WL and NPD sites, CNL is now seeking to change both the timelines and the methods to be used to decommission.

The CNSC has received formal proposals from CNL to accelerate decommissioning at NPD and the WR-1 reactor at WL. Both of these proposals involve 'in-situ decommissioning', where major underground structures would be left in place, filled with grout, and capped. In both cases, in-situ decommissioning is not permitted by the current licensing basis, nor is it the end-state documented in CNL's current CNSC staff-accepted decommissioning plans.

For each of the NPD and WR-1 projects, CNL has submitted a licence application to the CNSC and prepared a draft EIS for comment by the public, the CNSC and other provincial and federal departments. CNSC staff undertook a review of CNL's draft EISs and conducted licensing reviews pursuant to the NSCA and its associated regulations. As the responsible authority, and working with other federal departments, CNSC staff have identified a number of areas where additional information will need to be included in the final EISs and other technical supporting documentation. For each project, complete licensing and EIS submissions are required before CNSC staff can complete their assessment and proceed to public hearings.

For each project, following receipt of a complete licensing submission and final EIS, CNSC staff will write a CMD containing staff's assessment of the licence amendment and the EA report, in support of a hearing on the topic. This CMD will be available to the public and Indigenous groups prior to the Commission's public hearing, the date of which has not been set. The public will be offered the opportunity to submit written and/or oral interventions. Because there will be separate Commission decisions on these projects, they are out of the scope of this ROR.

Financial Guarantees for CNL sites

AECL is a Schedule III, Part 1 Crown Corporation under the *Financial Administration Act* and an agent of Her Majesty in Right of Canada. As an agent of Her Majesty in Right of Canada, AECL's liabilities are ultimately liabilities of Her Majesty in Right of Canada. While the restructuring of AECL has seen the ownership of CNL transferred to the Canadian National Energy Alliance, AECL retains ownership of the lands, assets and liabilities associated with CNL's licences. These liabilities have been officially recognized by the Minister of Natural Resources in a letter dated July 31, 2015 [19]. CNSC staff thus consider that specific financial guarantees for AECL's sites are not required.

5.10 Emergency Management at the CRL site

During the January 2018 relicensing hearing for the CRL site, the Commission requested an update on emergency planning at the CRL site following the permanent shutdown, defueling and dewatering of the NRU reactor.

CNL has assessed that a severe accident in the NRU facility, that is, an accident involving severe fuel degradation, is no longer possible. CNSC staff concur with this assessment. Due to this reduction in risk, CNL's Severe Accident Management Program (designed specifically for NRU operations) is no longer in use. Ongoing work in NRU is now managed under CNL's Emergency Operating Procedure, as is used for the remainder of the CRL site. CNSC staff are in agreement with this change.

6 OVERALL CONCLUSIONS

This report summarizes the CNSC staff assessment on the performance of CNL at the CRL, WL, PHAI, DP, G-1 and NPD sites in 2018. CNSC staff concluded that these sites operated safely during 2018. This conclusion is based on assessments of licensee activities that included site inspections, reviews of reports submitted by licensees, and event and incident reviews, supported by follow-up and general communication with the licensees.

For 2018, the performance in all 14 SCAs was rated as "satisfactory" with the exception of the Security SCA at WL, which was rated "below expectations".

CNSC staff's compliance activities confirmed that:

- Radiation protection programs at all CNL sites adequately controlled radiation exposures, keeping doses ALARA;
- Environmental protection programs at all CNL sites were effective in protecting the environment; and
- Conventional health and safety programs at all CNL sites continue to protect workers.

CNSC staff will continue to provide regulatory oversight at all CNL sites, to ensure that CNL continues to make adequate provision to protect the health, safety and security of workers, Canadians and the environment, and continues to implement Canada's international obligations on the peaceful use of nuclear energy.

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5. CMD 18-H107, Licence Replacement, *"Submission from CNSC Staff on CNL's Application to Separate the Licence for Douglas Point, Gentilly-1 and Nuclear Power Demonstration into Three Licences"* (e-Doc 5718399)
6. CMD 19-H101, *"Application by Canadian Nuclear Laboratories Ltd. for the Amendment of the Port Granby Long-Term Low-Level Radioactive Waste Management Project Licence WNSL-W1-2311.01/2021"* (e-Doc 5725072)
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19. Letter, Hon. G. Rickford to M. Binder, July 31, 2015 (e-Doc 4815508)

20. CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive materials in airborne and liquid effluents for normal operation of nuclear facilities*, March 2014

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ACRONYMS

Acronym	Definition
AECL	Atomic Energy of Canada Limited
AL	Action Level
ALARA	As Low As Reasonably Achievable
ALWTC	Active Liquid Treatment Centre
AOO	Algonquins of Ontario
BE	Below Expectations
Cameco	Cameco Corporation
CANDU	Canada Deuteurium-Uranium
CEAA 2012	Canadian Environmental Assessment Act, 2012
CMD	Commission Member Document
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CRL	Chalk River Laboratories
DDPs	Detailed Decommissioning Plans
DP	Douglas Point
DRL	Derived Release Limit
EA	Environmental Assessment
ECIS	Emergency Cooling Injection System
EIS	Environmental Impact Statement
EMP	Environmental Monitoring Program
EMS	Environmental Management System
ENL	Eldorado Nuclear Limited
ERA	Environmental Risk Assessment
FS	Fully Satisfactory
G-1	Gentilly-1
GCNWA	Grand Conseil de la Nation Waban-Aki
GFP	Global First Power
HEU	Highly Enriched Uranium
HSM	Historic Saugeen Métis
IAEA	International Atomic Energy Agency
IEMP	Independent Environmental Monitoring Program

Acronym	Definition
IK	Indigenous Knowledge
Km	Kilometers
LCH	Licence Conditions Handbook
LLA	Long-lived Alpha
LLW	Low-Level Waste
LTWMF	Long-Term Waste Management Facility
MMF	Manitoba Métis Federation
MNO	Métis Nation of Ontario
MPF	Molybdenum Production Facility
mSv	Millisievert
MWe	Megawatt Electric
MWth	Megawatt Thermal
NEW	Nuclear Energy Worker
NPD	Nuclear Power Demonstration
NPRI	National Pollutant Release Inventory
NRTEDL	Nuclear Research and Test Establishment Decommissioning Licence
NRTEOL	Nuclear Research and Test Establishment Operating Licence
NRU	National Research Universal
NRX	National Research Experimental
NSCA	Nuclear Safety and Control Act
NSDF	Near Surface Disposal Facility
PDP	Preliminary Decommissioning Plan
PFP	Participant Funding Program
PGP	Port Granby Project
PHAI	Port Hope Area Initiative
PHP	Port Hope Project
PIDP	Public Information and Disclosure Program
RLTI	Reportable Lost Time Injury
ROR	Regulatory Oversight Report
SA	Satisfactory
SCA	Safety and Control Area
SDR	Slowpoke Demonstration Reactor

Acronym	Definition
SMR	Small Modular Reactor
SON	Saugeen Ojibway Nation
UA	Unacceptable
USNRC	United States Nuclear Regulatory Commission
WFDL	Waste Facility Decommissioning Licence
WNSL	Waste Nuclear Substances Licence
WL	Whiteshell Laboratories
WMF	Waste Management Facility
WR-1	Whiteshell Reactor No.1
WSIB	Workplace Safety and Insurance Board
WWTP	Waste Water Treatment Plant
ZED	Zero Energy Deuteurium

GLOSSARY

For definitions of terms used in this document, see REGDOC-3.6 Glossary of CNSC Terminology, which includes terms and definitions used in the *Nuclear Safety and Control Act* (NSCA) and the regulations made under it, and in CNSC regulatory documents and other publications.

A. LIST OF INSPECTIONS AT CNL SITES IN 2018

Table A-1: List of inspections at Chalk River Laboratories

Inspection Number	Dates	SCAs Covered	Number of Enforcement Actions Issued	Safety Significance of Enforcement Actions
CNL-NRU-2018-01	February 13-14, 2018	Conventional health and safety Operating performance Radiation protection Human performance management Security Safeguards and non-proliferation	0	N/A
CNL-FMC-2018-01	February 22, 2018	Conventional health and safety Environmental protection Operating performance Radiation protection	0	N/A
CNL-SD&D-2018-03	March 6, 2018	Conventional health and safety Environmental protection Radiation protection	0	N/A
CNL-CRL-2018-01	June 9-10, 2018	Management system	0	N/A
CNL-UC-2018-01	July 4, 2018	Conventional health and safety Operating performance Radiation protection Waste management	0	N/A
Security Field Inspection	July 24, 2018	Security	2	Low
CNL-WTC-2018-02	August 7-8, 2018	Conventional health and safety Operating performance Radiation protection Waste management	1	Low
CNL-WMA-2018-01	August 9, 2018	Conventional health and safety Operating performance Radiation protection	0	N/A

CNL-EP-2018-01	August 21-24, 2018	Environmental protection Operating performance Human performance management	0	N/A
Security Field Inspection	October 25, 2018	Security	0	N/A
Security Force-on-Force Exercise	November 22, 2018	Security	0	N/A
Training Inspection	December 4-7, 2018	Human performance management Security	9	Low

Table A-2: List of inspections at Whiteshell Laboratories

Inspection Number	Dates	SCAs Covered	Number of Enforcement Actions Issued	Safety Significance of Enforcement Actions
CNL-WL-2018-01	May 15-16, 2018	Operating performance Radiation protection Conventional health and safety Waste management Emergency management and fire protection	0	N/A
CNL-WL-2018-02	October 29-30, 2018	Management system Operating performance Radiation protection Conventional health and safety Human performance management Waste management and decommissioning	1	Low

Table A-3: List of inspections at the Port Hope Project

Inspection Number	Dates	SCAs Covered	Number of Enforcement Actions Issued	Safety Significance of Enforcement Actions
CNL-PHAI-PHP-2018-01	March 7, 2018	Radiation protection	4	Low

CNL-PHAI-2018-01	May 31-June 1, 2018	Management system	0	N/A
CNL-PHAI-PHP-2018-02	July 19, 2018	Radiation protection Environmental protection Conventional health and safety Management system	4	Low
CNL-PHAI-PHP-2018-03	September 8, 2018	Conventional health and safety Emergency management and fire protection Radiation protection	1	Low
CNL-PHAI-PHP-2018-04	October 11-12, 2018	Management system Physical design Radiation protection Conventional health and safety	5	Low

Table A-4: List of inspections at the Port Granby Project

Inspection Number	Dates	SCAs Covered	Number of Enforcement Actions Issued	Safety Significance of Enforcement Actions
CNL-PHAI-PGP-2018-01	February 20, 2018	Environmental protection Radiation protection Conventional health and safety Fitness for service Operating performance Emergency management and fire protection	7	Low
CNL-PHAI-PGP-2018-02	February 21, 2018			
CNL-PHAI-PGP-2018-03	March 8, 2018	Conventional health and safety Radiation protection	10	Low
CNL-PHAI-PGP-2018-04	April 17-19, 2018	Conventional health and safety Management system	5	Low
CNL-PHAI-PGP-2018-05	July 20, 2018	Radiation protection Environmental protection Conventional health and safety Management system	0	N/A
CNL-PHAI-PGP-2018-06	November 22-23, 2018	Environmental protection Radiation protection Conventional health and safety	0	N/A

Table A-5: List of inspections at Douglas Point, Gentilly-1 and Nuclear Power Demonstration

Inspection Number	Dates	SCAs Covered	Number of Enforcement Actions Issued	Safety Significance of Enforcement Actions
Douglas Point CNL-DPWF-2018-01	September 19, 2018	Radiation protection Human performance management Conventional health and safety Operating performance Security Emergency management and fire protection	2	Low
Gentilly- 1 CNL-G-1-2018-01	March 7, 2018	Conventional health and safety Management system Radiation protection Waste management and decommissioning	0	N/A
NPD CNL-NPD-2018-01	October 16-17, 2018	Radiation protection Human performance management Conventional health and safety Security Emergency management and fire protection Waste management Environmental protection	0	N/A

B. SAFETY AND CONTROL AREA DEFINITIONS

The CNSC evaluates how well licensees meet regulatory requirements and CNSC performance expectations for programs in 14 safety and control areas (SCAs). The SCAs are grouped into three functional areas: management, facility and equipment, and core control processes.

Table B-1: Safety and Control Area Framework

Functional area	Safety and control area	Definition	Specific areas
Management	**Management system**	Covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.	▪ management system ▪ organization ▪ performance assessment, improvement and management review ▪ operating experience (OPEX) ▪ change management ▪ safety culture ▪ configuration management ▪ records management ▪ management of contractors ▪ business continuity
	Human performance management	Covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.	▪ human performance program ▪ personnel training ▪ personnel certification ▪ initial certification examinations and requalification tests ▪ work organization and job design ▪ fitness for duty
	Operating performance	Includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.	▪ conduct of licensed activity ▪ procedures ▪ reporting and trending ▪ outage management performance ▪ safe operating envelope ▪ severe accident management and recovery ▪ accident management and recovery
	Safety analysis	Covers maintenance of the safety analysis that	▪ deterministic safety analysis ▪ hazard analysis

Functional area	Safety and control area	Definition	Specific areas
Facility and equipment		supports the overall safety case for the facility. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards.	▪ probabilistic safety analysis ▪ criticality safety ▪ severe accident analysis ▪ management of safety issues (including research and development programs)
	Physical design	Relates to activities that impact the ability of structures, systems and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.	▪ design governance ▪ site characterization ▪ facility design ▪ structure design ▪ system design ▪ component design
	Fitness for service	Covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.	▪ equipment fitness for service/equipment performance ▪ maintenance ▪ structural integrity ▪ aging management ▪ chemistry control ▪ periodic inspection and testing

Functional area	Safety and control area	Definition	Specific areas
Core control processes	**Radiation protection**	Covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained as low as reasonably achievable (ALARA).	▪ application of ALARA ▪ worker dose control ▪ radiation protection program performance ▪ radiological hazard control ▪ estimated dose to public
	Conventional health and safety	Covers the implementation of a program to manage workplace safety hazards and to protect workers.	▪ performance ▪ practices ▪ awareness
	Environmental protection	Covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.	▪ effluent and emissions control (releases) ▪ environmental management system ▪ assessment and monitoring ▪ protection of the public ▪ environmental risk assessment
	Emergency management and fire protection	Covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.	▪ conventional emergency preparedness and response ▪ nuclear emergency preparedness and response ▪ fire emergency preparedness and response
	Waste management	Covers internal waste-related programs that form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning.	▪ waste characterization ▪ waste minimization ▪ waste management practices ▪ decommissioning plans

Functional area	Safety and control area	Definition	Specific areas
Core control processes	**Security**	Covers programs required to meet security requirements stipulated in the regulations, the licence, orders or expectations for the facility or activity.	▪ facilities and equipment ▪ response arrangements ▪ security practices ▪ drills and exercises
	Safeguards and non-proliferation	Covers the programs and activities required for the successful implementation of the obligations arising from the Canada/International Atomic Energy Agency (IAEA) safeguards agreements, as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*.	▪ nuclear material accountancy and control ▪ access and assistance to the IAEA ▪ operational and design information ▪ safeguards equipment, containment and surveillance ▪ import and export
	Packaging and transport	Programs that cover the safe packaging and transport of nuclear substances to and from the licensed facility.	▪ package design and maintenance ▪ packaging and transport ▪ registration for use
Other matters of regulatory interest			
▪ Environmental assessments ▪ CNSC consultation – Indigenous communities ▪ CNSC consultation – other ▪ Cost recovery ▪ Financial guarantees ▪ Improvement plans and significant future activities ▪ Licensee public information program ▪ Nuclear liability insurance			

C. SAFETY AND CONTROL AREA RATING METHODOLOGY

Performance ratings used in this report are defined as follows:

Fully satisfactory (FS)

Safety and control measures implemented by the licensee are highly effective. In addition, compliance with regulatory requirements is fully satisfactory, and compliance within the safety and control area or specific area exceeds requirements and Canadian Nuclear Safety Commission (CNSC) expectations. Overall, compliance is stable or improving, and any problems or issues that arise are promptly addressed.

Satisfactory (SA)

Safety and control measures implemented by the licensee are sufficiently effective. In addition, compliance with regulatory requirements is satisfactory. Compliance within the safety and control area or specific area meets requirements and CNSC expectations. Any deviation is only minor, and any issues are considered to pose a low risk to the achievement of regulatory objectives and the CNSC's expectations. Appropriate improvements are planned.

Below expectations (BE)

Safety and control measures implemented by the licensee are marginally ineffective. In addition, compliance with regulatory requirements falls below expectations. Compliance within the safety and control area or specific area deviates from requirements or CNSC expectations to the extent that there is a moderate risk of ultimate failure to comply. Improvements are required to address identified weaknesses. The licensee or applicant is taking appropriate corrective action.

Unacceptable (UA)

Safety and control measures implemented by the licensee are significantly ineffective. In addition, compliance with regulatory requirements is unacceptable and is seriously compromised. Compliance within the overall safety and control area or specific area is significantly below requirements or CNSC expectations or there is evidence of overall non-compliance. Without corrective action, there is a high probability that the deficiencies will lead to an unreasonable risk. Issues are not being addressed effectively, no appropriate corrective measures have been taken, and no alternative plan of action has been provided. Immediate action is required.

D. SAFETY AND CONTROL AREA RATINGS

Note that the following acronyms are used in this appendix:

FS = fully satisfactory SA = satisfactory BE = below expectations

Table D-1: Safety and control area summary, Chalk River Laboratories, 2014-2018

Safety and control areas	2014	2015	2016	2017	2018
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	BE	BE	BE	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table D-2: Safety and control area summary, Whiteshell Laboratories, 2014-2018

Safety and control areas	2014	2015	2016	2017	2018
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	BE
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table D-3: Safety and control area summary, Port Hope Project, 2014-2018

Safety and control areas	2014	2015	2016	2017	2018
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table D-4: Safety and control area summary, Port Granby Project, 2014-2018

Safety and control areas	2014	2015	2016	2017	2018
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table D-5: Safety and control area summary, Douglas Point Waste Facility, 2014-2018

Safety and control areas	2014	2015	2016	2017	2018
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table D-6: Safety and control area summary, Gentilly-1 Waste Facility, 2014-2018

Safety and control areas	2014	2015	2016	2017	2018
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table D-7: Safety and control area summary, Nuclear Power Demonstration Waste Facility, 2014-2018

Safety and control areas	2014	2015	2016	2017	2018
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

E. DOSES TO NUCLEAR ENERGY WORKERS AND NON-NUCLEAR ENERGY WORKERS AT CNL SITES

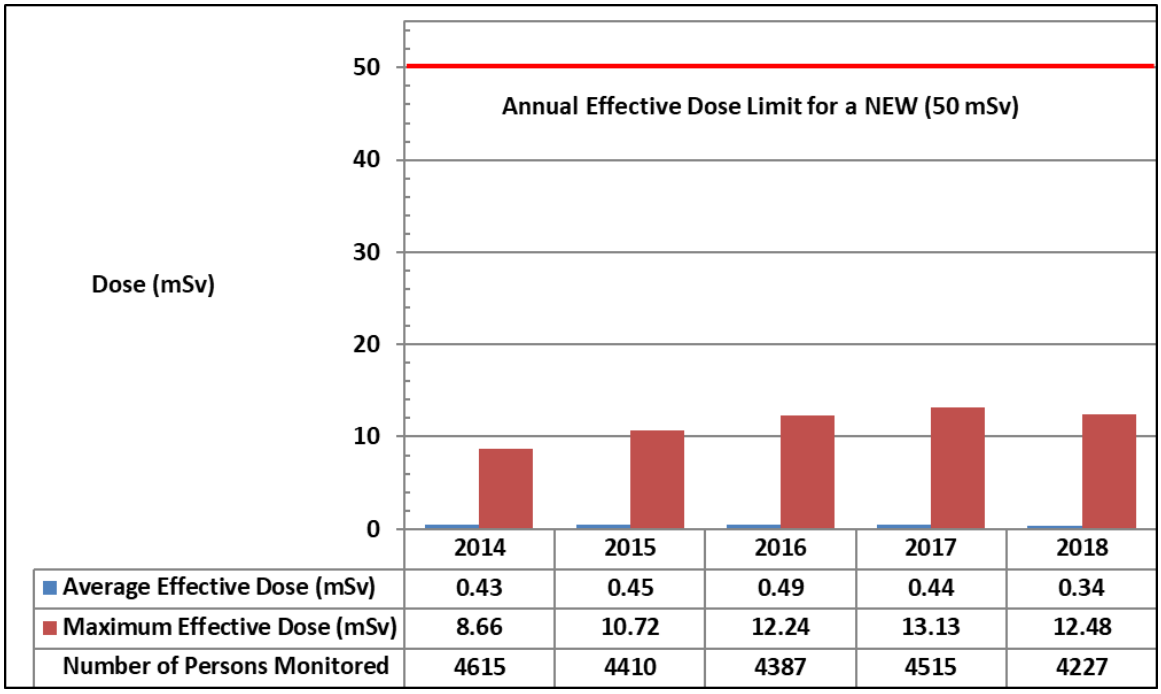
This appendix presents information on doses to Nuclear Energy Workers (NEWs) and non-NEWs at CNL sites.

Chalk River Laboratories

Figure E-1 provides the average effective doses and the maximum effective doses to NEWs from 2014 to 2018. The maximum annual effective dose received by a NEW in 2018 was 12.48 mSv; approximately 25 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period.

The dose fluctuations from year to year are attributed to the scope and duration of the radiological work conducted along with the dose rates associated with the work.

Figure E-1: Average and maximum effective doses to NEWs at CRL from 2014-2018



	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	0.43	0.45	0.49	0.44	0.34
Maximum Effective Dose (mSv)	8.66	10.72	12.24	13.13	12.48
Number of Persons Monitored	4615	4410	4387	4515	4227

As shown in tables E-1 and E-2, equivalent doses (skin and extremity) at the CRL site were below the CNSC regulatory equivalent dose limit for a NEW of 500 mSv/year. The maximum equivalent (skin) dose received by a NEW in 2018 was 15.84 mSv; approximately 3 percent of the regulatory limit for equivalent dose of 500 mSv in a one-year dosimetry period. The maximum equivalent (extremity) dose received by a NEW in 2018 was 44.83 mSv; approximately 9 percent of the regulatory limit for equivalent dose of 500 mSv in a one-year dosimetry period.

Table E-1: Equivalent (skin) doses to NEWs at CRL from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average skin dose (mSv)	0.53	0.55	0.60	0.53	0.40	n/a
Maximum skin dose (mSv)	21.73	15.75	16.54	19.95	15.84	500 mSv/year

Table E-2: Equivalent (extremity) doses to NEWs at CRL from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average extremity dose (mSv)	3.26	2.84	3.71	6.10	4.85	n/a
Maximum extremity dose (mSv)	22.50	29.32	41.59	85.06	44.83	500 mSv/year

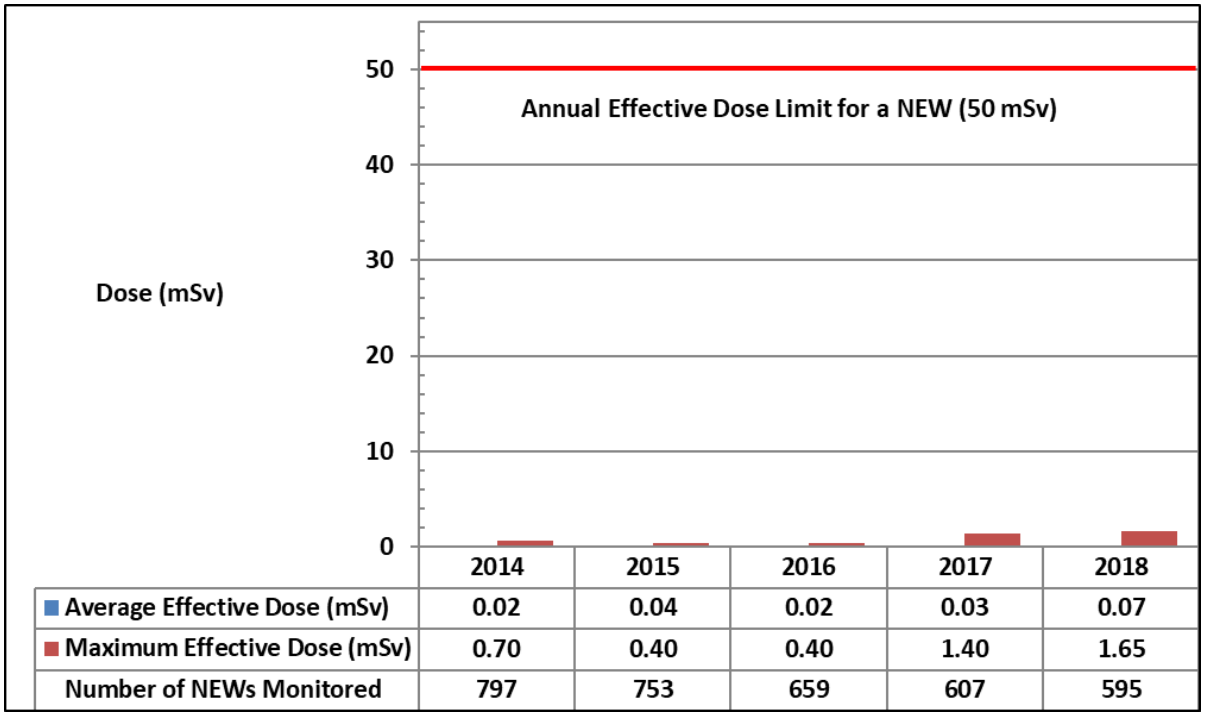
Non-NEWs at CRL

In 2018, the maximum annual effective dose received by a non-NEW was 0.32 mSv; approximately 32 percent of the regulatory limit for effective dose of 1 mSv in a one-year dosimetry period.

Whiteshell Laboratories

Figure E-2 provides the average effective doses and the maximum effective doses to workers from 2014 to 2018. The maximum annual effective dose received by a NEW in 2018 was 1.7 mSv, approximately 3 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. The highest annual average effective dose in this period was 0.07 mSv. These slight increases in individual exposures, both occurring in 2018, are attributed to decommissioning activities performed in the Building 200 Active Liquid Waste Treatment Centre (ALWTC).

Figure E-2: Average and maximum effective doses to NEWs at WL from 2014-2018



	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	0.02	0.04	0.02	0.03	0.07
Maximum Effective Dose (mSv)	0.70	0.40	0.40	1.40	1.65
Number of NEWs Monitored	797	753	659	607	595

As shown in tables E-3 and E-4, equivalent doses (skin and extremity) at the WL site were below the CNSC regulatory equivalent dose limit for a NEW of 500 mSv/year. The maximum equivalent (skin) dose received by a NEW in 2018 was 3.72 mSv; approximately 1 percent of the regulatory limit for equivalent dose of 500 mSv in a one-year dosimetry period. The maximum equivalent (extremity) dose received by a NEW in 2018 was 36.71 mSv; approximately 7 percent of the regulatory limit for equivalent dose of 500 mSv in a one-year dosimetry period. The increasing trend in 2017 and 2018 is attributed to decommissioning activities in the ALWTC and maintenance activities (notably manipulator maintenance).

Table E-3: Equivalent (skin) doses to NEWs at WL from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average skin dose (mSv)	0.02	0.04	0.02	0.05	0.12	n/a
Maximum skin dose (mSv)	1.6	0.65	0.36	2.90	3.72	500 mSv/year

Table E-4: Equivalent (extremity) doses to NEWs at WL from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average extremity dose (mSv)	0.36	0.09	0.05	1.51	5.02	n/a
Maximum extremity dose (mSv)	1.25	0.72	0.11	11.35	36.71	500 mSv/year

Non-NEWs at WL

In 2018, external dosimeters issued to non-NEWs at WL did not record any measureable doses.

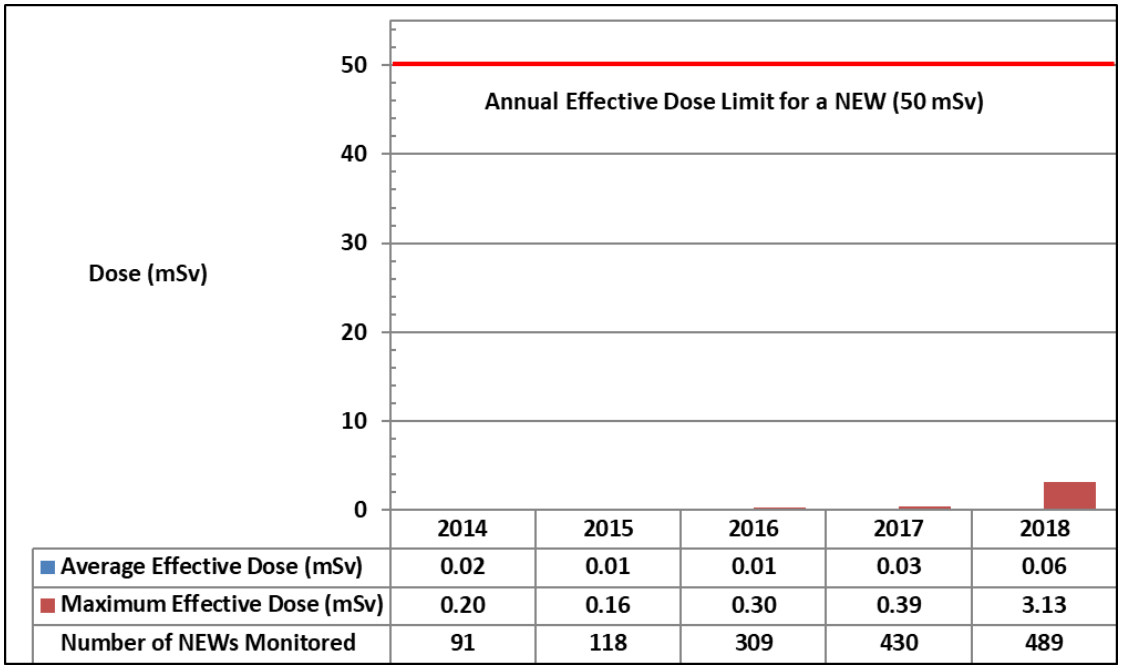
Remediation Sites

Port Granby

Figure E-3 provides the average effective doses and the maximum effective doses for all NEWs from 2014 to 2018. In 2018, the maximum total effective dose for a NEW at the PGP was 3.13 mSv, approximately 6 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. The average effective dose for all NEWs was 0.06 mSv. In 2018, occupational doses at PGP were higher than previous years. This was attributed to an increase in the scope of work that was performed.

The 2018 total effective dose includes whole body dose, assessed with external dosimetry, and internal dose, assessed from radon and ling-lived alpha (LLA) in air. The total number of NEWs includes all contractors involved in work at the PGP as well as CNL staff.

Figure E-3: Average and maximum effective doses to NEWs at PGP from 2014-2018



	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	0.02	0.01	0.01	0.03	0.06
Maximum Effective Dose (mSv)	0.20	0.16	0.30	0.39	3.13
Number of NEWs Monitored	91	118	309	430	489

As shown in Table E-5 below, skin doses at the PGP were also well below the CNSC regulatory equivalent dose limit for a NEW of 500 mSv/year. The maximum skin dose for a NEW at the PGP in 2018 was 2.44 mSv, and the average skin dose for all NEWs was 0.05 mSv.

Table E-5: Equivalent (skin) doses to NEWs at PGP from 2014-2018

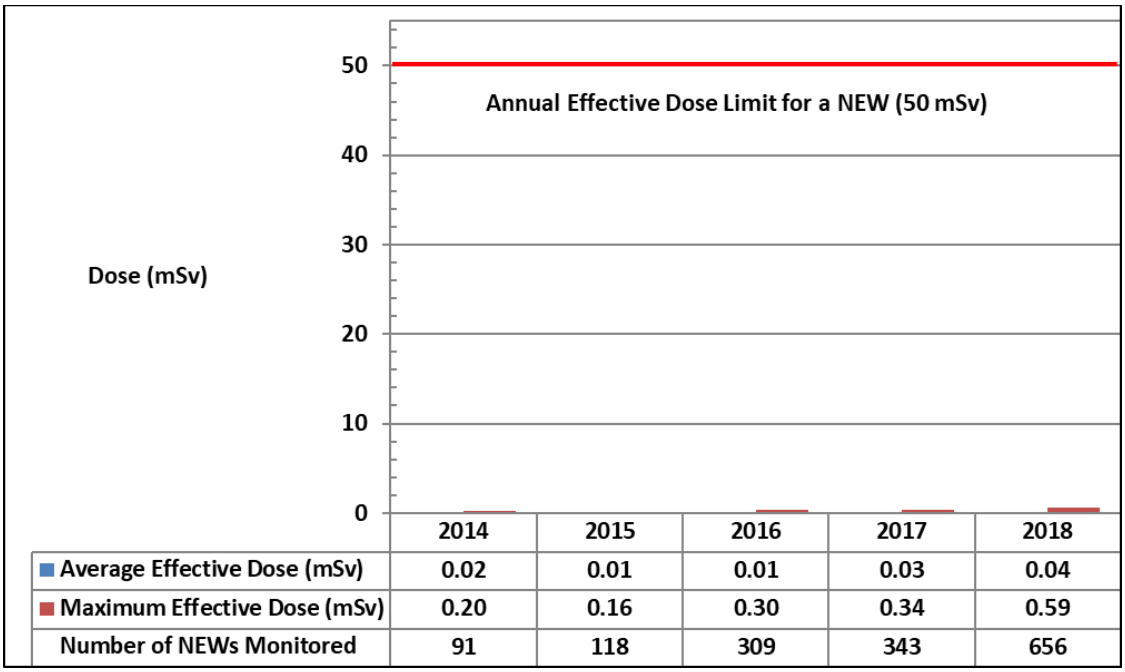
Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average skin dose (mSv)	0.01	0.01	0.01	0.04	0.05	n/a
Maximum skin dose (mSv)	0.16	0.16	0.30	0.34	2.44	500 mSv/year

Port Hope

Figure E-4 provides the average effective doses and the maximum effective doses for all NEWs from 2014 to 2018. In 2018, the maximum total effective dose for a NEW at the PHP was 0.59 mSv, approximately 1 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. The average effective dose for all NEWs was 0.04 mSv. December 2017 marked the beginning of hauling on-site waste into the newly constructed Cell 1 mound at the PHP.

The 2018 total effective dose includes whole body dose, assessed with external dosimetry, and internal dose, assessed with PAD and/or results from radon progeny and LLA in air. The total number of NEWs includes all contractors involved in work at the PHP as well as CNL staff.

Figure E-4: Average and maximum effective doses to NEWs at PHP from 2014-2018



	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	0.02	0.01	0.01	0.03	0.04
Maximum Effective Dose (mSv)	0.20	0.16	0.30	0.34	0.59
Number of NEWs Monitored	91	118	309	343	656

As shown in Table E-6, skin doses at the PHP were also well below the CNSC regulatory equivalent dose limit for a NEW of 500 mSv/year. The maximum skin dose for a NEW at the PHP in 2018 was 0.33 mSv, and the average skin dose for all NEWs was 0.04 mSv.

Table E-6: Equivalent (skin) doses to NEWs at PHP from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average skin dose (mSv)	0.01	0.01	0.01	0.04	0.04	n/a
Maximum skin dose (mSv)	0.16	0.16	0.30	0.34	0.33	500 mSv/year

Non-NEWs at Remediation Sites

In 2018, the maximum annual effective dose received by non-NEWs were 0.004 mSv at the PGP, and 0.02 mSv at the PHP. These doses are well below the annual regulatory dose limit of 1 mSv in a one-year dosimetry period.

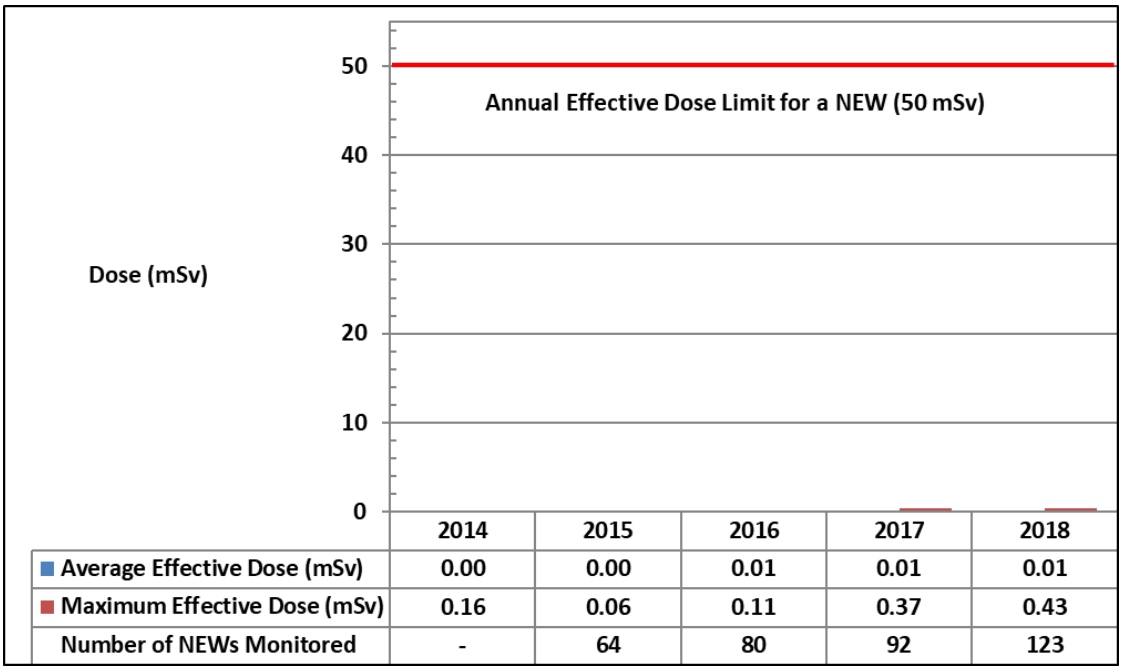
DP, G-1 and NPD Waste Facilities

Douglas Point Waste Facility

Figure E-5 provides the average effective doses and the maximum effective doses to NEWs from 2014 to 2018. In 2018, the maximum effective dose received by a NEW at DP was 0.43 mSv, approximately 1 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period.

There has been an increase in the number of workers at DP over these years, mainly attributed to an increase in project work activities. These work activities have resulted in slight increases in the maximum effective doses to workers when compared to previous years.

Figure E-5: Average and maximum effective doses to NEWs at DP from 2014-2018



	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	0.00	0.00	0.01	0.01	0.01
Maximum Effective Dose (mSv)	0.16	0.06	0.11	0.37	0.43
Number of NEWs Monitored	-	64	80	92	123

Annual average and maximum equivalent (skin) dose results for NEWs at DP from 2014 to 2018 are provided in Table E-7. In 2018, the maximum skin dose received by a NEW at DP was 0.43 mSv, which is well below the CNSC's annual regulatory equivalent dose limit of 500 mSv.

Table E-7: Equivalent (skin) doses to NEWs at DP from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Regulatory Limit
Average skin dose (mSv)	0.00	0.00	0.01	0.01	0.01	n/a
Maximum skin dose (mSv)	0.12	0.06	0.11	0.37	0.43	500 mSv/year

Non-NEWs at DP

In 2018, external dosimeters issued to non-NEWs at DP did not record any measureable doses.

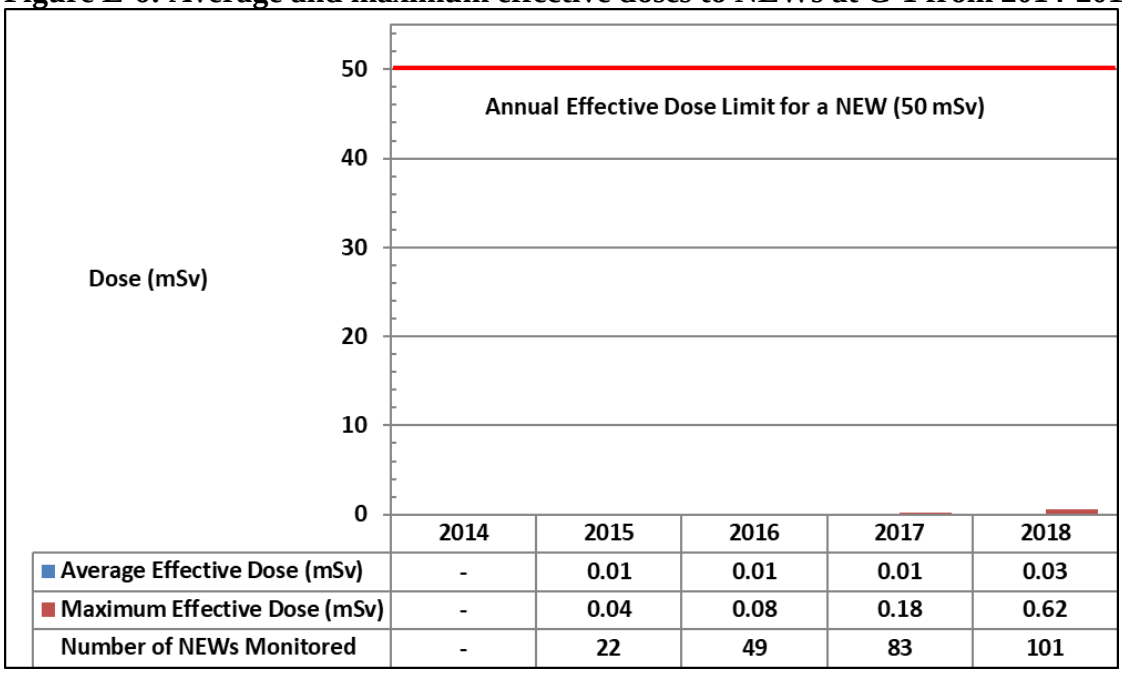
Gentilly-1 Waste Facility

Figure E-6 provides the average effective doses and the maximum effective doses to NEWs at G-1 from 2014 to 2018. In 2018, the maximum effective dose received by a NEW at the G-1 was 0.62 mSv, approximately 1 percent of the regulatory limit for effective dose of 50 mSv.

In 2014, no NEW received any measureable dose above the detection limit of 0.1 mSv for the dosimeter type. The total number of NEWs monitored in 2014 is unavailable.

Since 2015, there has been an increase in the number of workers on site, along with slight increases in radiation doses to NEWs, due to an increase in planned work activities (both maintenance tasks and project activities).

Figure E-6: Average and maximum effective doses to NEWs at G-1 from 2014-2018



	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	-	0.01	0.01	0.01	0.03
Maximum Effective Dose (mSv)	-	0.04	0.08	0.18	0.62
Number of NEWs Monitored	-	22	49	83	101

Annual average and maximum equivalent (skin) dose results for NEWs at G-1 from 2014 to 2018 are provided in Table E-8. In 2018, the maximum skin dose received by a NEW at G-1 was 0.62 mSv, which is well below the CNSC's annual regulatory equivalent dose limit of 500 mSv.

Table E-8: Equivalent (skin) doses to NEWs at G-1 from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average skin dose (mSv)	-	0.01	0.01	0.01	0.03	n/a
Maximum skin dose (mSv)	-	0.04	0.08	0.18	0.62	500 mSv/year

Note: "-" means that no measurable dose was recorded.

Extremity dosimeters were worn by certain contractors in 2018 due to the conduct of hazard reduction projects where the hands were preferentially exposed. The maximum dose recorded on an extremity dosimeter was 17.27 mSv, which is well below the CNSC's annual regulatory equivalent dose limit of 500 mSv.

Non-NEWs at G-1

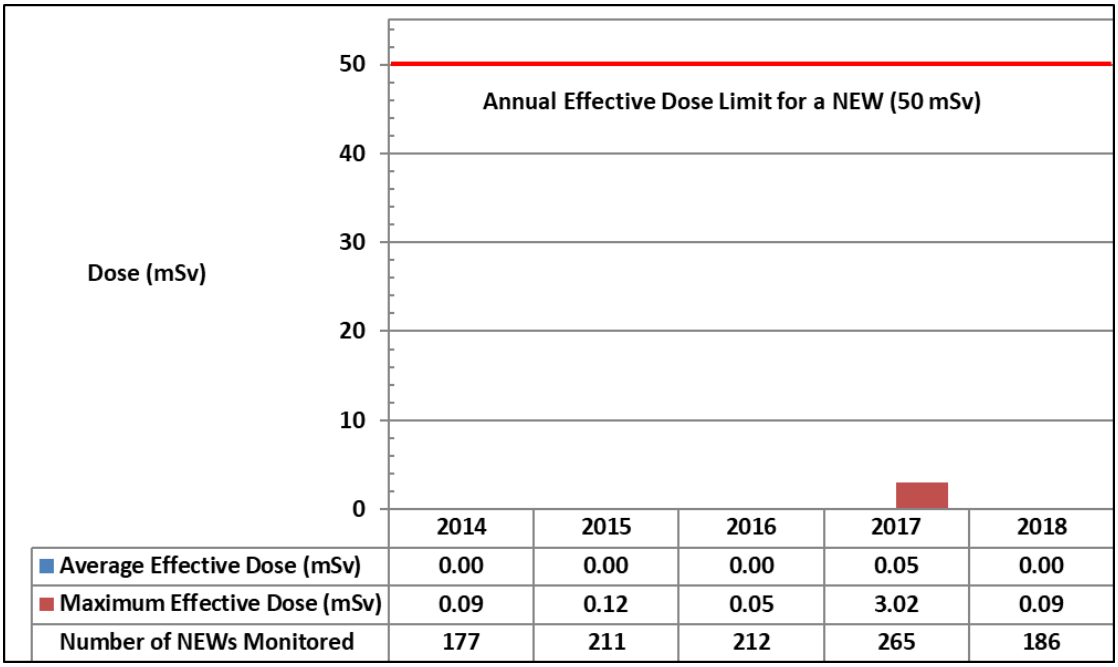
In 2018, external dosimeters issued to non-NEWs at G-1 did not record any measureable doses.

Nuclear Power Demonstration Waste Facility

Figure E-7 provides the average effective doses and the maximum effective doses to NEWs from 2014 to 2018. In 2018, the maximum effective dose received by a NEW at NPD facility was 0.09 mSv, which is well below the CNSC's annual regulatory effective dose limit of 50 mSv.

Since 2014, there has been a significant increase of work activities at NPD, including the management of low level radioactive waste and various characterization activities. Particularly in 2017, characterization work and hazard reduction activities (i.e., asbestos abatement) resulted in an increase in radiation doses to NEWs when compared to previous years. The maximum individual effective dose of 3.02 mSv was received by a contractor engaged in asbestos abatement activities in the Boiler Room.

Figure E-7: Average and maximum effective doses to NEWs at NPD from 2014-2018



	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	0.00	0.00	0.00	0.05	0.00
Maximum Effective Dose (mSv)	0.09	0.12	0.05	3.02	0.09
Number of NEWs Monitored	177	211	212	265	186

Annual average and maximum equivalent (skin) dose results for NEWs at NPD, from 2014 to 2018, are provided in Table E-9. In 2018, the maximum skin dose received by a NEW at NPD was 0.09 mSv, which is well below the CNSC's annual regulatory equivalent dose limit of 500 mSv.

Table E-9: Equivalent (skin) doses to NEWs at NPD from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Annual Regulatory Dose Limit for a NEW
Average skin dose (mSv)	0.00	0.00	0.00	0.04	0.00	n/a
Maximum skin dose (mSv)	0.09	0.12	0.00	3.03	0.09	500 mSv/year

Non-NEWs at NPD

In 2018, external dosimeters issued to non-NEWs at NPD did not record any measureable doses.

F. ESTIMATED DOSE TO THE PUBLIC

This appendix contains information on the estimated dose to the public around CNL sites. Regulatory release limits known as derived release limits or DRLs are site-specific calculated releases that could, if exceeded, expose a member of the public of the most highly exposed group to a committed dose equal to the regulatory annual dose limit of 1 mSv/year. DRLs are calculated using CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive materials in airborne and liquid effluents for normal operation of nuclear facilities*. [20]

As per the *Radiation Protection Regulations* subsection 1(3), and considering the fact that the radiological releases from all the sites covered by this ROR have remained small fractions of the DRLs applicable to those sites, the contribution to the dose to the public from these releases remains a very small fraction of the prescribed limit for the general public.

Chalk River Laboratories

CNL has implemented an Environmental Monitoring Program (EMP) at CRL, which complies with the CSA N288.4, *Environmental Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills*. Table F-1 provides dose to the public from CNL-CRL site since 2014.

Table F-1: Maximum Effective Doses to a Member of the Public from 2014-2018

Dose Data	2014	2015	2016	2017	2018	Regulatory Dose Limit
Maximum Effective Dose (mSv)	0.060	0.082	0.078	0.087	0.036	1 mSv/year

The maximum dose in each year since 2014 has been well below the dose limit of 1 mSv/year. Furthermore, at no point during that period did the emissions from the CRL site exceed the constraint for dose to the public of 0.30 mSv/yr.

Whiteshell Laboratories

The dose to critical groups from releases from CNL-WL in 2018 was 0.000036 mSv, which is well below the regulatory dose limit of 1 mSv/year.

Table F-2: Maximum effective dose to a member of the public, CNL-WL, 2014-2018

Dose data	2014	2015	2016	2017	2018	Regulatory dose limit
Maximum effective dose (mSv)	<0.002	<0.001	7.5E-05	4.8E-05	3.6E-05	1 mSv/year

Remediation Sites

A modified approach for calculating estimated dose to the public was performed by CNL for PHAI sites in 2018, and included both radon monitoring and fence line dosimeter measurements at both PHP and PGP sites.

The annual estimated doses to the public at PGP and PHP sites in 2018 were 0.020 mSv/year and 0.0275 mSv/year, respectively, which are well below that annual regulatory dose limit of 1 mSv.

Table F-3: Maximum effective dose to a member of the public, PGP, 2014-2018

Dose data	2014	2015	2016	2017	2018	Regulatory dose limit
Maximum effective dose (mSv)	0.00383	0.0084	0.00543	0.00571	0.020	1 mSv/year

Table F-4: Maximum effective dose to a member of the public, PHP, 2014-2018

Dose data	2014	2015	2016	2017	2018	Regulatory dose limit
Maximum effective dose (mSv)	0.02867	0.09352	0.01195	0.0045	0.0275	1 mSv/year

Douglas Point Waste Facility

All releases of radioactive material in DP effluents are a small fraction of their respective DRLs and thus, continue to indicate minimal impact on the public or the environment. DP is located within the Bruce Nuclear Site. The Bruce Power environmental monitoring program captures any environmental impacts from the small contribution from DP. The dose to the public from the Bruce Nuclear Site, including contributions from the DP, remain *de minimus* (below 0.01 mSv/year).

Gentilly-1 Waste Facility

The effluent monitoring plan assessment conducted in 2016 by CNL determined that there is minimal or no source of airborne radioactivity from routine operations at G-1. In addition, all liquid releases were discharged through Gentilly-2 effluent system, operated by Hydro-Québec, and represent a small fraction of the total releases from the larger Gentilly site. The Hydro-Québec's Gentilly-2 environmental monitoring program captures any environmental impacts from the small contribution from G-1. The dose to the public from the Gentilly-2 nuclear site, including contributions from G-1, remain *de minimus* (below 0.01 mSv/year).

Nuclear Power Demonstration Waste Facility

NPD is no longer discharging liquid effluents from the facility sumps to the Ottawa River, and there were no such releases during the 2018 reporting period. All other releases of radioactive material in NPD effluents are a small fraction of their respective DRLs and thus, continue to indicate minimal impact on the public or the environment. CNL's environmental monitoring at CRL will regionally overlap with the NPD waste facility, so information from CRL's off-site environmental monitoring program could also be considered. CNSC staff have determined that the public dose from NPD remains at a very small fraction of the public dose limit.

G. LOST-TIME INJURY INFORMATION

This appendix contains information on the number, frequency and severity of recordable lost-time injuries at the CNL sites covered by this ROR, with data presented back to 2014.

Frequency and severity are calculated per 100 full-time workers (equivalent to 200,000 worker-hours per year) using the following formulas:

Frequency rate = (# of Lost-Time Injuries) x (200 000 hrs of exposure) / (person hours worked)

Severity rate = (# of Working Days Lost) x (200 000 hrs of exposure) / (person hours worked)

Table G-1: Summary of CRL's recordable lost time injuries (RLTI), frequency and severity *(Source: CNL)*

Year	2014	2015	2016	2017	2018
Person Hours Worked (all CNL)	6 248 900	6 294 295	6 405 670	-	-
Person Hours Worked (CRL only)	-	-	-	5 597 015	5 369 450
Lost-Time Injuries	9	2	6	4	5
Working Days Lost	37	7	47	10	69[a]
Frequency	0.29	0.06	0.19	0.14	0.18
Severity	1.18	0.22	1.47	0.36	2.47
[a] Lost time and work days lost in 2018 data is based on US Occupational Safety and Health Administration Guidelines, therefore the rates will be slightly increased .					

Note that prior to 2017, CNL did not provide data for person-hours worked on CRL site alone, therefore total CNL hours worked are used in place of that data. This skews frequency and severity data for the CRL site for the 2014-2016 years, and makes comparison between pre- and post-2017 data for CRL difficult.

For 2018, 69 working days were lost at CRL, the most since 2014. 60 of these were attributable to a single injury, which was incurred when a worker tripped and fell from a flat-bed truck trailer.

Table G-2: Summary of WL's recordable lost time injuries (RLTI), frequency and severity *(Source: CNL)*

Year	2014	2015	2016	2017	2018
Person Hours Worked	883 500	741 000	684 450	706 000	688 000
Lost-Time Injuries	4	0	1	3	1
Working Days Lost	54	0	5	27	5
Frequency	0.9	0	0.29	0.85	0.28
Severity	12.2	0	1.46	7.67	1.45

The frequency numbers for CRL and WL can be compared to lost-time injury rate data from the Ontario Workplace Safety and Insurance Board (WSIB); the WSIB's lost-time injury rate is calculated using the same formula as frequency rate shown above. WSIB data is shown in Table G-3 below.

Table G-3: WSIB Lost-Time Injury Rates data for select industries

Industry Sector	2014	2015	2016	2017	2018
Automotive	1.06	0.94	1.06	1.05	1.14
Construction	1.13	1.09	1.15	1.15	1.13
Municipal	1.51	1.44	1.49	1.65	1.64
Transportation	1.83	1.59	1.76	1.74	1.90
Chemicals/Process	0.69	0.6	0.75	0.73	0.77
Electrical	0.35	0.37	0.4	0.43	0.41
Manufacturing	0.64	0.59	0.67	0.64	0.70

It can be seen that Frequency for lost-time injuries at CNL sites is less than WSIB data for most industries since 2014.

The PHP, PGP, DP, G-1 and NPD sites have not recorded a lost-time injury since 2014; the person-hours worked for these sites are provided below for comparison with the same data for CRL and WL. RLTI frequency and severity cannot be calculated if there are no lost-time injuries over the period in question.

Table G-4: Person-hours worked at PHP, PGP, DP, G-1 and NPD *(Source: CNL)*

Year	2014	2015	2016	2017	2018
Person Hours Worked – PHAI	Not Available				260 776
Person Hours Worked – DP	20 400	28 960	29 600	30 080	31 320
Person Hours Worked – G-1	4 600	6 160	7 240	8 600	9 320
Person Hours Worked – NPD	20 000	32 800	34 900	34 500	30 300
Lost-Time Injuries for PHP, PGP, DP, G-1 and NPD	0	0	0	0	0

H. DERIVED RELEASE LIMITS (DRLS) AND TOTAL ANNUAL RELEASE OF RADIONUCLIDES DIRECTLY[12] TO THE ENVIRONMENT

During the December 2018 Commission meeting, CNSC staff committed to providing an annual update to the Commission on the decision on radionuclide reporting in the National Pollutant Release Inventory (NPRI). The CNSC is making radionuclide release data more readily accessible to the public as part of its commitment to open government and its mandate to disseminate this information to the public. The commitment to provide data on the total annual release of radionuclides in the appendices of the ROR continues within this year's RORs. In addition, the CNSC and the NPRI are working together to establish active links between the CNSC and NPRI web sites. Stakeholder sub-group consisting of environmental non-governmental organizations and industry are completing active beta testing of the links between the NPRI site and existing CNSC data products (RORs, etc). The CNSC has also commenced the creation of downloadable digital databases of radionuclides releases further supplementing the range of CNSC environmental data products linked to the NPRI website. The downloadable databases are expected to become part of the active beta testing activities in the latter part of 2019.

Derived Release Limits

While it is possible to calculate a specific DRL for each radionuclide released by a given site, it may not be practical nor necessary to monitor each of these separately. In such cases, emitted radionuclides may be organized into groups that are selected based on factors such as physicochemical properties and method of monitoring. DRLs can then be established for the radionuclide group applying a number of simplifying and conservative (i.e., protective) assumptions such as assuming that the group is composed entirely of the most restrictive radionuclide representative of the group. The most restrictive radionuclide can differ for different nuclear facilities depending on releases, local conditions and the choice of the representative person. Emission monitoring may then be carried out using a non-radionuclide-specific method for the group rather than for specific radionuclides. The most common DRL groupings for airborne releases are noble gases, radio-iodines, particulate beta/gamma, and particulate alpha, while the most common DRL groupings for liquid releases are beta/gamma emitters and alpha.

Licensees are required to demonstrate that their releases are not only below their respective DRLs but that the sum of their release are below 1 mSv/year, the public regulatory dose limit. To ensure these limits are respected, licensees also are required to develop action levels significantly below their DRLs as a means of detecting elevated releases meriting follow-up investigations and actions to ensure releases are adequately controlled.

[12] Using definitions of the National Pollutant Release Inventory, these are on-site releases directly to atmosphere or surface waters and do not include releases to sewer or off-site treatment, storage or disposal facilities.

Total Annual Release of Relevant Radionuclides to the Environment

The following tables provide the annual load of key radionuclides directly released to atmosphere or to surface waters from licensed facilities operated by CNL for the reporting period of 2014 – 2018. Applicable DRLs are also presented, where they exist. There are no comparisons to limits and guidelines for PHAI sites because the Port Granby Project and the Port Hope Project have limits in their licences which are based on either monthly mean, weekly mean, or each grab sample.

Over this reporting period, there have been no exceedances of licence derived release limits and licence limits.

As CNL is the licence holder for the G-1 waste management facility, releases would be reported in this ROR. However, an effluent monitoring plan assessment conducted in 2016 confirmed that there is minimal or no source of airborne radioactivity at G-1. Therefore, airborne emissions are no longer monitored. Furthermore, all liquids from facility sumps were transferred to the Gentilly-2 facility effluent system to be managed and discharged by Hydro-Quebec. These releases are included in the reported Gentilly-2 releases available in the 2017 and in the 2018 *Regulatory Oversight Report for Nuclear Power Generating Sites*.

Chalk River Laboratories

Table H-1: Chalk River Laboratories annual radionuclide releases to atmosphere for 2014 – 2018.

Year	Tritium: (HTO:Bq)	Carbon-14 (Bq)	Noble Gas (Bq-MeV)	Iodine-131 (Bq)	Argon-41 (Bq)	Xenon-133 (Bq)
DRL	**1.25E+16**	**2.14E+15**	**4.96E+16**	**3.96E+12**	**6.50E+16**	**8.35E+17**
2018	2.29E+14	2.54E+11	6.50E+12	1.02E+08	2.59E+15	N/A [a]
2017	2.50E+14	4.90E+11	6.50E+12	3.82E+08	1.16E+16	N/A [a]
2016	2.30E+14	4.84E+11	8.50E+14	5.17E+10	1.07E+16	3.12E+15
2015	2.77E+14	3.77E+11	1.20E+15	1.03E+11	1.29E+16	4.89E+15
2014	2.60E+14	8.69E+11	2.11E+15	2.06E+11	9.37E+15	8.68E+15

[a] After the safe shutdown of the Molybdenum Production Facility in 2017, there are no longer airborne releases of Xenon-133.

Table H-2: Chalk River Laboratories annual radionuclide releases to surface water for 2014-2018.

Year	Tritium: (HTO: Bq)	Gross Alpha (Bq)	Gross Beta (Bq)
DRL	**1.03E+17**	**1.32E+12**	**2.70E+13**
2018	1.93E+13	6.88E+08	2.84E+10
2017	3.81E+13	7.66E+08	4.17E+10
2016	3.50E+13	6.60E+08	3.22E+10
2015	3.94E+13	6.94E+08	3.96E+10
2014	3.07E+13	9.07E+08	2.62E+11

Whiteshell Laboratories

Table H-3: Whiteshell Laboratories annual radionuclide releases to atmosphere for 2014-2018.

Year	Tritium: (HTO: Bq)	Gross Alpha (Bq)	Gross Beta (Bq)
DRL	**8.58E+16**	**9.00E+10**	**3.60E+11**
2018	1.31E+10	9.13E+04	1.70E+05
2017	5.03E+10	9.34E+04	2.24E+05
2016	3.24E+10	9.46E+04	2.12E+05
2015	9.88E+10	9.79E+04	2.26E+05
2014	3.48E+10	8.82E+04	3.97E+05

Table H-4: Whiteshell Laboratories annual radionuclide releases to surface water for 2014-2018.

Year	Gross Alpha (Bq)	Uranium-total (Bq)	Plutonium-239/240 (Bq)	Plutonium-238 (Bq)	Americium-241 (Bq)	Gross Beta (Bq)	Strontium-90 (Bq)	Cesium-137 (Bq)
DRL	**1.33E+10**	**1.50E+11**	**1.33E+10**	**1.39E+10**	**1.25E+10**	**a**	**1.56E+11**	**1.39E+11**
2018	3.90E+07	1.16E+07	2.32E+07	1.84E+07	4.21E+06	1.94E+08	3.21E+07	1.51E+07
2017	3.88E+07	1.69E+07	1.20E+07	8.69E+06	5.10E+06	2.97E+08	6.67E+07	1.89E+07
2016	4.59E+07	N/A[b]	N/A	N/A	N/A	2.83E+08	6.08E+07	1.28E+07
2015	4.08E+07	N/A	N/A	N/A	N/A	2.23E+08	3.96E+07	1.65E+07
2014	4.76E+07	N/A	N/A	N/A	N/A	9.31E+07	6.61E+07	2.66E+07

[a] There is no DRL for gross beta because there is a DRL for the regulated components of gross beta (cesium-137 and strontium-90).

[b] Monitoring of uranium-total, plutonium-239/240, plutonium-238, and americium-241 began in 2017.

Port Granby Project

Table H-5: Port Granby Project annual radionuclide releases to surface water for 2014-2018.

Year	Radium-226 (MBq)	Uranium (kg)
2018	1.0	1.3
2017	1.0	1.4
2016	2.4	15.6
2015	4.6	29.0
2014	5.4	36.7

Port Hope Project

Table H-6: Port Hope Project annual radionuclide releases to surface water for 2014-2018.

	Releases from routine operations		Releases from non-routine operations	
Year	Radium-226 (MBq)	Uranium (kg)	Radium-226 (MBq)	Uranium (kg)
2018	0.7	0.5	5676.9	14.6
2017	0.8	0.1	15868.0	110.1
2016	3.3	19.3	N/A	
2015	4.5	20.7	N/A	
2014	7.7	23.0	N/A	

Table H-6 shows both releases from the Port Hope Project due to routine operations, and from emergency releases of treated water. In 2017, CNL began using the new Waste Water Treatment Plant to treat contaminated water, in place of the old Water Treatment Building. Due to heavy rainfall events in both 2017 and 2018, CNL restarted the Water Treatment Building to treat excess contaminated water, in accordance with their water contingency plan, and in order to avoid a release of untreated water to the environment. CNL's water management challenges in 2017 were the subject of an Event Initial Report to the Commission [21]. For both 2017 and 2018, there were no exceedances of regulatory limits and toxicity testing showed that the water was not acutely lethal to fish or to aquatic life.

For both the Port Granby Project and the Port Hope Project, the loadings were calculated by multiplying the monthly total volume released by the monthly average concentrations. The total annual loadings are a sum of the monthly loads.

Douglas Point

Table H-7: Douglas Point annual radionuclide releases to atmosphere for 2014-2018

Year	Tritium: (HTO: Bq)	Gross Alpha (Bq)	Gross Beta (Bq)	Carbon-14 (Bq)
DRL	**5.46E+17**	**3.69E+12**	**3.69E+12**	**3.22E+15**
2018	7.96E+11	3.07E+03	4.55E+04	1.51E+09
2017	1.12E+11	1.64E+03	2.29E+04	N/A[b]
2016	1.59E+11	1.68E+03	1.91E+04	N/A
2015	1.33E+10	N/A[a]	N/A	N/A
2014	2.74E+11	N/A	N/A	N/A

[a] Monitoring of gross alpha and gross beta began in 2016.

[b] Monitoring of carbon-14 started in 2018 because new activities that have a potential for a measurable release of C-14 started.

Table H-8: Douglas Point annual radionuclide releases to surface water for 2014-2018.

Year	Tritium: (HTO: Bq)	Gross Alpha (Bq)	Gross Beta (Bq)
DRL	**2.04E+17**	**3.43E+13**	**3.43E+13**
2018	2.73E+10	1.18E+07	1.97E+07
2017	3.57E+10	1.12E+07	2.56E+07
2016	2.23E+10	9.00E+06	1.05E+07
2015	4.24E+10	N/A [a]	7.31E+07
2014	5.19E+10	N/A [a]	6.37E+07

[a] Monitoring of gross alpha began in 2016.

Nuclear Power Demonstration

Table H-9: Nuclear Power Demonstration annual radionuclide releases to atmosphere for 2014-2018.

Year	Tritium: (HTO: Bq)	Gross Beta (Bq)
DRL	**4.52E+16**	**3.83E+12**
2018	3.08E+11	4.23E+04
2017	1.48E+12	1.84E+05
2016	2.53E+11	4.30E+04
2015	2.15E+11	4.81E+04
2014	2.63E+11	5.27E+04

Table H-10: Nuclear Power Demonstration annual radionuclide releases to surface water for 2014-2018

Year	Tritium: (HTO: Bq)	Gross Beta (Bq)
DRL	**4.33E+17**	**2.56E+13**
2018	1.80E+09	5.91E+04
2017	1.08E+11	1.15E+06
2016	7.36E+10	2.56E+06
2015	6.61E+10	4.13E+06
2014	9.60E+10	6.08E+06

I. SELECTED WEBSITES

Atomic Energy of Canada Limited - https://www.aecl.ca/

Canadian National Energy Alliance - http://www.cnea.co/

Canadian Nuclear Laboratories - http://www.cnl.ca/en/home/default.aspx

Canadian Standards Association - https://www.csagroup.org/

The Canadian Nuclear Safety Commission - www.nuclearsafety.gc.ca

The CNSC's Independent Environmental Monitoring Program - https://nuclearsafety.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/index-iemp.cfm

CSA Standards via the CNSC website - https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/csa-standards.cfm