Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

UNPROTECTED/NON PROTÉGÉ

ORIGINAL/ORIGINAL

CMD: 23-M35

Date signed/Signé le : 21 AUGUST 2023

Regulatory Oversight Report

Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2022

Rapport de surveillance réglementaire

Rapport de surveillance réglementaire des installations de traitement de l'uranium et des substances nucléaires au Canada : 2022

Public Meeting

Réunion publique

Scheduled for:

December 13 or 14, 2023

Prévue pour :

13 ou 14 décembre 2023

Submitted by:

CNSC Staff

Soumis par :

Le personnel de la CCSN

e-Doc 6946334 (WORD)
e-Doc 7045516 (PDF)

Canada

Summary

This Commission member document (CMD) pertains to the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2022*.

There are no actions requested 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 des installations de traitement de l'uranium et des substances nucléaires au Canada: 2022*.

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

Signed/signé le

August 21, 2023

Digitally signed by Burton, Patrick
DN: C=CA, O=GC, OU=CNSC-CCSN, CN="Burton, Patrick"
Reason: I am the author of this document
Location: Ottawa, ON
Date: 2023.08.21 07:59:11-04'00'
Foxit PDF Editor Version: 12.1.2

Patrick Burton

Acting Director General

Directorate of Nuclear Cycle and Facilities Regulation

Directeur générale par intérim

Direction de la réglementation du cycle et des installations nucléaires

Table of contents

Changes to the 2022 regulatory oversight report

As with other regulatory oversight reports (ROR) produced by the Canadian Nuclear Safety Commission (CNSC), changes have been made to this report based on recommendations and/or direction from the Commission and feedback from intervenors. CNSC staff made the following changes to the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2022*:

- A description of environmental protection review (EPR) reports has been included (section 7.4)
- Terms of Reference for long term engagement with Indigenous Nations and communities are included in appendix N
- An appendix has been added which summarizes the number of issues, concerns and recommendations submitted by Indigenous Nations and communities who intervened in the previous (2021) uranium and nuclear substance processing facilities (UNSPF) ROR

Plain language summary

The *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2022* provides information on the safety performance of the following licensed facilities in Canada:

- Uranium processing facilities
  - Cameco Corporation Blind River Refinery, Blind River, Ontario
  - Cameco Corporation Port Hope Conversion Facility, Port Hope, Ontario
  - Cameco Fuel Manufacturing Inc., Port Hope, Ontario
  - BWXT Nuclear Energy Canada Inc., Toronto, Ontario
  - BWXT Nuclear Energy Canada Inc., Peterborough, Ontario
- Nuclear substance processing facilities
  - SRB Technologies (Canada) Inc., Pembroke, Ontario
  - Nordion (Canada) Inc., Ottawa, Ontario
  - Best Theratronics Ltd., Ottawa, Ontario
  - BWXT Medical Ltd., Ottawa, Ontario

Non-power reactors (McMaster University, Royal Military College of Canada, École Polytechnique de Montréal), which were last included in the 2020 Regulatory Oversight Report (ROR), will be included in a 2023 ROR as they are covered every 3 years.

This report is based on the work done by Canadian Nuclear Safety Commission (CNSC) staff to ensure the protection of the environment and the health and safety of the people around licensed uranium and nuclear substance processing facilities (UNSPFs) listed above. In 2022, all facilities operated safely. Monitoring data showed that the water and the food grown nearby were safe for consumption. There were no releases from UNSPFs that could have harmed human health or the environment.

This report also provides an update on CNSC staff's regulatory activities pertaining to public information, community engagement, and aspects of the CNSC's Independent Environmental Monitoring Program (IEMP) that relate to UNSPFs. Where possible, trends are shown and information is compared to previous years.

Each year, CNSC inspectors and experts complete inspections at the UNSPFs. The number and scope of inspections at each facility depend on the potential hazards (risks) the facility poses to people and the environment and on its performance history. The CNSC uses a risk-informed approach when planning inspections. Over the reporting period, CNSC staff performed a total of 24 inspections at the UNSPFs listed above. These inspections resulted in the issuance of 55 notices of non-compliance, which were all related to issues identified as being of low safety significance. In addition, to ensure that non-proliferation obligations were met, 34 International Atomic Energy Agency–initiated safeguards verification activities and 1 CNSC-initiated safeguards field activity were performed at the UNSPFs.

The CNSC uses 14 safety and control areas (SCAs) to evaluate the performance of each licensee; the resulting performance ratings are included in this report. Particular focus is placed on the radiation protection, environmental protection, and conventional health and safety SCAs, as these give a good overview of safety performance.

The SCA ratings in this report were derived from the results of activities conducted by CNSC staff to verify licensee compliance. These activities included onsite and virtual inspections, technical assessments, reviews of licensee reports, reviews of events and incidents, and ongoing exchanges of information with licensees. For the reporting period, CNSC staff rated all SCAs as "satisfactory" for each of the facilities covered in this report and confirmed that all facilities were operating safely.

The facilities discussed in this report lie within the traditional and/or treaty territories of many Indigenous Nations and communities. In 2022, CNSC staff undertook ongoing and meaningful engagement activities with Indigenous Nations and communities in relation to the facilities covered by this ROR. These engagement activities support the CNSC's commitment to meeting its consultation responsibilities and to continuing to build and strengthen positive relationships with Indigenous Nations and communities and respond to their issues and concerns. The CNSC is also making efforts to follow up with previous intervenors to explore how to address issues raised.

This report is available on the CNSC website, and the documents referenced in it are available upon request by contacting:

Senior Tribunal Officer, Commission Registry
Tel.: 613-858-7651 or 1-800-668-5284
Fax: 613-995-5086
Email: interventions@cnsc-ccsn.gc.ca

1. Introduction

Through the application 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 and safety of persons and the environment and to implement Canada's international commitments on the peaceful use of nuclear energy. The CNSC also disseminates 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 and licence conditions.

This regulatory oversight report (ROR) provides an overview of CNSC regulatory efforts and staff's assessment of uranium and nuclear substance processing facilities (UNSPFs) in Canada for the 2022 calendar year.

The facilities covered by this report are:

- Uranium processing facilities[1]
  - Cameco Corporation Blind River Refinery (BRR), Blind River, Ontario (FFL-3632.00/2032)
  - Cameco Corporation Port Hope Conversion Facility (PHCF), Port Hope, Ontario (FFOL-3631.00/2027)
  - Cameco Fuel Manufacturing Inc. (CFM), Port Hope, Ontario (FFL-3641.00/2043)
  - BWXT Nuclear Energy Canada Inc. (BWXT NEC Toronto), Toronto, Ontario (FFL-3621.00/2030)
  - BWXT Nuclear Energy Canada Inc. (BWXT NEC Peterborough), Peterborough, Ontario (FFL-3620.00/2030)
- Nuclear substance processing facilities[1]
  - SRB Technologies (Canada) Inc. (SRBT), Pembroke, Ontario (NSPFL-13.00/2034)
  - Nordion (Canada) Inc. (Nordion), Ottawa, Ontario (NSPFOL-11A.01/2025)
  - Best Theratronics Ltd. (BTL), Ottawa, Ontario (NSPFOL-14.00/2029)
  - BWXT Medical Ltd., Ottawa, Ontario (NSPFL-15.00/2031)

[1] Each alpha-numeric expression refers to the licence held by the licensee, where FFOL = fuel facility operating licence; FFL = fuel facility licence; and NSPFOL = nuclear substance processing facility operating licence; NSPFL = nuclear substance processing facility licence.

This report discusses all safety and control areas (SCAs), but focuses on radiation protection, environmental protection, and conventional health and safety, as they provide a good overview of safety performance at licensed facilities. The report also provides an overview of licensee operations, licence changes, major developments at licensed facilities and sites, and reportable events. In addition, the report includes information on engagement with Indigenous Nations and communities, public information programs, and COVID-19 responses by the CNSC and the licensees.

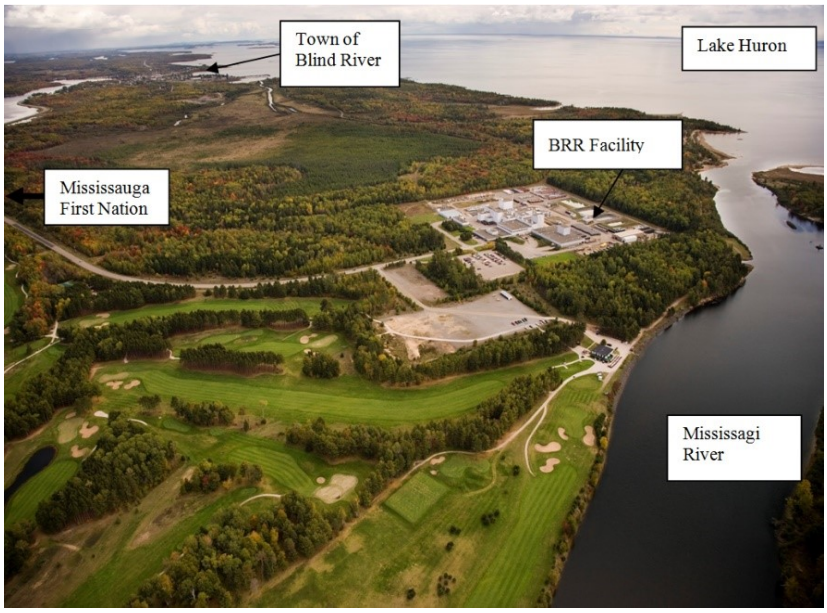
2. Uranium processing facilities

Uranium processing facilities are part of the nuclear fuel cycle that includes refining, conversion, and fuel manufacturing. The fuel produced is used in nuclear power plants for the generation of electricity.

2.1 Cameco Blind River Refinery

Cameco Corporation owns and operates the Blind River Refinery (BRR), in Blind River, Ontario. The facility is located about 5 km west of the town of Blind River and south of Mississauga First Nation, as shown in figure 2-1. The facility is located within the Robinson-Huron and Robinson-Superior Treaties territory and the traditional territory of the Anishinabek, Métis and Odawa peoples, in particular the Mississauga First Nation.

Figure 2-1: Aerial view of the Blind River Refinery, showing its proximity to the town of Blind River, Ontario, the Mississauga First Nation, Lake Huron, and the Mississauga River.



(Source: Cameco)

The BRR facility refines uranium concentrates (yellowcake) received from uranium mines in Canada and around the world to produce uranium trioxide (UO_3), an intermediate product of the nuclear fuel cycle. The primary recipient of the UO_3 is Cameco's Port Hope Conversion Facility (PHCF).

In 2022, CNSC staff conducted 4 inspections at the BRR that covered 5 SCAs. Table B-1 in appendix B lists these inspections and the 23 resulting NNCs.

CNSC staff are satisfied that Cameco's BRR operated safely in 2022 and in accordance with its licensing basis.

2.1.1 2021 BRR licence renewal

In November 2021, the Commission conducted a virtual public hearing on the renewal of Cameco's BRR operating licence. CNSC staff's assessment of the renewal application was presented publicly during the hearing as Commission member document CMD 21-H9.

In February 2022, the Commission made a decision on the Cameco BRR licence renewal application, as documented in the Record of Decision. In its decision, the Commission renewed Cameco's BRR licence (FFL-3632.00/2032) for a period of 10 years and accepted the proposed new financial guarantee.

2.2 Cameco Port Hope Conversion Facility

Cameco Corporation owns and operates the Port Hope Conversion Facility (PHCF), which is located in Port Hope, Ontario, and is in the traditional territory of the Michi Saagiig Anishinaabe people. These lands are covered by the Williams Treaty between Canada and the Mississauga and Chippewa Nations. The facility is situated on the north shore of Lake Ontario, approximately 100 km east of Toronto. Figure 2-2 shows an aerial view of the PHCF.

Figure 2-2: Aerial view of the Port Hope Conversion Facility.

(Source: Cameco)

PHCF converts UO_3 powder produced by Cameco's BRR into uranium dioxide (UO_2) and uranium hexafluoride (UF_6). UO_2 is used in the manufacturing of Canada Deuterium Uranium (CANDU) reactor fuel, while UF_6 is exported for further processing before being converted into fuel for light-water reactors.

In 2022, CNSC staff conducted 4 inspections at PHCF that covered 10 SCAs, as well as compliance verification activities associated with the Vision in Motion (VIM) project (discussed below). Table B-2 in appendix B lists these inspections and the 4 resulting NNCs.

CNSC staff are satisfied that Cameco's PHCF operated safely in 2022 and in accordance with its licensing basis.

2.2.1 PHCF Financial Guarantee

In 2022, CNSC staff received an updated preliminary decommissioning plan (PDP) and financial guarantee from Cameco for the PHCF to fulfill the requirement to update the PDP and cost estimate at a minimum every 5 years. At the end of 2022, CNSC staff's assessment was underway in preparation for a hearing in writing in 2023.

2.2.2 Vision in Motion

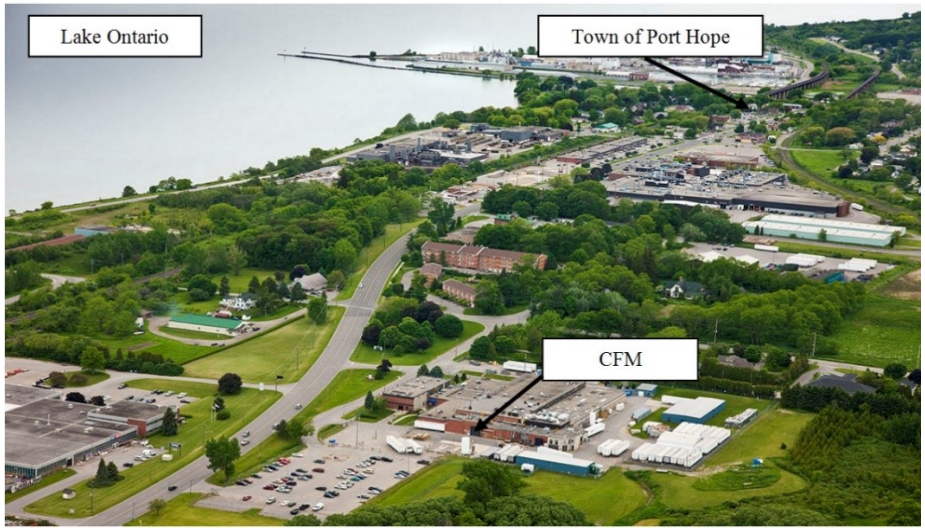
VIM is Cameco's project to clean up and renew the PHCF site. The project builds on work now underway through the Port Hope Area Initiative (PHAI) to address historic low-level radioactive waste issues in the municipality of Port Hope. The VIM project is being carried out under Cameco's operating licence, FFOL-3631.00/2027. Licence condition 16.1 states: "The licensee shall implement and maintain a program to carry out clean-up, decontamination and remediation work". VIM activities were impacted by the continuing COVID-19 pandemic in 2022. For example, the VIM project adjusted its medium and long-term schedule in line with the new closure dates of the CNSC-licensed Canadian Nuclear Laboratories (CNL) Port Hope Project Long-Term Waste Management Facility (LTWMF). Cameco took the opportunity to re-sequence the plan in line with the post pandemic closure date of the LTWMF. Mobilization of field crews and on-site activities were limited to smaller crews, however, crew sizes increased during the summer months to support the interior deconstruction of the former UF_6 plant (Building 27). In 2022, Cameco carried out VIM work that included:

- the preparation and transfer of stored wastes to the CNSC-licensed CNL LTWMF
- the removal of interior equipment and accumulated waste materials in Building 27 (the former UF_6 plant); tower hoarding was completed in preparation for full demolition in 2023
- the commissioning of the new liquid hydrogen station and the removal of the old hydrogen station

2.3 Cameco Fuel Manufacturing Inc.

Cameco Fuel Manufacturing Inc. (CFM) is a wholly owned subsidiary of Cameco Corporation. CFM is in the traditional territory of the Michi Saagiig Anishinaabe people. These lands are covered by the Williams Treaty between Canada and the Mississauga and Chippewa Nations. CFM operates 2 facilities: a nuclear fuel fabrication facility licensed by the CNSC in Port Hope, Ontario (referred to as CFM in this report); and a metals manufacturing facility in Cobourg, Ontario, which manufactures fuel bundle and reactor components. This latter facility is not licensed by the CNSC and is not discussed further in this report. Figure 2-3 shows an aerial view of the CFM facility.

Figure 2-3: Aerial view of the Cameco Fuel Manufacturing facility and its proximity to Lake Ontario and the town of Port Hope



(Source: Cameco)

The CFM facility manufactures fuel pellets from UO_2 powder and assembles nuclear reactor fuel bundles. The finished fuel bundles are primarily shipped to Canadian nuclear power reactors.

In 2022, CNSC staff conducted 4 inspections at CFM that covered 9 SCAs. Table B-3 of appendix B lists these inspections and the 8 resulting NNCs.

CNSC staff are satisfied that CFM operated safely in 2022 and in accordance with its licensing basis.

2.3.1 CFM licence renewals

In February 2022, the Commission issued its decision (Record of Decision), granting a 1-year renewal of the CFM licence, which expired on February 28, 2023. Cameco had requested the 1-year licence term to separate future CFM licence renewal from the licence renewal activities for Cameco's BRR. CNSC staff's findings and recommendations were documented in CMD 21-H105, which was reviewed by the Commission at a hearing in writing following a 60-day intervention period which commenced in September 2021.

In October 2021, Cameco submitted an application for a 20-year renewal of the CFM licence. In its application, Cameco requested its production limit be increased from 125 tonnes of UO_2 as pellets during any calendar month to 1,650 tonnes of uranium as UO_2 pellets per year. Following a review of Cameco's application and supporting documents, CNSC staff's findings and recommendations were documented in CMD 22-H12, which was reviewed by the Commission at a public hearing in Cobourg (Ontario) on November 23, 2022. In January 2023, the Commission issued its decision (Record of Decision), granting a 20-year renewal of the CFM licence, which expires on February 28, 2043. The Commission directed that, at the midpoint of the 20-year licence period and no later than 2033, CFM shall provide to the Commission a comprehensive midterm update on the conduct of its licensed activities and compliance with requirements.

2.4 BWXT Nuclear Energy Canada Inc.

BWXT Nuclear Energy Canada Inc. (BWXT NEC) produces nuclear fuel bundles used by Ontario Power Generation's Pickering and Darlington nuclear generating stations. BWXT NEC has licensed operations in 2 locations: Toronto and Peterborough, Ontario. Figures 2-4 and 2-5 show aerial views of the BWXT NEC facilities. The Toronto facility is located within the traditional territory of many nations, including the Mississaugas of the Credit, the Anishnabeg, the Chippewa, the Haudenosaunee and the Wendat peoples, and now home to many diverse First Nations, Inuit and Métis peoples. The Peterborough facility resides in the traditional territory of the Michi Saagiig Anishinaabe people. These lands are covered by the Williams Treaty between Canada and the Mississauga and Chippewa Nations.

Figure 2-4: Aerial view of the BWXT NEC Toronto facility outlined in red.

(Source: Google Maps)

Figure 2-5: Aerial view of the BWXT NEC Peterborough facility outlined in red.

(Source: Google Earth)

The Toronto facility produces CANDU nuclear fuel pellets using UO_2 supplied by PHCF. The Peterborough facility manufactures CANDU nuclear fuel bundles using the uranium pellets from Toronto and zircaloy tubes manufactured in-house. The Peterborough facility also runs a fuel services business involved with the manufacturing and maintenance of equipment for use in nuclear power plants.

In 2022, CNSC staff conducted 4 inspections at BWXT NEC that covered 6 SCAs. Table B-4 in appendix B lists these inspections and the 8 resulting NNCs.

In addition, the Ontario Ministry of Environment, Conservation and Parks conducted 1 inspection at the Toronto facility focussed on waste generation. No non compliances were raised from this inspection.

Section 7.3.2 provides details on follow-up on activities done in accordance with the Commission's Record of Decision and staff's Peterborough public engagement plan.

CNSC staff are satisfied that the BWXT NEC facilities operated safely in 2022 and in accordance with their licensing basis.

2.4.1 BWXT NEC Financial Guarantee

In December 2022, CNSC staff received an updated preliminary decommissioning plan (PDP) and financial guarantee from BWXT NEC for the Toronto and Peterborough facilities. CNSC staff's assessment in 2023 will be presented at a hearing in writing.

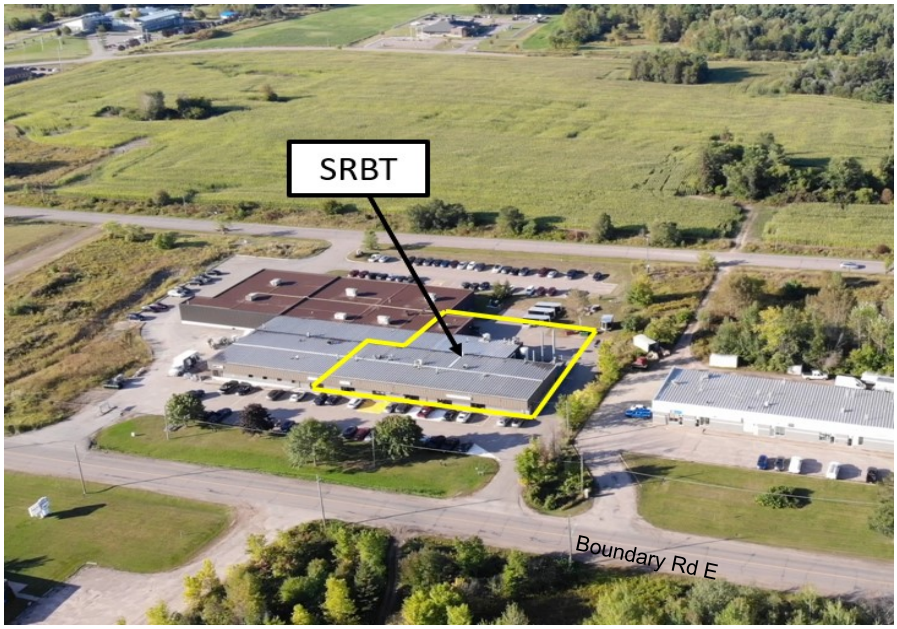
3. Nuclear substance processing facilities

Nuclear substance processing facilities use nuclear substances to manufacture various products for end uses in industrial or medical applications. The nuclear substances can be used for lighting self-luminous emergency and exit signs, sterilizing items such as surgical gloves for sanitary reasons, and providing cancer diagnosis and treatment. All of the facilities are located within the traditional unceded territory of the Algonquin Anishinaabeg peoples.

3.1 SRB Technologies (Canada) Inc.

SRB Technologies (Canada) Inc. (SRBT) operates a Class IB facility manufacturing gaseous tritium light sources (GTLSs) on the outskirts of Pembroke, Ontario, located approximately 150 km northwest of Ottawa. The nuclear facility has been in operation since 1990. Figure 3-1 shows an aerial view of the SRBT facility.

Figure 3-1: Aerial view of the SRBT facility outlined in yellow.



(Source: SRBT)

The SRBT facility processes tritium gas (HT) to produce sealed glass capsules coated with phosphorescent powder and filled with HT to generate continuous light. Examples of such GTLSs include signs, markers, and tactical devices. SRBT distributes its products in Canada and internationally.

In 2022, CNSC staff conducted 2 inspections at SRBT that covered 4 SCAs. Table B-5 in appendix B lists these inspections and the 6 resulting NNCs.

CNSC staff are satisfied that SRBT operated safely in 2022 and in accordance with its licensing basis.

3.1.1 2022 SRBT licence renewal

In June 2021, CNSC staff received SRBT's application for a 15-year renewal of its nuclear substance processing facility operating licence. In April 2022, the Commission conducted a virtual public hearing on the renewal of SRBT's operating licence. CNSC staff's assessment of the renewal application was presented publicly during this hearing as CMD 22-H8.

In June 2022, the Commission made a decision on SRBT's licence renewal application, as documented in the Record of Decision. In its decision, the Commission renewed the licence (NSPFL-13.00/2034) for a period of 12 years.

3.2 Nordion (Canada) Inc.

Nordion (Canada) Inc. (Nordion) is located in Ottawa, Ontario, and is licensed to operate a Class IB nuclear substance processing facility. Figure 3-2 shows an aerial view of the Nordion facility.

Figure 3-2: Aerial view of the Nordion facility outlined in orange.

(Source: Nordion / Canadian Aerial Photo Corporation)

Nordion provides cobalt-60 and gamma irradiation systems for medical devices, food safety and health care industries, and innovative applications.

In 2022, CNSC staff conducted 2 inspections at Nordion that covered 2 SCAs. Table B-6 in appendix B lists these inspections and there were no resulting NNCs.

CNSC staff are satisfied that Nordion operated safely in 2022 and in accordance with its licensing basis.

3.2.1 Nordion Financial Guarantee

In 2022, CNSC staff received an updated Preliminary Decommissioning Plan (PDP) and financial guarantee from Nordion (CMD 22-H106.1) to reflect, primarily, the removal of decommissioning activities and costs for which BWXT Medical is now responsible. CNSC staff's assessment of the PDP and financial guarantee was presented at a hearing in writing in December 2022 (CMD 22-H106).

In February 2023, the Commission approved Nordion's revised financial guarantee (Record of Decision).

3.3 Best Theratronics Ltd.

Best Theratronics Ltd. (BTL) operates a Class IB facility, manufacturing medical devices in Ottawa, Ontario. Figure 3-3 shows an aerial view of the BTL facility.

Figure 3-3: Aerial view of the Best Theratronics Ltd. facility.

(Source: Google Maps)

BTL manufactures cyclotrons and medical equipment, including cobalt-60-based external beam radiation therapy units and cesium-137 self-contained irradiators for blood irradiation.

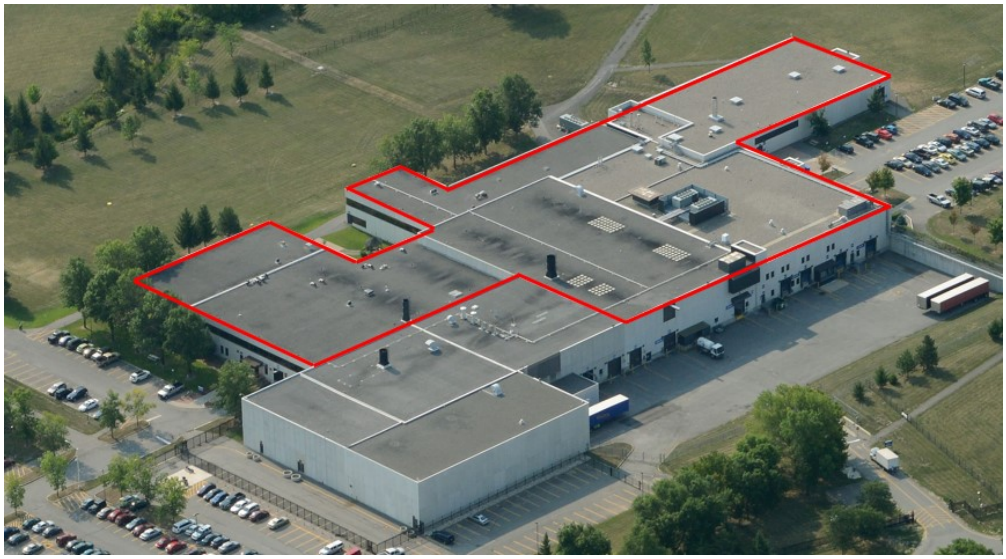
In 2022, CNSC staff conducted 2 inspections at BTL that covered 2 SCAs. Table B-7 in appendix B lists this inspection and the 6 resulting NNCs.

CNSC staff are satisfied that BTL operated safely in 2022 and in accordance with its licensing basis.

3.4 BWXT Medical Ltd.

BWXT Medical Ltd. (BWXT Medical) operates a Class IB nuclear substance processing facility in Ottawa, Ontario. Figure 3-4 shows an aerial view of the BWXT Medical facility.

Figure 3-4: Aerial view of the BWXT Medical facility outlined in red.



(Source: Nordion / Canadian Aerial Photo Corporation)

BWXT Medical processes unsealed radioisotopes such as yttrium-90 and indium-111 for health and life sciences applications. The facility is composed of a nuclear medicine production facility where the radioisotopes used in nuclear medicine are processed.

In 2022, CNSC staff conducted 2 inspections at BWXT Medical that covered 8 SCAs. Table B-6 in appendix B lists these inspections and there were no resulting NNCs.

CNSC staff are satisfied that BWXT Medical operated safely in 2022 and in accordance with its licensing basis.

4. CNSC regulatory oversight

The CNSC performs regulatory oversight of licensed facilities to verify compliance with the requirements of the NSCA and the associated regulations made under it, each site's licence and licence conditions, and any other applicable standards and regulatory documents (REGDOCs).

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 each SCA's key components. Further information on the SCA framework can be found on the CNSC's website.

4.1 Regulatory activities

CNSC staff conducted many risk-informed regulatory oversight activities at Canada's UNSPFs in 2022. Table 4-1 presents CNSC staff's licensing and compliance verification efforts for these facilities for the reportable year.

Table 4-1: CNSC inspections, licensing and compliance verification efforts at UNSPFs, and safeguards verification activities led by the International Atomic Energy Agency (IAEA) and by CNSC staff (2022).

Licensee	Number of CNSC inspections	Person-days, compliance verification activities	Person-days for licensing activities	IAEA-led safeguards inspections	CNSC-led safeguards inspections
BRR	4	188	12	7	0
PHCF	4	281	8	8	0
CFM	4	196	485	6	0
BWXT NEC*	4	200	1	9	1
SRBT	2	51	146	0	0
Nordion	2	138	39	1	0
BTL	2	96	2	1	0
BWXT Medical	2	76	9	2	0

*Note: 3 CNSC inspections covered both the Toronto and Peterborough facilities and the 4th inspection (Emergency Preparedness) covered Toronto only; person-days for compliance and licensing activities for the Toronto and Peterborough facilities are combined; 5 IAEA-led safeguards inspections covered the Toronto facility, and 4 covered Peterborough; 1 CNSC-led safeguards inspection occurred at the Toronto facility only.

Compliance verification

The CNSC ensures licensee compliance through verification, enforcement, and reporting activities. CNSC staff implement compliance plans for each site by conducting regulatory activities, including inspections, desktop reviews, and technical assessments of licensee programs, processes, and reports.

Appendix A contains a list of annual compliance reports prepared by the licensees for the period January to December 2022.

Appendix B contains a list of CNSC inspections carried out at UNSPFs in 2022. All findings in these inspections were of low safety significance, and none had an impact on safety at the facilities.

Licensing

CNSC staff's licensing activities include drafting new or amended licences, preparing CMDs, and drafting or revising licence conditions handbooks (LCHs).

When CNSC regulatory documents are published, CNSC staff update the LCHs as applicable for each site, taking into consideration the licensee's implementation plans. Appendix C provides a list of changes to UNSPFs LCHs in 2022. CNSC staff verify the implementation as part of ongoing compliance verification activities. Appendix D provides a list of CNSC regulatory documents implemented in 2022 at UNSPFs and used by CNSC staff for compliance verification. Appendix E presents the financial guarantee amounts for each facility.

IAEA safeguards activities

Under the terms of the Canada–IAEA safeguards agreements, the IAEA performs verification activities to confirm that all nuclear material in Canada remains in peaceful use. The CNSC regulatory framework requires Canadian operators to provide the access, assistance and information required for the IAEA to complete its activities. CNSC staff ensure operator compliance with these requirements.

4.2 Performance ratings, 2022

CNSC staff assign performance ratings to licensees based on the results of regulatory oversight activities. These ratings are either "satisfactory" (SA) or "below expectations" (BE) for the UNSPFs (2022). The "fully satisfactory" (FS) rating has not been in use since 2019. For 2022, CNSC staff rated the performance in each SCA as SA for all UNSPFs. Appendix F provides the SCA ratings for each licensee from 2018 to 2022.

5. CNSC assessment of safety at UNSPF

The CNSC regulates all aspects of safety at nuclear sites in Canada, including risks to workers, the public and the environment. All 14 SCAs, discussed in the following paragraphs, have been assessed. Detailed information is provided on radiation protection, conventional health and safety, and environmental protection, since these 3 SCAs are considered the most indicative of safety performance at UNSPFs. In particular, the SCAs of radiation protection and conventional health and safety are a good measure of the safety of workers, while the SCA of environmental protection is an appropriate measure of the safety of people and the environment.

5.1 Management system

The management system SCA covers the framework that establishes the processes and programs required to ensure that an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.

CNSC staff assess performance in the management system SCA by verifying the compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. The specific areas assessed within the management system include organization; planning and controlling business activities; resource management; communication; safety culture; change management; information management; work management; problem identification and resolution; and performance assessment, improvement, and management review.

NNCs from 1 inspection related to the management system SCA were issued for the following licensee over the reporting period:

- BRR – 7 NNCs related to documenting changes to the organizational chart and supervisor meeting frequency, ensuring completeness of records, ensuring that audits are adequately documented and that all elements of the management system are reviewed, and ensuring that information concerning vendor commissioning is documented.

The licensee has taken, or has committed to take, necessary corrective actions to address the above-noted NNCs. The findings were of low safety significance and did not affect the health and safety of workers, people or the environment, or the safe operation of the facility.

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained and implemented satisfactory management system programs for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.2 Human performance management

The human performance management SCA 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.

CNSC staff assess performance in the human performance management SCA by verifying the compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. For this SCA, CNSC staff verify that licensees are in compliance with REGDOC-2.2.2, *Personnel Training* [2], and their documented personnel training programs.

There were no NNCs related to the human performance management SCA over the 2022 reporting period. CNSC staff concluded that the UNSPFs met regulatory requirements and maintained satisfactory ratings in the human performance management SCA for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.3 Operating performance

The operating performance SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

CNSC staff assess performance in the operating performance SCA by verifying that policies, programs, methods and procedures are in place for the safe operation and maintenance of nuclear facilities. Verification of compliance with the requirements of this SCA is included as part of the CNSC's compliance verification activities, including desktop reviews of annual reports, reviews of event reports and related corrective actions, and planned or reactive inspections.

There were no NNCs related to the operating performance SCA over the 2022 reporting period. CNSC staff concluded that the UNSPFs implemented and maintained effective operating programs in order to ensure that licensed activities are conducted safely and in compliance with regulatory requirements. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.4 Safety analysis

The safety analysis SCA includes maintenance of the safety analysis that 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.

CNSC staff assess performance in the safety analysis SCA by verifying the compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. CNSC

staff verify that licensees maintain safety analysis reports (SARs) that include updated information on the description of the facility and the measures in place to protect the safety of workers, the public and the environment under normal operations, abnormal, and accident conditions. CNSC staff assess the SARs to ensure that they provide an assessment of the potential consequences and demonstrate the safety case through defence in depth.

There were no NNCs from inspections related to the safety analysis SCA for the licensees covered in this report. CNSC staff concluded that the UNSPFs met regulatory requirements and maintained satisfactory ratings in the safety analysis SCA for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.5 Physical design

The physical design SCA 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.

CNSC staff assess performance in the physical design SCA by verifying compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. CNSC staff verify the physical design SCA requirements by ensuring the implementation of national codes and standards for structural design and maintaining authorized inspection agency formal agreements including those relating to pressure-retaining programs where applicable.

One NNC from an inspection related to the physical design SCA was issued for the following licensee over the reporting period:

- CFM – 1 NNC related to obtaining pressure vessel certificates of inspection from authorized inspection agency after inspections are completed.

The licensee has taken all necessary corrective actions to address the above-noted NNC. The finding was of low safety significance and did not affect the health and safety of workers, people or the environment, or the safe operation of the facility.

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained satisfactory ratings in the physical design SCA for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.6 Fitness for service

The fitness for service SCA 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 verify all equipment is available to perform its intended design function when called upon to do so.

CNSC staff assess performance in the fitness for service SCA by verifying compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. CNSC staff verify that the programs cover activities that affect the physical condition of structures, systems and components over time. Specific areas are assessed within this SCA to ensure that the fitness for service programs are supported by detailed procedures on preventative maintenance, measuring and testing of equipment and new equipment validation.

One NNC from an inspection related to the fitness for service SCA was issued for the following licensee over the reporting period:

- CFM – 1 NNC related to ensuring full completion of work order documentation.

The licensee has taken all necessary corrective actions to address the above-noted NNC. The finding was of low safety significance and did not affect the health and safety of workers, people and the environment, or the safe operation of the facility.

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained satisfactory ratings in the fitness for service SCA for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.7 Radiation protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations* [3]. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled, and maintained as low as reasonably achievable (ALARA).

NNCs from inspections related to the radiation protection SCA were issued for the following licensees over the reporting period:

- BRR – 9 NNCs related to provision of information to nuclear energy workers, training and qualification of radiation protection staff, posting areas and labelling containers where nuclear substances are present, and maintaining radiation instrumentation.
- BWXT NEC – 1 NNC related to a worker not wearing a thermoluminescent dosimeter in a designated area.
- SRBT – 2 NNCs related to ensuring that signage and labelling around the facility are in accordance with the *Radiation Protection Regulations.*
- BTL – 3 NNCs related to calibration of radiation instrumentation, frivolous posting of radiation symbols, and a gap analysis between their Radiation Program Manual and the *Radiation Protection Regulations.*

The licensees have taken, or committed to take, corrective actions to address the above noted NNCs. The findings were of low safety significance and did not affect the health and safety of workers, people or the environment, or the safe operation of the facility. CNSC staff rated the radiation protection SCA at all UNSPFs as satisfactory.

Appendix J contains data on doses to workers for the UNSPFs from 2018 to 2022.

Application of ALARA

CNSC staff confirmed that all UNSPFs continued to implement radiation protection measures to keep radiation exposures and doses to persons ALARA. The CNSC requirement for licensees to apply the ALARA principle has consistently resulted in these doses staying well below regulatory dose limits.

Worker dose control

Radiation protection programs include dosimetry methods, identification of workers requiring nuclear energy worker (NEW) status, and the methods for radiation safety of workers. Radiation protection programs vary, depending on the radiological hazards present and the expected magnitude of doses received by workers. CNSC staff confirmed that all UNSPFs monitored and controlled the radiation exposures and doses received by all persons present at their licensed facilities, including workers, contractors, and visitors. Direct comparison between facilities of doses received by NEWs does not necessarily provide an appropriate measure of a licensee's effectiveness in implementing its radiation protection program, since radiological hazards differ across these facilities due to complex and varying work environments.

Radiation protection program performance

CNSC staff conducted regulatory oversight activities at UNSPFs to verify that the licensees' radiation protection programs complied with regulatory requirements. These oversight activities included inspections, desktop reviews, and compliance verification activities specific to radiation protection. Through these activities, CNSC staff confirmed that all these licensees have effectively implemented their radiation protection programs to control occupational exposures to workers and keep doses ALARA.

Action levels

Action levels for radiological exposures are established as part of the licensees' radiation protection programs. Each licensee is responsible for identifying the parameters of its own program(s) to represent timely indicators of potential losses of control of the program(s). These licensee-specific action levels may also change over time, depending on operational and radiological conditions.

If an action level is reached, it triggers the licensee to determine the cause, notify the CNSC and, if applicable, take corrective action to restore the effectiveness of the radiation protection program. It is important to note that occasional action

level exceedances indicate that the action level chosen is likely an adequately sensitive indicator of a potential loss of control of the program.

There were no radiation protection action levels reached at the UNSPFs in 2022.

Radiological hazard control

CNSC staff verified that UNSPFs continued to implement acceptable measures to monitor and control radiological hazards in their facilities. These measures included delineation of zones for contamination control purposes and in-plant air-monitoring systems. Licensees demonstrated that they have implemented workplace monitoring programs to protect workers. The licensees have also demonstrated that levels of radioactive contamination were below limits within their facilities throughout the year.

Conclusion

CNSC staff concluded that the UNSPFs implemented and maintained effective radiation protection programs for the reportable year. The licensees' programs are effective in ensuring the health and safety of persons working in their facilities. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.8 Conventional health and safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers.

Based on regulatory oversight activities, CNSC staff rated the performance of all UNSPFs for the conventional health and safety SCA as "satisfactory".

Appendix K contains health and safety information for each UNSPFs from 2018 to 2022.

Performance

Employment and Social Development Canada (ESDC) and the CNSC regulate conventional health and safety programs at UNSPFs. CNSC staff monitor compliance with regulatory reporting requirements and, when a concern is identified, consult with ESDC staff.

Licensees are required to report to the CNSC as directed by section 29 of the *General Nuclear Safety and Control Regulations* (GNSCR) [4], including reports on serious illnesses or injuries incurred or possibly incurred as a result of a licensed activity.

A key performance measure for the conventional health and safety SCA is the number of lost-time injuries (LTIs) that occur per year. An LTI is an illness or injury that takes place at work and results in the worker being unable to return to work to carry out their duties for a period of time.

LTIs that were incurred or possibly incurred as a result of a licensed activity were reported by the following licensees over the reporting period:

- Nordion: 1 LTI was recorded for an employee who injured their knee tripping on an ergonomic mat while getting up from a chair. The employee required knee surgery as a result of this injury. Corrective actions included better storage of ergonomic mats and to develop training on the proper use of ergonomic mats.
- BWXT Medical: 1 LTI was recorded for a worker who injured their forehead and fingers while operating a hand drill and temporarily lost consciousness. 911 was called and paramedics arrived and transported the worker to the hospital.

In addition, LTIs that did not occur as a result of a licensed activity were reported by the following licensees in their annual compliance reports over the reporting period:

- BWXT NEC Toronto: 14 LTIs were recorded for employees who tested positive for COVID-19, shortly after the lifting of the provincial mask mandate. These cases resulted in lost time, potentially due to workplace exposure.
- BWXT NEC Peterborough: 2 LTIs associated with slip and falls outside of licensed operations and were deemed as not reportable events to the CNSC.

Practices

Licensees are responsible for developing and implementing conventional health and safety programs for the protection of their workers. These programs must comply with Part II of the *Canada Labour Code* [5].

CNSC staff conducted desktop reviews and inspections at all UNSPFs to verify compliance of the licensees' conventional health and safety programs with regulatory requirements.

One NNC from an inspection related to the conventional health and safety SCA was issued for the following licensee over the reporting period:

- CFM – 1 NNC related to completion of internal requirements associated with joint health and safety committee meeting minutes.

The licensee has taken all necessary corrective actions to address the above-noted NNC. The finding was of low safety significance and did not affect the health and safety of workers, people, the environment, or the safe operation of the facility.

Awareness

Licensees are responsible for ensuring that workers have the knowledge to identify workplace hazards and take the necessary precautions to protect against those hazards. This is accomplished through training and ongoing internal communications with workers.

During inspections, CNSC staff verify that workers are trained to identify hazards at the facilities. CNSC staff confirmed that the UNSPFs have effectively implemented their conventional health and safety programs to keep workers safe.

Conclusion

CNSC staff concluded that the UNSPFs implemented their conventional health and safety programs satisfactorily for the reportable year. The programs are effective in protecting the health and safety of persons working in these facilities. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.9 Environmental protection

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

Based on regulatory oversight activities, CNSC staff rated the environmental protection SCA at all UNSPFs as “satisfactory”.

NNCs from 1 inspection related to the environmental protection SCA were issued for the following licensee over the reporting period:

- PHCF – 2 NNCs related to the calibration of fluoride monitors and Hi-Vol air samplers.

The licensee has taken all necessary corrective actions to address the above noted NNCs. The findings were of low safety significance and did not affect the health and safety of workers, people, the environment, or the safe operation of the facility.

Appendix G provides the total annual releases of radionuclides for the UNSPFs from 2018 to 2022. Appendix H contains data on dose to the public from 2018 to 2022. Appendix I contains supplemental environmental data for all licensees.

Effluent and emissions control (releases)

All UNSPFs implement effluent monitoring programs commensurate with the risks of their operations. Airborne and waterborne releases of radioactive and hazardous substances at UNSPFs remained below regulatory limits in 2022.

Action levels

Action levels serve as an early warning system to ensure that licensees are carefully monitoring their operations and performance to prevent release limits from being exceeded. Action level exceedances are reportable to the CNSC.

Licensee performance is not evaluated on the number of action level exceedances in a given period, but rather, on how the licensee responds and implements corrective actions to enhance program performance and prevent reoccurrence. Licensees are required to periodically review their action levels to validate their effectiveness.

The following environmental action level exceedances were reported to the CNSC in 2022:

- PHCF: Cameco reported uranium sanitary sewer results from the combined facility discharge that were above the daily action level of 100 ug/L on 15 occasions between March and September 2022 (average concentration 146 ug/L). The facility discharge was well below the sanitary sewer uranium limit of 275 ug/L (monthly average) for each month in 2022. Groundwater infiltration, exacerbated by heavy precipitation events was the primary contributing factor to these exceedances. Cameco has implemented corrective actions and are continuing to repair and upgrade sections of the sanitary sewer network as part of the VIM project.
- PHCF: On June 28, 2022, the main stack daily average for uranium emissions at the UF_6 plant exceeded the action level of 40 gU/h, at a value of 45 gU/h. The result remained well below the licence limit of 280 gU/h. An investigation determined that UF_4 bypassed a breached filter resulting in the elevated uranium emission. As a corrective action, Cameco replaced this filter.
- PHCF: On August 31, 2022, the main stack daily average for fluoride emissions at the UF_6 plant exceeded the action level of 230 g HF/h, at a value of 236 g HF/h. The result remained well below the licence limit of 650 g HF/h. This exceedance was a result of a fluorine leak in the UF_6 plant compressor room due to a failed inlet valve. As a corrective action, Cameco replaced the valve.

CNSC staff concluded that there was no impact to workers, the public or the environment as a result of these action level exceedances. CNSC staff reviewed the licensee's corrective actions in relation to the exceedances and are satisfied with the licensee's responses.

Environmental management system

The CNSC requires each licensee to develop and maintain an environmental management system (EMS) that provides a framework for integrated activities related to environmental protection. The EMS is described in the environmental management program and includes activities such as the establishment of annual environmental objectives, goals and targets. Licensees conduct internal audits of

their programs at least once a year. As part of regular compliance verification, CNSC staff review and assess these objectives, goals and targets. CNSC staff determined that the UNSPFs established and implemented their EMS in compliance with CNSC regulatory requirements.

Assessment and monitoring

CNSC staff verify that UNSPFs have environmental monitoring programs commensurate with the risks of the operations at each of their facilities. The environmental monitoring programs are designed to monitor releases of radioactive and hazardous substances, and to characterize the quality of the environment associated with the licensed facility. CNSC staff determined that the UNSPFs established and implemented environmental monitoring programs in compliance with CNSC regulatory requirements, where applicable.

Environmental risk assessment

Environmental risk assessment (ERA) is a systematic process used by licensees to identify, quantify, and characterize the risk posed by contaminants and physical stressors in the environment on human and other biological receptors, including the magnitude and extent of the potential effects associated with a facility.

ERAs provide the basis for the scope and complexity of environmental monitoring programs at UNSPFs.

Facility ERAs are to be reviewed on a 5-year cycle, or more frequently if major facility changes are proposed that would trigger a predictive assessment.

In general, all UNSPFs facilities have submitted ERAs which are compliant with CSA N288.6 requirements. The ERA for BTL has been submitted and is under review.

Protection of people

The protection of the public within the environmental protection SCA is related to ensuring that members of the public are not exposed to unreasonable risk with respect to hazardous and nuclear substances released from the licensed facilities. Licensees use effluent and environmental monitoring programs to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health. CNSC staff receive reports of discharges to the environment in accordance with reporting requirements outlined in the licence and the LCH. Based on assessments of the programs at the UNSPF, CNSC staff concluded that the public continues to be protected from facility emissions of hazardous substances.

Estimated dose to the public

The maximum dose to the public from licensed activities is calculated by considering monitoring results from air emissions, liquid effluent releases and gamma radiation. The CNSC's requirement to follow the ALARA principle, taking into account social and economic factors, means that licensees must monitor their facilities and keep doses to the public below the annual public dose limit of 1 millisievert per year (mSv/year) prescribed in the *Radiation Protection Regulations* [3].

Table H-1 of appendix H compares estimated public doses from 2018 to 2022 for the UNSPFs. Estimated doses to the public from all these facilities continued to be well below the regulatory annual public dose limit of 1 mSv/year.

Conclusion

CNSC staff concluded that the UNSPFs have implemented their environmental protection programs satisfactorily for the reportable year. The licensees' programs are effective in protecting the health and safety of people and the environment. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.10 Emergency management and fire protection

The emergency management and fire protection SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions.

CNSC staff assess performance in the emergency management and fire protection SCA by verifying the compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. Specific areas assessed within this SCA include licensee response to conventional and nuclear events, both onsite and offsite, and events that can affect the facility. CNSC staff ensure that comprehensive fire protection programs are also in place to minimize the risk to the health and safety of persons and to the environment from fire, through appropriate fire protection system design, fire safety analysis, fire-safe operation and fire prevention.

NNCs from inspections related to the emergency management and fire protection SCA were issued for the following licensees over the reporting period:

- CFM – 2 NNCs associated with qualification of emergency response team members, and the completion/maintenance of fire extinguisher inspection records.
- BWXT NEC (Toronto) – 5 NNCs related to transfer of command, alarms and PA systems, training, and documentation.
- BTL – 3 NNCs related to number of minimum qualified personnel in the emergency response organization, fire safety training needs analysis, and emergency response equipment.

The licensees have taken, or committed to take, corrective actions to address the above-noted NNCs. The findings were of low safety significance and did not affect the health and safety of workers, people, the environment, or the safe operation of the facilities.

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained satisfactory ratings in the emergency management and fire protection SCA for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.11 Waste management

The waste management SCA 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 SCA also covers the planning for decommissioning.

CNSC staff assess performance in the waste management SCA by verifying the compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. CNSC staff ensure that the licensees properly manage wastes throughout the lifecycle of a nuclear facility, which includes maintaining an up-to-date waste inventory and ensuring continued waste tracking.

The CNSC requires that licensees have a decommissioning plan and financial guarantee to ensure that sufficient financial resources are available to fund all approved decommissioning activities. CNSC staff confirmed that the financial guarantees remain valid, in effect, and sufficient (Appendix E).

NNCs from inspections related to the waste management SCA were issued for the following licensees over the reporting period:

- BRR – 3 NNCs related to waste management practices (labels on waste containers, properly delineating waste storage areas, and waste segregation).
- PHCF – 2 NNCs related to following proper waste segregation practices and documenting waste management records.

The licensees have taken all necessary corrective actions to address the above-noted NNCs. The findings were of low safety significance and did not affect the health and safety of workers, people, the environment, or the safe operation of the facility.

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained and implemented satisfactory waste management programs for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.12 Security

The security SCA covers the programs required to implement and support the security requirements stipulated in the regulations, licence, orders, or expectations for the facility or activity.

CNSC staff assess performance in the security SCA by verifying the compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. Specific areas assessed within this SCA include programs and procedures relating to access control, response arrangements, security practices, cyber security and drills and exercises. CNSC staff ensure that the security programs in place prevent the loss, unauthorized removal or sabotage of nuclear substances, nuclear materials, prescribed equipment and information.

Security inspections and details of security arrangements with the licensees are protected and not publicly available. NNCs from inspections related to the security management SCA were issued for the following licensees over the reporting period:

- BRR – 3 NNCs related to security.
- SRBT – 3 NNCs related to security.

The licensees have taken all necessary corrective actions to address the above noted NNCs. The findings were of low safety significance and did not affect the health and safety of workers, people and the environment, or the safe operation of the facility.

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained and implemented satisfactory security programs for the applicable reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.13 Safeguards and non-proliferation

The safeguards and non-proliferation SCA covers the programs and activities required for the successful implementation of the obligations arising from the Canada/IAEA safeguards agreements, as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons* (NPT).

CNSC staff assess performance in the safeguards and non-proliferation SCA by verifying licensee compliance through desktop reviews and in-field activities, including participation in IAEA verification activities (see table 4-1). CNSC staff verify that licensees meet Canada's international safeguards obligations as well as other measures arising from the NPT. CNSC staff ensure that the licensees have implemented and maintained effective programs to allow the implementation of both safeguards measures and non-proliferation commitments.

CNSC staff continue to monitor the facility compliance with REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy* [6]. Licensees require a licence, separate from the licensing of their operations, for the import and export of controlled nuclear substances, equipment and information identified in the *Nuclear Non-proliferation Import and Export Control Regulations* [7].

CNSC staff concluded that the UNSPF[2] met regulatory requirements and maintained and implemented satisfactory safeguards and non-proliferation programs for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

5.14 Packaging and transport

The packaging and transport SCA covers the safe packaging and transport of nuclear substances to and from licensed facilities. CNSC staff assess performance in the packaging and transport SCA by verifying compliance of licensee documents and programs through desktop reviews and through compliance verification inspections that are planned or reactive. CNSC staff ensure that all elements of package design, package maintenance, and the registration for use of certified packages are in compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015* (PTNSR) [8] and *Transportation of Dangerous Goods Regulations* (TDGR) [9].

NNCs from inspections related to the packaging and transport SCA were issued for the following licensees over the reporting period:

- CFM – 3 NNCs associated with ensuring transportation of dangerous goods training certificates are fully completed in accordance with TDGR, and ensuring excepted packages are compliant with PTNSR.
- BWXT NEC (Toronto and Peterborough) – 2 NNCs related to legibility of markings on packages and compliance with the requirements of paragraph 29(2)(a) of PTNSR for excepted packages.
- SRBT – 1 NNC related to ensuring that the information provided in transport documents are in accordance with the TDGR and the PTNSR.

The licensees have taken corrective actions to address the above noted NNCs. The findings were of low safety significance and did not affect the health and safety of workers, people, or the environment.

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained satisfactory ratings in the packaging and transport SCA for the reportable year. CNSC staff will continue to monitor performance through regulatory oversight activities pertaining to this SCA.

[2] The safeguards and non-proliferation SCA is not applicable to SRBT as there is no licence condition for the facility. SRBT manages a small quantity of depleted uranium (below exemption quantity as per the *Nuclear Substances and Radiation Devices Regulations* [10]) used as a storage medium for tritium, not for its radioactive properties.

6. Indigenous consultation and engagement

6.1 CNSC staff engagement activities

The CNSC is committed to building long-term relationships and conducting ongoing engagement with Indigenous Nations and communities who have an interest in CNSC-regulated facilities within their traditional and/or treaty territories. The CNSC's ongoing Indigenous engagement practices include:

- sharing information and discussing topics of interest with Indigenous Nations and communities
- seeking feedback and input on CNSC processes
- responding to issues and concerns
- collaborating in two-way dialogue on an ongoing basis
- collaborating on drafting relevant sections of CNSC reports
- providing opportunities to participate in environmental monitoring through the CNSC's Independent Environmental Monitoring Program (IEMP)
- funding opportunities through the CNSC's Participant Funding Program (PFP) to support participation in Commission proceedings and ongoing regulatory activities

The UNSPFs in Canada falls within the traditional and treaty territories of many Indigenous Nations and communities, as listed in appendix M.

CNSC staff's efforts in 2022 supported the CNSC's ongoing commitment to meet its consultation obligations and build positive relationships with Indigenous peoples with interests in Canada's UNSPFs. CNSC staff continued to work with Indigenous Nations, communities, and organizations to identify opportunities for formalized and regular engagement throughout the lifecycle of these facilities and welcomed the opportunity to meet with Indigenous Nations and communities to discuss and address topics of interest or concern. In 2022, CNSC staff's engagement with Indigenous Nations and communities on the UNSPFs included:

- SRBT licence renewal, April 2022: Notifying identified Nations and communities of the licence renewal and ways to get involved, hosting meetings and webinars, and making PFP available.
- BWXT-Toronto IEMP, June 2022: Engaged with Mississaugas of Scugog Island First Nation (MSIFN) and Curve Lake First Nation (CLFN) regarding the IEMP sampling plan for BWXT-Toronto, offered identified Nations and communities the opportunity to participate in the sampling process in person alongside CNSC staff, and provided PFP. The results of the 2022 BWXT-Toronto IEMP can be found in section 7.5.
- CFM licence renewal, November 2022: Notifying identified Nations and communities of the licence renewal and ways to get involved, hosting meetings and webinars, and making PFP available.

- UNSPFs ROR, December 2022: Notifying identified Nations and communities of the ROR process and how to participate, offering meetings and opportunities to follow up on interventions and comments from the 2021 UNSPFs ROR, hosting a webinar, and making PFP available.
- The CNSC awarded participant funding to assist Indigenous Nations and communities, members of the public and stakeholders in reviewing this ROR and in submitting comments to the Commission. Participant funding recipients are listed in appendix O.

Tracking of ROR Issues, Concerns and Recommendations

In order to effectively track and respond to requests and recommendations from the interventions submitted by Indigenous Nations and communities, CNSC staff have established an internal tracking process. CNSC uses this tool to summarize the requests, concerns and recommendations included in the interventions in relation to each ROR, or other Commission proceedings as appropriate. This process includes populating internal tracking tables, in which CNSC staff document responses and proposed action items as needed. Therefore, in response to the Commission's request for information on issues and concerns tracking from interventions received specifically in relation to the RORs, CNSC staff have included an additional appendix in this year's ROR. Appendix P provides key information about the number of issues, concerns and recommendations submitted by each Indigenous Nation and community in relation to the 2021 UNSPFs ROR. Additionally, appendix P presents the number of issues and concerns for which CNSC staff have either responded directly or provided an approach to meaningfully address and close out specific requests, concerns and recommendations where possible. Overall, CNSC has a path forward in response to all of the requests, concerns and recommendations raised by Indigenous Nations and communities from the 2021 UNSPFs ROR, and is actively working with each to resolve or close out their requests and recommendations, where appropriate.

CNSC Terms of Reference for Long-Term Engagement with Indigenous Nations and Communities

CNSC staff have formalized several long-term engagement relationships with interested Indigenous Nations and communities through Terms of Reference (ToR) collaboratively developed between the specific Nations or communities and CNSC. A summary of the engagement activities that occurred in 2022 in relation to each of the existing ToRs for long-term engagement with these Nations and communities was collaboratively drafted and signed by CNSC and each respective Indigenous Nation or community and can be found in appendix N. The ToRs and associated work plans include regular meetings, an accountability and governance structure, specific collaborative activities, as well as topics, facilities, sites, and projects of interest. In 2022, the CNSC developed and finalized ToRs for long-term engagement with the following Indigenous Nations and communities with an interest in UNSPFs sites and activities:

- the Algonquins of Pikwakanagan First Nation

- Mississaugas of Scugog Island First Nation
- Kebaowek First Nation

This is in addition to existing ToRs with Curve Lake First Nation and the Metis Nation of Ontario. In total, CNSC staff have signed 8 ToRs for long-term engagement to date and are working on developing a number of others in the coming years with interested Indigenous Nations and communities. CNSC staff continue to remain open to developing ToRs for long-term engagement with other interested Nations and communities with nuclear facilities in their territories upon request.

6.2 Licensee engagement activities

In 2022, CNSC staff continued to monitor the engagement work conducted by the UNSPFs licensees to ensure that there was active engagement and communication with Indigenous Nations and communities interested in their facilities, and that activities were carried out in relation to the relevant licensing and Commission hearing processes that occurred in 2022. Details about specific licensee engagement with Indigenous Nations and Communities can be found in appendix N.

CNSC staff confirmed that the licensees have Indigenous engagement and outreach programs. Throughout 2022, the UNSPFs licensees met and shared information with interested Indigenous Nations, communities and organizations. Engagement efforts included emails, letters, and meetings, as well as site visits and tours, upon request. The CNSC encourages licensees to continue to develop relationships and engage with Indigenous Nations and communities who have expressed an interest in their activities.

Feedback received by Indigenous Nations and communities on engagement with UNSPFs in 2022

In response to concerns raised by Indigenous Nations and communities in their interventions in relation to the UNSPFs ROR for 2021 that their input was not being incorporated into CNSC's assessment of licensees, CNSC staff sought formal feedback from Indigenous Nations and communities with regards to their perspectives and feedback on UNSPFs licensees' engagement with them in 2022 to be included in the 2022 UNSPFs ROR. This input sought feedback from those Nations that CNSC staff regularly engage with as per existing ToRs for long-term engagement meetings. Of the Nations CNSC requested feedback from relevant to this ROR, Curve Lake First Nation responded providing written feedback regarding Cameco and BWXT NEC. Their submission is as follows:

Feedback on Cameco and BWXT NEC Engagement from Curve Lake First Nation:

In 2022, Cameco and Curve Lake First Nation have continued routine meetings. Cameco has continued to provide information on reportable events at every meeting, which CLFN finds valuable. Sharing why reportable events are happening, and what Cameco is doing to avoid those events from happening again helps build trust between Cameco and Curve Lake First Nation. Cameco consistently shares these events on a monthly basis, and CLFN expects other licencees to identify this action as a best practice.

Cameco
In 2022, CLFN had the opportunity to participate to the Cameco's commission hearing in the case of its application to renew the class IB Nuclear Fuel Facility Licence for CFM in Port Hope, Ontario. The comments that CLFN provided have been considered and Cameco is expected to provide feedback to CLFN on how those comments will be integrated.

In 2022, Cameco and CLFN are working on a relationship agreement. This framework will allow for a more structured and consistent approach on how both parties will work together going forward. In 2023, CLFN will be inviting Cameco to visit the community.

BWXT
In 2022, BWXT and CLFN had less occasions to meet. This is in part due to a change of staff at BWXT. At the July 2022 meeting, CLFN was made aware of BWXT's annual compliance review results and had the opportunity to ask questions about these results. BWXT also initiated discussions on potential economic opportunities with CLFN. CLFN and BWXT have not had the chance to meet since October of 2022.

Moving forward, these monthly virtual meetings will be converted into hybrid in-person meetings where possible, and to allow BWXT to meet with CLFN Chief and Council on a more regular basis. We will continue to work together in finding better ways of communicating, sharing information, and include CLFN into BWXT activities like monitoring.

CNSC Indigenous Consultation and Engagement Findings

CNSC staff are satisfied with the level and quality of Indigenous engagement conducted by UNSPFs licensees with regards to their operations and proposed projects at different sites in 2022. CNSC staff encourage licensees to continue to remain flexible and responsive to the requests and needs of the Indigenous Nations and communities that have an interest in sites, facilities, and proposed projects.

7. Events and other matters of regulatory interest

7.1 Reportable events

Detailed requirements for reporting unplanned situations or events at UNSPFs to the CNSC are included in the applicable LCH. CNSC REGDOC-3.1.2, *Reporting Requirements for Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills* [11], came into force for UNSPFs in January 2019. Over the period covered by this report, licensees complied with the event reporting requirements of REGDOC-3.1.2.

CNSC staff are satisfied with licensees' responses to reportable events. Licensees conducted investigations and/or implemented corrective actions for all reportable events, described below, to the satisfaction of CNSC staff. As a result, CNSC staff concluded that all UNSPFs managed operations safely and that there were no impacts to workers, the public or the environment.

Appendix L provides a summary of the reportable events that occurred at each facility over the review period. In total, there were 27 events reported in 2022, as described below, and none had an impact on the environment, the health and safety of persons, or the maintenance of national or international security.

BRR

- On October 10, 2022, there was a transportation incident on Highway 17 near Calvin, Ontario. A truck carrying uranium ore concentrate enroute to BRR was involved in an accident. There was no impact or damage to the sea container however, the trailer was damaged. There were no injuries or releases of nuclear material.

PHCF

- On May 28, 2022, an individual climbed the PHCF site security fence and gained unauthorized entry to the property. All security systems worked as designed to alert the security group of the event. Cameco's investigation determined there was no information to suggest that the breach was preplanned or that the individual intended to do harm to personnel or property.
- On August 18, 2022, approximately 600 L of chlorinated municipal water from the UF_6 plant sprinkler system went into the storm sewer catch basin which leads to the Port Hope harbour. The sprinkler system was not holding air as required. This allowed the system to charge with water due to low pressure. Cameco determined the low air pressure switch failed to operate so it was repaired to prevent reoccurrence. There were no impacts to the environment as a result of this discharge.

- On November 18, 2022, approximately 480 L of chlorinated municipal water from the UO_2 plant sprinkler system discharged in the sprinkler room. Some of the water exited the building and entered a storm sewer catch basin. Cameco's Emergency Response Team was activated and after determining there was no fire, the sprinkler system was isolated to stop the release. Cameco's investigation determined that excessive heat from a steam discharge in the sprinkler room caused the system to activate. In addition, Cameco determined the thermostat in the sprinkler room was too low, so it was relocated to better represent the temperature of the entire area. There were no impacts to the environment as a result of this discharge.
- On December 23, 2022, there was a watermain leak east of Building 29. The chlorinated municipal water reached a nearby storm sewer catch basin. Employees were able to minimize the leak down to 5psi; however, the entire flow could not be isolated to prevent potential contamination to enter the municipal water system. Approximately 40,000 L of chlorinated municipal water from the storm sewer catch basin was released into the Port Hope harbour. The cause of the leak was a radial break in the water main pipe which was repaired by Cameco as a corrective action. There were no impacts to the environment as a result of this discharge.
- On December 24, 2022, a power outage occurred at PHCF. This created a lack of air pressure within the UF_6 plant sprinkler system causing the system to charge with water. The decision was made to drain and isolate the sprinkler system in order to prevent an unplanned release. Approximately 900 L of municipal chlorinated water was released to the ground, some of which was able to enter a nearby storm sewer catch basin which discharged to the Port Hope harbour. Cameco's investigation determined that the sprinkler system had a small air leak which was not able to hold the clapper valve closed, resulting in the system charging with water. Cameco completed a third-party inspection of the sprinkler piping as part of their scheduled annual testing and maintenance. There were no impacts to the environment as a result of this discharge.

CFM

- On July 6, 2022, a fire alarm was automatically activated when fumes from re-tarring of the roof entered through a door and triggered an adjacent smoke detector. The building was evacuated, CFM's Emergency Operations Centre (EOC) activated, and first responders arrived on site, verifying that no fire was present.
- On July 21, 2022, a fire alarm was triggered by a CO_2 fire suppression system associated with equipment that was no longer in use (a pellet press dust collector). The building was evacuated, CFM's EOC was activated, and first responders arrived on site, verifying that no fire was present.

- On December 24, 2022, a winter storm caused a power outage which resulted in a loss of plant air pressure. The loss of air pressure caused a valve to open allowing water to move into the sprinkler system piping. No water was released from the sprinklers; however, sensors detected the movement of water into the piping, which in turn triggered a fire alarm. An evacuation was not necessary given the limited number of people on site. First responders arrived on site and verified that no fire was present.

BWXT NEC

- On 2 occasions, beryllium occupational exposure limit (OEL) exceedances for beryllium area operators at the BWXT NEC Peterborough facility were reported to CNSC staff:
    - On January 7, 2022, an OEL exceedance was reported from sampling conducted December 15, 2021. The result was 0.082 ug/m^3 8-hour time weighted average (TWA) on an OEL of 0.05 ug/m^3 TWA.
    - On May 16, 2022, an OEL exceedance was reported from sampling conducted April 28, 2022. The result was 0.11 ug/m3 TWA on an OEL of 0.05 ug/m3 TWA.

  BWXT NEC provided a root cause analysis as part of the investigation into these event occurrences and proposed corrective actions which were acceptable to CNSC staff. The corrective actions have been implemented and the effectiveness of the corrective actions is still under review by the licensee. CNSC staff will be reviewing this event and the effectiveness of the corrective actions as part of a focused inspection in fall of 2023. There was no impact on health as a result of these exposures.
- On May 4, 2022, a tank containing sulphuric acid in the beryllium processing area of the BWXT Peterborough facility overflowed, resulting in a spill inside the facility. After cleanup, BWXT implemented corrective actions including overflow sensors and updated work instructions as result of this event. There were no releases to the environment and no workers were injured as a result of this event.
- On June 23, 2022, BWXT Peterborough reported a false fire alarm. The alarm resulted from work being conducted on the sprinkler system and the subsequent re-pressurization.
- On December 28, 2022, BWXT Toronto reported a sprinkler pipe water discharge from a sprinkler head in Building 9 due to rupture of a frozen pipe. BWXT has identified and implemented 3 corrective actions related to this event.

SRBT

- No events were reported to CNSC.

Nordion

- On February 26, 2022, an issue with Nordion's GammaCell sample chamber was reported to CNSC. The sample chamber was not allowed to engage in the fully shielded irradiation position due to a piece of coolant tubing being caught in the path of the chamber. Radiation fields were measured and deemed acceptable, and the tubing was removed and repaired. A Nordion service technician assessed the GammaCell unit, and it was determined to be functioning properly. There were no impacts to workers, nor impact on the environment as a result of this event.
- On March 29, 2022, CNSC staff identified that Nordion had exported model RSL 2089 Co-60 sources using a CNSC export licence that only allowed for the export of model C-188 sources. Corrective actions were made to process multiple source models.
- On April 8, 2022, Nordion shipped an empty trailer with fixed contamination to Bruce Power without dangerous goods paperwork or placarding. Nordion had assessed the contamination to be below exemption levels, but it was ultimately determined that the contamination was above exemption levels, and the shipment should have been designated as Class 7. There were no radiation doses to persons, nor impact on the environment as a result of this event. The trailer was taken out of service for additional decontamination. Nordion also updated its contamination monitoring program as a result of this occurrence.
- On June 22, 2022, Nordion was advised by a contract carrier that a shipment carrying Co-60 was involved in a minor accident in transit. There were no injuries, radiation doses to persons, nor impact on the environment as a result of this event.
- On October 17, 2022, an employee injured their knee tripping on an ergonomic mat while getting up from a chair. The employee required knee surgery as a result of this injury. This event resulted in a lost-time injury lasting 73 days. Corrective actions included better storage of ergonomic mats and to develop training on the proper use of ergonomic mats.

BTL

- No events were reported to CNSC.

BWXT Medical

- On May 16, 2022, a fire alarm was triggered due to low flow alarm in a sprinkler system. Nordion and BWXT Medical staff were evacuated from the building. Ottawa Fire Services were called and determined it to be a false alarm.
- On May 24, 2022, a package containing 10 GBq of Y-90 shipped from BWXT Medical was found damaged at the FedEx depot in Florida. It is believed the damage occurred while in FedEx possession. There were no releases of nuclear material.
- On May 26, 2022, a fire alarm was triggered due to a faulty pull station. There was no audible alarm and no evacuation, however Ottawa Fire Service was dispatched automatically.
- On July 18, 2022, a worker injured their forehead and fingers while operating a hand drill and temporarily lost consciousness. 911 was called and paramedics arrived and transported the worker to the hospital. The event resulted in a lost time injury.
- On August 9, 2022, a Type A package containing 3 GBq Y-90 was damaged during transport. The damage was detected upon tendering of the package at the airport terminal in Toronto. The package was held until BWXT Medical could make arrangements for return. There was no impact on the health and safety of persons nor the environment.
- On September 5, 2022, a fire alarm was triggered in a stairwell adjacent to an active area in the building leased by BWXT Medical. The building was evacuated, and Ottawa Fire Service responded and investigated. There were no signs of smoke or fire, and it was determined to be a false alarm.
- On October 5, 2022, a Type A package containing 3 GBq of Y-90 that was received at a hospital in San Francisco (USA) had a small puncture hole on the bottom. The radiation safety officer at the receiving hospital confirmed no contamination was found from the package and that small penetration was into the styrofoam packaging, but not all the way to the lead pot. They performed an evaluation and accepted the dose for use.
- On October 27, 2022, a truck south of Golden BC on Hwy 95 containing a UN 2908 Type B package flipped and caught fire as a result of a crash with another vehicle. RCMP confirmed there was no impact to the integrity of the package due to the accident/fire. The package was an Excepted package and empty. There were 2 casualties in this accident (the other vehicle) in addition to minor injuries to the 2 occupants of the truck.

7.2 PHCF reactive inspection and issuance of warning letter

CNSC staff conducted a reactive inspection at Cameco's PHCF from December 7-9, 2022, in response to information received via its external complaint process related to PHCF licensed activities. Details of the external complaint are confidential. Based on the assessment of the information gathered from the inspection team, CNSC staff concluded that PHCF remains in compliance with their licensing requirements.

During the inspection, CNSC staff witnessed that certain Cameco staff chose to stop the inspection and advised others to not speak to or answer questions from the CNSC inspection team. After being advised of the potential repercussions by the CNSC inspection team, Cameco subsequently complied in a timely fashion and the onsite portion of the inspection was completed by the inspection team without further interventions.

After further review, CNSC staff determined that this conduct by Cameco was in contravention of section 36 of the NSCA and on May 11, 2023, a warning letter was issued to Cameco based on CNSC's graded enforcement approach[3]. As requested by CNSC staff in the warning letter, Cameco responded with planned actions to ensure that Cameco personnel are aware of their obligations under the NSCA during the conduct of an inspection.

7.3 Public engagement

Public engagement includes activities carried out directly by CNSC staff, and activities carried out by licensees.

7.3.1 CNSC

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 Nations and communities, often participating in meetings or events in communities with an interest in nuclear sites. This allows CNSC staff to answer questions about the CNSC's mandate and role in regulating the nuclear industry. Appendix P presents the number of issues and concerns for which CNSC staff have either responded to directly or provided an approach to meaningfully address and close out specific requests, concerns and recommendations where possible.

CNSC public outreach related to the UNSPFs in 2022 included hosting and participating in webinars, sending a mailout to inform of CFM licence renewal, and hosting a booth at the Port Hope Fall fair in September.

[3] For more on the graded approach, see REGDOC 3.5.3, *Regulatory Fundamentals.*

In addition, CNSC staff have and continue to engage with the Nuclear Transparency Project on the matters they raised in the 2021 ROR to help facilitate their review of this ROR.

The CNSC awarded participant funding to assist Indigenous Nations and communities, members of the public and stakeholders in reviewing this ROR and in submitting comments to the Commission. Participant funding recipients are listed in appendix O.

7.3.2 CNSC activities – BWXT NEC Peterborough

The 2022 ROR provides a follow-up on activities done in accordance with the Commission Record of Decision and staff's Peterborough Public Engagement Plan.

In 2022, CNSC staff conducted extended air sampling for beryllium around the Peterborough facility in response to concerns from the local community about potential beryllium impacts. This activity was done in collaboration with Dr. Aherne (Associate Professor, Trent University and member of BWXT NEC's Community Liaison Committee). Three locations were identified and sampled which included the Prince of Wales School located near the facility. The results confirmed that levels of beryllium in air are very low and well below provincial ambient air quality guidelines (AAQC) that is protective of human health and the environment.

CNSC also updated its BWXT NEC Peterborough facility webpage providing a link to a frequently asked questions page, which aims to provide information about the air sampling campaign, as well as answers to questions from members of the public about environmental monitoring and health. The report on the beryllium in air sampling campaign will be posted on CNSC's BWXT NEC Peterborough facility webpage and shared with stakeholders including BWXT's Community Liaison Committee members.

CNSC staff are committed to continuing to share information of interest that relates to BWXT NEC and to continue to engage with the public, Indigenous Nations and communities and other interested parties.

7.3.3 Uranium and nuclear substance processing facilities

All UNSPF licensees are required to maintain and implement public information and disclosure programs (PIDPs), in accordance with REGDOC-3.2.1, *Public Information and Disclosure* [12]. These programs are supported by disclosure protocols that outline the type of facility information to be shared with the public and that provide details on how that information is to be shared. This ensures that timely information about the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities, is effectively communicated to the public.

CNSC staff monitor licensee implementation of the PIDPs to ensure that communication with target audiences is regular and meaningful. CNSC staff also review yearly program updates to verify that licensees are taking public feedback into consideration and making program adjustments accordingly. All UNSPFs have approved PIDPs.

The COVID-19 pandemic challenged licensees to adapt their engagement activities to a virtual and/or hybrid setting. In 2022, licensees began to reintroduce in-person events, while maintaining digital communication tools to reach their audience via multiple methods. Activities included:

- providing website and social media updates
- providing updates to the local public and stakeholders through regular newsletters (both virtual and direct mail)
- engaging with local / national media to provide operational and facility updates
- in-person and virtual/hybrid events and sponsorship, organizing webinars and creating new community support funds which could be accessed by important local efforts and organizations

CNSC staff concluded that the UNSPFs met regulatory requirements and maintained and implemented satisfactory PIDPs for the reportable year.

7.4 Environmental protection review reports

CNSC staff conduct environmental protection reviews (EPRs) for all licence applications with potential environmental interactions, in accordance with CNSC's mandate under the NSCA and associated regulations. An EPR is a science-based environmental technical assessment conducted by CNSC staff. The fulfillment of other aspects of the CNSC's mandate, such as regulating safety and security, are met through other oversight activities.

Starting in 2021, the CNSC began a new approach for publishing stand-alone EPR reports online. These reports are separate from a specific licensing decision to allow interested Indigenous Nations and communities and members of the public additional time to review information related to environmental protection and engage with CNSC staff on any areas of interest or concern. All available EPR reports can be found on the CNSC website. EPR reports are typically conducted to align with the facility's ERA cycle, which is approximately every 5 years or whenever there is a major change to the facility. CNSC staff have posted the following 3 EPR reports for UNSPFs:

- EPR report: Blind River Refinery (2021)
- EPR report: SRB Technologies (2023)
- EPR report: Cameco Fuel Manufacturing Inc. (2022)

The information in EPR reports support staff's recommendations to the Commission in future licensing and regulatory decisions on whether the proposal provides adequate protection of the environment and the health of people.

7.5 CNSC Independent Environmental Monitoring Program

The CNSC requires that each nuclear facility licensee develops, implements, and maintains an environmental monitoring program as appropriate to demonstrate that the public and the environment are protected from any releases to the environment related to the facility's nuclear activities. CNSC staff evaluate and assess the results of these monitoring programs to determine compliance with the applicable requirements and limits, as set out in the regulations that govern Canada's nuclear industry.

The Independent Environmental Monitoring Program (IEMP) is an independent from licensee, technical environmental sampling program in publicly accessible areas around nuclear facilities, while using CNSC resources effectively and efficiently. The CNSC continues to strive to build Indigenous and public trust in the CNSC's regulation of the nuclear industry, and thus implements an IEMP as one tool of confirming the effectiveness of a licensee's monitoring program and to promote more awareness and information sharing of CNSC's work in the protection of people and the environment. The IEMP is a regulatory tool that complements and informs the CNSC's ongoing compliance verification program. The IEMP does not rely on licensees to provide samples. CNSC staff or independent contractors obtain samples from publicly accessible areas around nuclear facilities, then measure and report the amounts of radiological and hazardous substances present in these samples to the Commission, Indigenous Nations and communities, and the public.

In 2022, CNSC staff conducted independent environmental monitoring around BWXT NEC Toronto. There were no results of concern. In addition, these results are consistent with the results submitted by the licensee. The IEMP results add to the body of evidence and supports CNSC staff's assessment that the public and the environment in the vicinity of the uranium and nuclear substance processing facilities are protected and that the licensees' environmental protection programs are effective.

Results from previous IEMP sampling campaigns are available on the CNSC's Web page.

7.6 COVID-19 response

7.6.1 CNSC

In 2022, compliance activities for UNSPFs continued both remotely and onsite on a risk-informed basis in observance of relevant COVID-19 health protocols. A hybrid virtual/in-person approach is now regularly employed during inspections to minimize the amount of time spent on site.

7.6.2 UNSPFs

The UNSPFs continued to follow COVID-19 public health guidelines, as measures such as having workers wear face masks, limiting the size of groups of employees in any areas, daily screening of employees and testing gradually became voluntary instead of mandatory. COVID-19 requirements at UNSPFs were generally reduced towards the end of 2022.

The UNSPF communicated COVID-related information to the CNSC in different manners such as regular bilateral meetings. In addition, reporting of COVID cases did occur in the BWXT NEC annual compliance report (see section 5.8).

8. Overall conclusions

CNSC staff concluded that, in 2021, UNSPFs in Canada operated safely. This assessment was based on CNSC staff's verification of licensee activities, including inspections, reviews of reports submitted by licensees, and reviews of events supported by follow-up and general communication with the licensees.

For 2022, the performance ratings for all UNSPFs in all 14 SCAs were rated as "satisfactory".

CNSC staff's compliance verification activities concluded that:

- radiation protection programs at all facilities were effective and adequately controlled radiation exposures, keeping doses ALARA
- environmental protection programs at all facilities were effective in protecting people and the environment
- conventional health and safety programs at all facilities continued to protect workers

CNSC staff concluded that the licensees discussed in this report made adequate provision to protect the health and safety of workers, to protect the public and the environment, and to meet Canada's international obligations on the peaceful use of nuclear energy.

CNSC staff will continue to provide regulatory oversight to all licensed facilities.

References

1. *Nuclear Safety and Control Act*, S.C. 1997, c. 9.
2. CNSC, REGDOC-2.2.2, *Personnel Training*, Ottawa, Canada, 2016.
3. *Radiation Protection Regulations*, SOR/2000-203.
4. *General Nuclear Safety and Control Regulations*, SOR/2000-202.
5. *Canada Labour Code*, R.S.C., 1985, c. L-2.
6. CNSC, REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*, Ottawa, Canada, 2018.
7. *Nuclear Non-proliferation Import and Export Control Regulations*, SOR/2000-210.
8. *Packaging and Transport of Nuclear Substances Regulations*, SOR/2015-145.
9. *Transportation of Dangerous Goods Regulations*, SOR/2001-286.
10. *Nuclear Substance and Radiation Devices Regulations,* SOR/2000-207
11. CNSC, REGDOC-3.1.2, *Reporting Requirements for Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills*, Ottawa, Canada, 2018.
12. CNSC, REGDOC-3.2.1, *Public Information and Disclosure*, Ottawa, Canada, 2018.
13. CNSC, REGDOC-3.6, *Glossary of CNSC Terminology*, Ottawa, Canada, 2019.
14. Ontario Regulation 419/05: Air Pollution – Local Air Quality, under the Environmental Protection Act, R.S.O. 1990, c. E. 19.
15. CSA Group, CSA N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills,* 2015.
16. Ontario Ministry of the Environment, *Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*, Table 3: Full Depth Generic Site Condition Standards in a Non-Portable Groundwater Condition for Industrial/Commercial/Community Property Use (Fine to Medium Textured Soils), 2011.
17. Canadian Council of Ministers of the Environment, *Canadian Water Quality Guidelines for the Protection of Aquatic Life*, 1999.
18. Canadian Council of Ministers of the Environment, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health*, 1999.
19. Health Canada, *Guidelines for Canadian Drinking Water Quality*, 2017.
20. Ontario Ministry of the Environment, Conservation and Parks, *Ontario's Ambient Air Quality Criteria,* 2019.
21. Ministry of the Environment, *Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act*, Table 1: Full Depth Background Site Condition Standards, 2011.

Acronyms and abbreviations

For definitions of terms and acronyms used in this document, except for those listed below, see REGDOC 3.6, *Glossary of CNSC Terminology* [13].

ALARA	as low as reasonably achievable
BE	below expectations
Bq	becquerel
BRR	Blind River Refinery
BTL	Best Theratronics Ltd.
BWXT NEC	BWXT Nuclear Energy Canada Inc.
CAD	Canadian dollar
Cameco	Cameco Corporation
CANDU	Canada Deuterium Uranium
CCME	Canadian Council of Ministers of the Environment
CFM	Cameco Fuel Manufacturing Inc.
CLFN	Curve Lake First Nation
CMD	Commission member document
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
Co-60	cobalt-60
CSA	Canadian Standards Association (now CSA Group)
DRL	derived release limit
EMS	environmental management system
EPR	environmental protection review
ERA	environmental risk assessment
ESDC	Employment and Social Development Canada
FFL	fuel facility licence
FFOL	fuel facility operating licence
FS	fully satisfactory
GBq	gigabecquerel
GNSCR	*General Nuclear Safety and Control Regulations*
GTLS	gaseous tritium light source
HT	tritium gas
HTO	hydrogenated tritium oxide or tritiated water
HNO_3	nitric acid
IAEA	International Atomic Energy Agency
IEMP	Independent Environmental Monitoring Program
kBq	kilobecquerels
LCH	licence conditions handbook
LTI	lost-time injury
LTWMF	Long Term Waste Management Facility
m^3	cubic metres

MECP	Ministry of the Environment, Conservation and Parks (Ontario)
MeV	Megaelectron volt
mg	milligram
mg/L	milligram per litre
MOE	Ministry of the Environment
MSIFN	Mississaugas of Scugog Island First Nation
mSv	millisievert
NEW	nuclear energy worker
Nm	nitrogen
NNC	notice of non-compliance
NO_2	nitrogen dioxide
Nordion	Nordion (Canada) Inc.
NOx	nitrogen oxides
NPT	*Treaty on the Non-Proliferation of Nuclear Weapons*
NSCA	*Nuclear Safety and Control Act*
NSPFL	nuclear substance processing facility licence
NSPFOL	nuclear substance processing facility operating licence
PFP	Participant Funding Program
PHAI	Port Hope Area Initiative
PHCF	Port Hope Conversion Facility
PIDP	public information and disclosure programs
REGDOC	regulatory document
ROR	regulatory oversight report
SA	satisfactory
SAR	safety analysis report
SCA	safety and control areas
SRBT	SRB Technologies (Canada) Inc.
TLD	thermoluminescent dosimeter
ToR	terms of reference
TSP	total suspended particulate
U	uranium
UF_6	uranium hexafluoride
µg	microgram
UNSPF	uranium and nuclear substance processing facilities
UO_2	uranium dioxide
UO_3	uranium trioxide
µSv	microsievert
VIM	Vision in Motion

A. Links to licensee websites and annual compliance reports

Licensee	Website	Annual compliance reports
BRR	Blind River Refinery	2022 annual compliance report
PHCF	Port Hope Conversion Facility	2022 annual compliance report
CFM	Cameco Fuel Manufacturing	2022 annual compliance report
BWXT NEC Toronto	BWXT Nuclear Energy Canada	2022 annual compliance report
BWXT NEC Peterborough	BWXT Nuclear Energy Canada	2022 annual compliance report
SRBT	SRB Technologies (Canada) Inc	2022 annual compliance report
Nordion	Nordion	2022 annual compliance report
BTL	Best Theratronics Ltd.	2022 annual compliance report
BWXT Medical	BWXT Medical Ltd.	2022 annual compliance report

B. CNSC inspections

Table B-1: Inspections, BRR, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
CAMECO-BRR-2022-01	Management systems	Feb. 21-23, 2022	7
CAMECO-BRR-2022-02	Waste management, radiation protection, conventional health and safety	Sep. 13-14, 2022	4
CAMECO-BRR-2022-03	Radiation protection	Oct. 19-20, 2022	9
CAMECO-BRR-2022-04	Security	Oct. 6, 2022	3

Table B-2: Inspections, PHCF, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
CAMECO-PHCF-2022-01	Environmental protection	Apr. 4-6, 2022	2
CAMECO-PHCF-2022-02	Packaging and transport, conventional health and safety	May 13-17, 2022	0
CAMECO-PHCF-2022-03	Waste management	Dec. 5-7, 2022	2
CAMECO-PHCF-2022-04	Reactive inspection	Dec. 7-9, 2022	0

Table B-3: Inspections, CFM, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
CAMECO-CFM-2022-01	Fitness for service, operating performance, conventional health and safety, radiation protection, human performance management, waste management	Jan. 19-21, 2022	3
CAMECO-CFM-2022-02	Packaging and transport, conventional health and safety	May 18-19, 2022	3
CAMECO-CFM-2022-03	Safety analysis, fitness for service	Aug. 16-17, 2022	0
CAMECO-CFM-2022-04	Emergency management and fire protection	Oct. 25-26, 2022	2

Table B-4: Inspections, BWXT NEC Toronto and Peterborough, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
BWXT-NEC-2022-01	Environmental protection	Feb. 15-17, 2022	0
BWXT-NEC-2022-02	Fitness for service	Mar. 29-30, 2022	0
BWXT-NEC-2022-03	Emergency management and fire protection	Jun. 8-10, 2022	5
BWXT-NEC-2022-04	Packaging and transport, radiation protection, conventional health and safety, environmental protection	Aug. 23-25, 2022	3

Table B-5: Inspections, SRBT, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
SRBT-2022-01	Security	Oct. 25 2022	3
SRBT-2022-02	Packaging and transport, radiation protection, conventional health and safety	Nov. 29-30, 2022	3

Table B-6: Inspections, Nordion, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
NORDION-2022-01	Management systems	Sep. 12-13, 2022	0
NORDION-2022-02	Emergency management and fire protection	Oct. 12-14, 2022	0

Table B-7: Inspections, BTL, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
BTL-2022-01	Radiation protection	Jan. 11-12, 2022	3
BTL-2022-02	Emergency management and fire protection	Mar. 22-24, 2022	3

Table B-8: Inspections, BWXT Medical, 2022

Inspection title	Safety and control areas	Inspection date	# NNCs
BWXT Medical-2022-01	Conventional health and safety, operating performance, fitness for service, radiation protection, waste management, management systems	Mar. 9-11, 2022	0
BWXT Medical-2022-02	Emergency management and fire protection	Oct. 12-14, 2022	0

Note: Security inspection reports contain sensitive information and will not be made public.

C. Significant changes to licence conditions handbooks

Licensee	Date	Facility licence	Summary of changes
BRR	May 4, 2022	FFL-3632.00/2032	New LCH issued to support issuance of new licence by the Commission.
CFM	March 1, 2022	FFL-3641.00/2023	Issuance of LCH to reflect effective period of 1 year licence, commencing on March 1, 2022. New exposure-based release limits and administrative changes also incorporated.
SRBT	July 26, 2022	NSPFL-13.00/2034	New LCH issued to support issuance of new licence by the Commission.

D. Regulatory document implementation

Regulatory documents are a key part of the CNSC's regulatory framework for nuclear activities in Canada. They explain to licensees and applicants what they must achieve in order to meet the requirements set out in the *Nuclear Safety and Control Act* [1] and the regulations made under the *Nuclear Safety and Control Act* [1].

When a new regulatory document or revision is published, CNSC staff will formally request the licensee to conduct a gap analysis and provide an implementation plan. The CNSC will review the plan. The dates provided in the implementation plan are considered the date that the regulatory document becomes effective at the site, at which point it becomes compliance verification criteria. The table below lists the REGDOCs that were implemented in 2022.

Licensee	Document number	Document title	Version	Status
BRR	REGDOC-2.1.2	Safety Culture	2018	Implemented
PHCF	REGDOC-2.1.2	Safety Culture	2018	Implemented
CFM	REGDOC-2.1.2	Safety Culture	2018	Implemented

E. Financial guarantees

Table E-1: Financial guarantees, uranium processing facilities

Facility	Amount (CAD)
BRR	$57,500,000
PHCF[4]	$128,600,000
CFM	$10,800,000
BWXT NEC Toronto[4]	$37,362,745
BWXT NEC Peterborough[4]	$10,775,122

Table E-2: Financial guarantees, nuclear substance processing facilities

Facility	Amount (CAD)
SRBT	$758,016
Nordion[5]	$45,124,748
BTL	$1,800,000
BWXT Medical	$10,540,000

[4]A revised PDP was received in 2022 and any changes to the financial guarantee will be reflected in a future ROR.
[5] Nordion's revised financial guarantee ($35,003,046 CAD) will be reflected in the 2023 ROR.

F. Safety and Control Area Ratings

Please note that only the ratings of "satisfactory" (SA) or "below expectations" (BE) were used for the UNSPFs. The "fully satisfactory" (FS) rating was not used, consistent with the approach used for the 2019 RORs. It is important to recognize that if a facility received an SCA rating of FS in previous RORs, and now has a rating of SA, it does not necessarily indicate a reduction in performance. The simplified rating approach considerably reduced the effort that is often needed to reach a consensus on a final rating.

Table F-1: SCA ratings, Blind River Refinery, 2018 –22

SCAs	2018	2019	2020	2021	2022
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	FS	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 F-2: SCA ratings, Port Hope Conversion Facility, 2018–22

SCAs	2018	2019	2020	2021	2022
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 F-3: SCA ratings, Cameco Fuel Manufacturing, 2018–22

SCAs	2018	2019	2020	2021	2022
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 F-4: SCA ratings, BWXT NEC Toronto and Peterborough, 2018–22

SCAs	2018	2019	2020	2021	2022
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 F-5: SCA ratings, SRB Technologies, 2018–22

SCAs	2018	2019	2020	2021	2022
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	FS	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	FS	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[6]	N/A	N/A	N/A	N/A	N/A
Packaging and transport	SA	SA	SA	SA	SA

[6] Specific IAEA reporting and verification activities are held in abeyance.

Table F-6: SCA ratings, Nordion, 2018–22

SCAs	2018	2019	2020	2021	2022
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	FS	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	FS	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table F-7: SCA ratings, Best Theratronics Ltd., 2018–22

SCAs	2018	2019	2020	2021	2022
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 F-8: SCA ratings, BWXT Medical, 2018–22

SCAs	2018	2019	2020	2021	2022
Management system	N/A	N/A	N/A	SA	SA
Human performance management	N/A	N/A	N/A	SA	SA
Operating performance	N/A	N/A	N/A	SA	SA
Safety analysis	N/A	N/A	N/A	SA	SA
Physical design	N/A	N/A	N/A	SA	SA
Fitness for service	N/A	N/A	N/A	SA	SA
Radiation protection	N/A	N/A	N/A	SA	SA
Conventional health and safety	N/A	N/A	N/A	SA	SA
Environmental protection	N/A	N/A	N/A	SA	SA
Emergency management and fire protection	N/A	N/A	N/A	SA	SA
Waste management	N/A	N/A	N/A	SA	SA
Security	N/A	N/A	N/A	SA	SA
Safeguards and non-proliferation	N/A	N/A	N/A	SA	SA
Packaging and transport	N/A	N/A	N/A	SA	SA

G. Total Annual Releases of Radionuclides Directly to the Environment

The CNSC is making radionuclide release data more readily accessible to the public and Indigenous Nations and communities as part of its commitment to Open Government and its mandate to disseminate this information. This appendix reflects the continued commitment to provide data, within the regulatory oversight reports, on the total annual release of radionuclides.

CNSC staff have commenced publishing annual releases of radionuclides to the environment from nuclear facilities on the Open Government Portal.

Direct releases of radionuclides to the environment from uranium fuel refinery, manufacturing and conversion facilities are primarily limited to uranium released to the atmosphere. As uranium is more chemically toxic than radiologically toxic, releases are monitored as total uranium. As a result, the annual load is reported in kilograms. Of these facilities, only Cameco's BRR has direct releases to surface water, with the relevant radionuclides being uranium and radium-226.

Direct releases to the environment for SRBT, Nordion, and BWXT Medical are limited to atmospheric releases. SRBT, Nordion, and BWXT Medical have no direct releases to surface waters. BTL does not have any airborne or liquid radiological releases.

H. Public Dose Data

This appendix contains information on the estimated dose to the public around UNSPFs. Radiological releases from all the sites covered by this ROR remain well under the derived release limits (DRLs) applicable to those sites and the contribution to the dose to the public from these releases remains well below the regulatory limit for the public of 1 mSv/year, as set out in the *Radiation Protection Regulations* [3].

Table H-1: Public dose comparison table, uranium and nuclear substance processing facilities, mSv, 2018–22

Facility	2018	2019	2020	2021	2022	Regulatory Limit, mSv
BRR	0.005	0.005	0.009	0.009	0.009	**1**
PHCF	0.173	0.127	0.117	0.086	0.118	**1**
CFM	0.030	0.027	0.020	0.306[1]	0.293[1]	**1**
BWXT NEC Toronto	0.0004	0.023	0.0057	0.0175	0.0173	**1**
BWXT NEC Peterborough	<0.001	0.0115	<0.001	<0.001	0.0115	**1**
SRBT	0.0038	0.0021	0.0024	0.0020	0.0020	**1**
Nordion	0.000067	0.00087	0.00122	0.00185	0.00156	**1**
BWXT Medical	N/A	N/A	N/A	0.0005	0.0005	**1**
BTL[2]	N/A	N/A	N/A	N/A	N/A	**1**

N/A = not applicable; mSv = millisievert

[1]The estimated dose to the public is higher in 2021 and 2022 than in previous years but there has not been an actual increase in emissions/dose from the facility. Cameco submitted revised DRLs, which included an update to the public dose calculation formulas. The revisions included airborne and liquid emissions in the calculation and a new location for the critical receptor so the results from 2021 and 2022 cannot be compared to the results from previous years.

[2]No activities occur inside the BTL facility that result in the release of radioactive material to the environment.

I. Environmental Data

This appendix provides environmental data for the UNSPFs. Unless otherwise indicated, no environmental action levels were exceeded.

Blind River Refinery

Atmospheric emissions
Cameco monitors uranium, nitrogen oxides (NO_x), nitric acid (HNO_3), and particulates released from facility stacks. The monitoring data in table I-1 demonstrates that atmospheric emissions from the facility continued to be effectively controlled, as annual averages were consistently well below their respective licence limits between 2018 and 2022.

Table I-1: Air emission monitoring results, Blind River Refinery, 2018–22

Parameter	Value	2018	2019	2020	2021	2022	Licence Limit[1]
Dust collection and exhaust ventilation stack: uranium (g/h)	Annual weekly average	0.05	0.05	0.06	0.08	0.08	**93[2]**
Dust collection and exhaust ventilation stack: uranium (g/h)	Annual weekly maximum	0.18	0.10	0.11	0.14	0.24	**93[2]**
Absorber stack: uranium (g/h)	Annual weekly average	0.01	0.01	0.01	0.01	0.01	**21[2]**
Absorber stack: uranium (g/h)	Annual weekly maximum	0.03	0.01	0.02	0.02	0.04	**21[2]**
Absorber stack: NO_X + HNO_3 (kg NO_2/h)	Annual weekly average	2.3	3.3	3.2	2.9	2.9	**19[3]**
Absorber stack: NO_X + HNO_3 (kg NO_2/h)	Annual weekly maximum	4.8	5.2	5.4	4.8	4.3	**19[3]**
Incinerator stack: uranium (g/h)	Annual weekly average	<0.01	<0.01	<0.01	<0.01	<0.01	**29[2]**

Parameter	Value	2018	2019	2020	2021	2022	Licence Limit[1]
Incinerator stack: uranium (g/h)	Annual weekly maximum	0.01	0.01	0.01	0.01	<0.01	**29[2]**
All stacks: Particulate (g/h)	Annual weekly average	9.8	12	10	10	10	**15,000[3]**
All stacks: Particulate (g/h)	Annual weekly maximum	22	25	17	17	18	**15,000[3]**

HNO_3 = nitric acid; g/h = gram per hour; kg/h = kilogram per hour; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides
Note: Results less than detection limit are denoted as "<".
[1] Limits were revised in 2022. For the licence limits that were applicable in 2018-2021, please refer to the 2021 Nuclear Substance and Processing Facilities Regulatory Oversight Report
[2] Limit based on weekly averaging
[3] Limit based on daily averaging

Liquid effluent

There are 3 sources of liquid effluent from the BRR facility: plant effluent, storm water runoff, and sewage treatment plant effluent. These effluents are collected in lagoons and treated, as required, prior to discharge into Lake Huron. Cameco monitors uranium, radium-226, nitrates, and pH in liquid effluents to demonstrate compliance with their respective licence limits.

Table I-2 summarizes the average monitoring results from 2018 to 2022. For 2022, the liquid discharges from the facility continued to be below (or, within, in the case of pH) their respective licensed limits.

Table I-2: Liquid effluent monitoring results, Blind River Refinery, 2018–22

Parameter	Value	2018	2019	2020	2021	2022	Licence Limit[1]
Uranium (mg/L)	Monthly average	0.01	0.01	0.01	0.01	0.02	**1.7**
Uranium (mg/L)	Monthly maximum	0.03	0.02	0.02	0.03	0.04	**1.7**
Nitrates (mg/L)	Monthly average	20	21	19	18	22	**N/A**
Nitrates (mg/L)	Monthly maximum	32	34	26	39	57	**N/A**

Parameter	Value	2018	2019	2020	2021	2022	Licence Limit[1]
Radium-226 (Bq/L)	Monthly average	0.01	0.01	0.01	<0.01	<0.01	**N/A**
Radium-226 (Bq/L)	Monthly maximum	0.01	0.01	0.01	0.01	0.1	**N/A**
pH	Daily minimum	7.3	7.2	7.0	7.3	7.0	**Minimum 6.0**
pH	Daily maximum	8.5	8.4	8.4	8.4	8.4	**Maximum 9.5**

mg/L = milligram per litre; Bq/ L= becquerel per litre
[1] Limits were revised in 2022. For the licence limits that were applicable in 2018-2021, please refer to the 2021 Nuclear Substance and Processing Facilities Regulatory Oversight Report.

Uranium in ambient air

The concentrations of uranium in the ambient air (average and maximum), as monitored by Cameco's sampling network around BRR, continue to be low and all values measured were below the Ontario Regulation (O. Reg) 419/05: Air Pollution – Local Air Quality standard for uranium of 0.03 µg/m^3 [14]. In 2022, the maximum concentrations of uranium in ambient air at each sampling location were 0.0010 µg/m^3 (Golf Course), 0.0021 µg/m^3 (Southeast Yard), 0.0087 µg/m^3 (East Yard), 0.0003 µg/m^3 (Hydro Yard), and 0.0004 µg/m^3 (Town of Blind River).

Groundwater monitoring

Cameco is in compliance with CSA N288.7-15, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [15]. Cameco has an extensive groundwater monitoring program in place around the BRR facility with 35 monitoring wells: 14 wells are located inside the perimeter fence and 21 wells are outside the fence line. Wells are monitored 1 to 3 times per year depending on the location relative to the refinery. Groundwater quality across the site meets the uranium standard set out in table 3 of the Soil, Ground Water, and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act,* published by the Ontario Ministry of the Environment (MOE) [16], as shown in table I-3. It should also be noted that groundwater in the area flows southwest towards the Mississauga River, and there are no groundwater wells for drinking water purposes located downstream of the site.

Table I-3: Annual groundwater monitoring results, Blind River Refinery, µg/L, 2018-22

Parameter	2018	2019	2020	2021	2022	MOE Standard*
Average uranium concentration, µg/L	2.3	2.0	1.4	1.7	1.5	**420**
Maximum uranium concentration, µg/L	27.0	14.0	14.0	25.0	20.0	**420**

µg/L = microgram per litre

Surface water monitoring

Cameco continues to monitor surface water for uranium, nitrate, radium-226, and pH at the location of BRR's outfall diffuser in Lake Huron. The concentrations of uranium, nitrate, radium-226, and the pH levels in the lake remained well below the Canadian Council of Ministers of the Environment (CCME) guidelines [17]. Table I-4 provides surface water monitoring results.

Table I-4: Surface water monitoring results at outfall diffuser in Lake Huron, Blind River Refinery, 2018–22

Parameter	2018	2019	2020	2021	2022	CCME Guideline*
Average Uranium (µg/L)	<0.7	<0.7	<0.7	<0.7	<0.7	**15**
Maximum Uranium (µg/L)	<0.7	<0.7	<0.7	<0.7	<0.7	**15**
Average Nitrate (mg/L as N)	0.2	0.1	0.2	0.2	0.1	**13**
Maximum Nitrate (mg/L as N)	0.2	0.2	0.2	0.2	0.3	**13**
Average Radium-226 (Bq/L)	0.0008	<0.0005	<0.0005	<0.0005	<0.0005	**N/A**
Maximum Radium-226 (Bq/L)	<0.0008	<0.0005	<0.0005	<0.0005	0.0006	**N/A**
Average pH	8.0	8.1	7.9	7.7	7.2	**6.5–9.0**
Maximum pH	8.3	8.2	7.9	8.3	8.0	**6.5–9.0**

Bq/L = becquerel per litre; mg/L = milligram per litre; µg/L = microgram per litre; CCME = Canadian Council of Ministers of the Environment

*CCME, *Canadian Water Quality Guidelines for the Protection of Aquatic Life* [17]

Note: Results below the detection limit are denoted as "<".

Soil monitoring

Cameco collects soil samples at a depth of 0 to 5 cm each year and 5 to 15 cm every 5 years to monitor uranium concentrations in surface soil. The purpose is to monitor the long-term effects of air emissions on soil quality resulting from the deposition of airborne uranium on soil in the vicinity of the BRR facility. The 2022 soil monitoring results remained consistent with the respective concentrations measured in previous years, as shown in table I-5. The average uranium in soil concentrations increased slightly in 2022 but remained within the historical range at each sampling location.

The average concentrations of uranium in soil measured near the BRR facility were close to Ontario's natural background levels (2.5 µg/g) and well below 23 µg/g, which is the most restrictive soil quality guideline set by the CCME for uranium (for residential and parkland land use) [18]. This data demonstrates that the current BRR operations do not contribute to the accumulation of uranium in the surrounding soil and no adverse consequences to human and environmental receptors are expected.

Table I-5: Soil monitoring results (0–5 cm depth), Blind River Refinery, µg/g, 2018–22

Parameter	2018	2019	2020	2021	2022	CCME Guideline*
Average uranium concentration within 1,000 m	2.0	2.1	1.4	1.6	2.4	**23**
Average uranium concentration outside 1,000 m	0.7	1.0	0.7	0.6	0.9	**23**
Maximum uranium concentration	3.7	3.8	2.5	2.9	5.7	**23**

cm = centimetre; m = metre; µg/g = microgram per gram; CCME = Canadian Council of Ministers of the Environment
*CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18]

Gamma monitoring

A portion of public dose from BRR operations is due to gamma radiation sources. Consequently, monitoring of gamma radiation effective dose rates at the fence line of the BRR main site and the nearby golf course (the critical receptor location) is essential to ensuring that levels of potential gamma radiation exposure are maintained ALARA. The land immediately outside the perimeter fence continues to be owned and controlled by Cameco. Therefore, Cameco has set an action level for gamma dose rates of 0.25 µSv/h at the north fence only because the critical receptor location for the gamma component of dose to the public is the neighbouring golf course north of the BRR site. Cameco uses environmental thermoluminescent dosimeters (TLDs) that are replaced monthly to measure the effective dose rates for gamma radiation.

In 2022, the maximum monthly gamma measurement for the north fenceline was below the action level and all fenceline gamma measurements remain consistent with values from previous years:

- East location measured 1.00 µSv/h (no action level is in place)
- North location measured 0.16 µSv/h (Cameco's action level is 0.25 µSv/h)
- South location measured 0.89 µSv/h (no action level is in place)
- West location measured 1.68 µSv/h (no action level is in place)

These measurements indicate that gamma dose rates are controlled and that the public is protected.

Port Hope Conversion Facility

Atmospheric emissions

Cameco monitors uranium, fluoride and ammonia released from PHCF stacks. Two daily average action levels were exceeded for uranium and fluoride emissions from the UF_6 plant as described in section 5.9. Table I-6 provides air monitoring data for 2018 to 2022. The annual averages have remained consistently below their respective licence limits for 2022 and demonstrates that atmospheric emissions from the facility continued to be effectively controlled.

Table I-6: Air emission monitoring results (annual daily average), Port Hope Conversion Facility, kg/h, 2018–22

Location	Parameter	2018	2019	2020	2021	2022	Licence Limit
UF_6 plant	Uranium	0.0014	0.0027	0.0025	0.0022	0.0025	**0.280**
UF_6 plant	Fluoride	0.030	0.018	0.028	0.029	0.020	**0.650**
UO_2 plant	Uranium	0.0007	0.0008	0.0006	0.0005	0.0005	**0.240**
UO_2 plant	Ammonia	1.7	2.1	2.0	2.0	2.4	**58**

UO_2 = uranium dioxide; UF_6 = uranium hexafluoride; kg/h = kilogram per hour

Liquid effluent

Cameco's PHCF collects and evaporates its process wastewater effluent. Its operating licence does not allow for any process wastewater effluent to be discharged from PHCF and there were no process liquid discharges from PHCF in 2022.

In compliance with the requirements of other regulators that have jurisdiction, Cameco's PHCF monitors releases of the following point source discharges that are non-process liquid effluent: cooling water, sanitary sewer, storm sewer, and the combined backwash stream associated with the harbour water intake system.

In 2022, Cameco's PHCF continued to observe elevated uranium concentrations in the UF_6 plant and UO_2 plant cooling water returns which can be attributed to the inner harbour remedial work by CNL that involved debris removal and resulted in sediment disturbances. Additionally, the CNL harbour water activities led to the diversion of surface water to the PHCF intake screen.

With respect to the daily sanitary sewer discharges, the action level was reached or exceeded 15 times in 2022, as described in the action levels subsection of section 5.9. Cameco is continuing to repair and replace sections of the sanitary sewer network and is upgrading it as part of the VIM project. CNSC staff concluded that in 2022, Cameco met its licence requirement not to discharge process wastewater effluent and to keep the sanitary sewer discharges below their respective release limits.

Uranium in ambient air

Cameco monitors ambient air at several locations around the PHCF site to measure air quality using high-volume air sampling of total suspended particles (TSP) (uranium from the air is collected on a filter and analyzed) to ensure that the impact of the facility's emissions to the environment is minimized. In 2022, the highest annual average concentration of uranium in TSP in ambient air was 0.003 $\mu g/m^3$ for a 24 hour period, which is consistent with values for the years 2018 to 2022. This value is well below the O.Reg 419/05: Air Pollution – Local Air Quality standard for an upper risk threshold of uranium of 1.5 $\mu g/m^3$ for a 24 hour period [14].

Groundwater monitoring

Cameco is in compliance with CSA N288.7-15, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [15].

The PHCF long-term groundwater monitoring program includes groundwater level monitoring and groundwater sampling at select wells. Cameco samples groundwater quality at the PHCF in the following monitoring wells:

- 12 active pumping wells on a monthly basis
- 56 monitoring wells in the overburden (soil) on a quarterly basis
- 16 monitoring wells in the bedrock on an annual basis

Groundwater quality across the site in 2022 was generally consistent with that reported in previous annual monitoring reports from the licensee. Similarly, groundwater flow patterns were consistent with what was observed historically, flowing southeast towards the turning basin.

The pump-and-treat wells have been performing as expected. The operation of the pump-and-treat system has resulted in capture of contaminant plumes originating under the footprints of the current and original UF_6 plants, as well as the UO_2 plant. The mass of contaminants removed by these pumping wells is slightly lower than in previous years (see table I-7 below). These results are either within historical ranges of fluctuation, or attributable to lower contaminant concentrations in pumped groundwater. Indeed, the mass of contaminants entering the harbour is less than calculated in previous years and does not exceed release objectives.

Table I-7: Mass of contaminants removed by pumping wells, Port Hope Conversion Facility, kg, 2018–22

Parameter	2018	2019	2020	2021	2022
Uranium	27.0	27.0	22.0	22.0	16.0
Fluoride	57.0	47.0	47.0	45.0	41.0
Ammonia	66.0	39.0	23.0	21.0	9.2
Nitrate	124.0	69.0	60.0	56.0	19.0
Arsenic	1.0	0.5	0.64	0.82	1.8

kg=kilogram

Surface water monitoring

The surface water quality in the harbour near the PHCF site has been monitored since 1977 through the analysis of samples collected from the south cooling water intake near the mouth of the Ganaraska River. The trend of surface water quality over time shows improvement since 1977 and very low uranium levels.

Surface water in the harbour is sampled at 13 locations on a quarterly basis with samples collected at depths slightly below the water surface and slightly above the sediment layer. Beginning in 2018, these sampling locations were restricted due to CNL's remedial harbour activities; however, PHCF has continued to monitor the cooling water intake since this is a good indication of the overall water quality under routine and baseline conditions, where routine refers to typical water quality conditions during facility operations and baseline refers to water quality conditions before this facility was in operation.

Table I-8 provides annual average and maximum concentrations of uranium, fluoride, nitrate, and ammonia monitored in the harbour water from 2018 to 2022. CNL harbour isolation works and CNL harbour remedial activities (dredging) have influenced the Port Hope Harbour water quality and have caused uranium concentrations in the cooling water intake to exceed the CCME water quality guideline of 15 µg U/L [17]. Since observing these elevated concentrations, CNL has implemented a more robust surface water quality monitoring program and has followed up appropriately to reduce, as much as possible, any environmental impacts. Once the contaminated sediment is removed from the harbour, the water quality is predicted to significantly improve. CNSC staff are satisfied that the surface water quality is being adequately monitored to ensure the protection of human health and the environment. CNL will continue to provide updates to Cameco and notify Cameco when dredging is taking place.

Although there was a maximum fluoride concentration in harbour water that measured 0.22 mg/L and this value exceeded the CCME freshwater guideline for the protection of aquatic life of 0.12 mg/L [17], this fluoride concentration was well below Health Canada's drinking water standard of 1.5 mg/L [19] and the lowest toxicity benchmark for sensitive aquatic biota of 11.5 mg/L [17]. This indicates these were safe fluoride levels for human health and were unlikely to cause adverse effects to aquatic biota.

Table I-8: Harbour water quality, Port Hope Conversion Facility, 2018–22

Parameter	2018	2019	2020	2021	2022	CCME Guideline*
Average Uranium (µg/L)	5.2	5.1	5.0	70	120	**15**
Maximum Uranium (µg/L)	31	46	12	540	500	**15**
Average Fluoride (mg/L)	0.16	0.092	0.09	0.066	0.11	**0.12**
Maximum Fluoride (mg/L)	0.36	0.18	0.15	0.17	0.22	**0.12**
Average Nitrate (mg/L)	1.0	0.95	0.92	1.0	0.89	**13**
Maximum Nitrate (mg/L)	1.8	1.6	1.7	1.9	1.9	**13**
Average Ammonia + ammonium (mg/L)	0.13	0.031	0.014	0.015	0.045	**0.3**
Maximum Ammonia + ammonium (mg/L)	0.47	0.21	0.14	0.17	0.76	**0.3**

mg/L = milligram per litre; µg/g = microgram per gram; CCME = Canadian Council of Ministers of the Environment
*CCME, *Canadian Water Quality Guidelines for the Protection of Aquatic Life* [17]

Soil monitoring

Cameco's annual soil monitoring program at PHCF monitors 3 locations at 3 different soil depths beyond the facility's fenceline. Two locations are within a 0 to 500 m radius from the facility, while 1 is within a 1,000 to 1,500 m radius from the facility. One location (adjacent to the Port Hope Water Treatment Plant) contains clean fill soil to remove any potential interference from historical soil contamination of uranium.

In 2022, the uranium in soil concentrations for all sampling depths at the clean fill soil location were found to be consistent with and virtually unchanged from values obtained during previous sampling years (see table I-9 for 0-5 cm soil sampling results for the clean fill soil location for 2018 to 2022). The results are also well below soil guidelines for residential and parkland set by the CCME in its *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18] and are within the range of natural background levels for Ontario (2.5 µg/g). The results suggest that current PHCF operations and their uranium emissions do not significantly contribute to the accumulation of uranium in soil.

Cameco has made a commitment to maintain the existing soil monitoring locations and report results to the CNSC each year. Reclamation activities, as part of the Port Hope Area Initiative, provide an opportunity for Cameco to review its soil monitoring station locations throughout the Port Hope community.

Table I-9: Uranium concentrations at waterworks side yard remediated with clean soil, Port Hope Conversion Facility, µg/g, 2018–22

Soil depth (cm)	2018	2019	2020	2021	2022	CCME Guideline*
0–5	0.91	0.82	0.91	0.87	1.1	**23**

cm = centimetre; µg/g = microgram per gram; CCME= Canadian Council of Ministers of the Environment
*CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18]

Fluoride monitoring

The impact of fluoride emissions on the local environment from PHCF facility operations is determined by monitoring fluoride concentrations and visible foliar damage in vegetation at sampling locations adjacent to the facility and in the surrounding community. The vegetation monitoring program, conducted in coordination with the Ontario Ministry of the Environment, Conservation and Parks (MECP), was modified to sample clusters of trees rather than single trees (starting in 2018). It was further modified in 2021 to remove 4 sampling sites, which was consistent with MECP feedback that these locations were not adding value to the monitoring program. Additionally, some trees previously monitored needed to be replaced with others due to downed trees and CNL's remedial work in the area. All values are well below the MECP's Ambient Air Quality Criteria (AAQC) [20] value for fluoride in dry forage of 35 ug/g

Table I-10: Fluoride concentration in local vegetation, Port Hope Conversion Facility, µg/g, 2018–2022

Parameter	2018	2019	2020	2021	2022	MECP's AAQC
Fluoride in vegetation, µg/g	<5.0	<5.0	<5.0	<5.0	<5.0	**35**

µg/g = microgram per gram; MECP = Ontario Ministry of the Environment, Conservation and Parks; AAQC = Ambient Air Quality Criteria
Note: For 2022, 14 of 26 samples were below the detection limit of 5 µg/g; for 2021, 16 of 26 samples were below the detection limit of 5 µg/g; for 2020, 28 of 33 samples were below the detection limit of 5 µg/g; for 2019, 31 of 34 samples were below the detection limit of 5 µg/g; and for 2018, 29 of 34 samples were below the detection limit of 5 µg/g.

Gamma monitoring

A portion of radiological public dose from PHCF operations is from gamma radiation sources. PHCF monitors gamma radiation effective dose rates at the fenceline of the 2 sites to ensure that potential exposure levels remain ALARA. The gamma radiation effective dose rates for both sites are measured with environmental TLDs supplied by a licensed dosimetry service.

The 2018 to 2022 maximum monthly doses for gamma radiation are shown in table I-11. In 2022, the maximum monthly gamma measurements were all below the respective derived release limits for this facility and remained consistent with values from previous years. The measurements indicate that gamma dose rates are controlled, and the public is protected.

Table I-11: Gamma monitoring results, maximum monthly, Port Hope Conversion Facility, µSv/h, 2018–22

Station number and site	2018	2019	2020	2021	2022	DRL
Station 2 - Sites 1 and 2	0.26	0.20	0.20	0.21	0.23	**0.57**
Station 13*/10 - Site 1	0.07*	0.00*/ 0.05	0.11	0.02	0.01	**0.40**
Station 21 - Site 2	0.07	0.06	0.09	0.03	0.06	**0.26**

µSv/h = microsievert per hour
*Refers to monitoring results for Station 13

Cameco Fuel Manufacturing Inc.

Atmospheric emissions

Cameco continued to monitor uranium released as atmospheric emissions from the CFM facility. The monitoring data in table I-12 demonstrates that stack and building exhaust ventilation emissions from the facility continued to be effectively controlled, as annual averages remained consistently well below their licence limits between 2018 and 2022.

Table I-12: Air emission monitoring results, Cameco Fuel Manufacturing, kg/year, 2018-22

Parameter	2018	2019	2020	2021	2022	Licence Limit
Total uranium discharge through stacks, kg/year	0.01	0.004	0.01	0.01	0.01	**14**
Total uranium discharge through building exhaust ventilation, kg/year	1.25	1.09	0.92	0.89	1.06	**14**

kg= kilogram

Liquid effluent

After liquid effluent generated from the production process is collected, an evaporator process is used to remove the majority of the uranium. The condensed liquid is sampled and analyzed prior to a controlled release to the sanitary sewer line. Cameco continues to monitor uranium released as liquid effluent from the facility. The monitoring data in table I-13 demonstrates that liquid effluent from the facility in 2022 remained consistently well below the licence limit and continued to be effectively controlled.

Table I-13: Liquid effluent monitoring results, Cameco Fuel Manufacturing, kg/year, 2018–22

Parameter	2018	2019	2020	2021	2022	Licence Limit
Total uranium discharge to sewer, kg/year	0.84	0.39	0.34	0.29	0.21	**475**

kg= kilogram

Uranium in ambient air

Cameco operates high-volume air samplers to measure the airborne concentrations of uranium at points of impingement of stack plumes. The samplers are located on the east, north, southwest and northwest sides of the facility. In 2022, the results from these samplers showed that the highest annual average concentration of uranium in ambient air (among the sampling stations) was 0.0003 µg/m^3. All of the values are well below the O.Reg 419/05: Air Pollution – Local Air Quality standard for uranium of 0.03 µg/m^3 [14].

Groundwater monitoring

Cameco is in compliance with CSA N288.7-15, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [15].

CFM has a network of 70 monitoring wells that includes 43 overburden, 23 shallow bedrock and 4 deep bedrock wells. Groundwater has been monitored at the site twice a year since 1999 and up to 10 pumping wells and 2 sumps were in operation during 2022. Table I-14 provides annual average and maximum concentrations of dissolved uranium in groundwater from 2018 to 2022.

Table I-14: Dissolved uranium concentrations in groundwater, Cameco Fuel Manufacturing, µg/L, 2018–22

Parameter	2018	2019	2020	2021	2022	MOE Standard*
Average dissolved uranium concentration, µg/L	78	115	107	53	40	**420**
Maximum dissolved uranium concentration, µg/L	2200	2300	2100	710	490	**420**

µg/L = microgram per litre
*MOE = Ministry of the Environment [17]

Groundwater quality across the site in 2022 generally met the MOE's Table 3 uranium standard of 420 µg/L. Concentrations of dissolved uranium in groundwater ranged from <0.1 µg/L to a maximum value of 490 µg/L across the site. Concentrations of uranium in groundwater exceeded the MOE Table 3 Standard in 1 of the 70 monitoring wells sampled. This exceedance relates to historic waste management practices. The soil impact is confined to a small area. The groundwater monitoring results confirmed that current operations are not contributing to the concentrations of uranium in groundwater on the licensed property.

Groundwater flow at the CFM site is generally from the west and northwest towards the east and southeast in 2022, consistent with historical observations. To the south of CFM (i.e., in the direction of groundwater flow), the closest property boundary (non-residential) is approximately 120 to 140 meters from the facility. As stated in the ERA, the potential for off-site migration of contaminants through groundwater movement is low due to the slow movement of groundwater and the operations of the groundwater recovery and treatment system at CFM. CFM's groundwater recovery system experienced significant downtime in 2022 and into 2023 due to the degradation of several key components and equipment failures. Despite the system downtime, its impacts on groundwater were not measurable, as demonstrated by the groundwater monitoring results in the fall of 2022 at locations downstream of the groundwater recovery wells. CNSC staff will review the 2023 monitoring data to confirm this observation. Groundwater below and downstream of the CFM facility is not used for drinking water purposes.

Surface water monitoring

In 2022, Cameco collected surface water samples at 9 locations in May, August, and October. Three of the sampling locations are drainage features where water is only intermittently present in the spring following rain events. All sample locations were on or adjacent to the licensed site and were analyzed for uranium. Table I-15 provides average uranium in surface water from 2018-2022.

I-15: Surface water quality monitoring results, Cameco Fuel Manufacturing, µg/L, 2018–22

Parameter	2018	2019	2020	2021	2022	CCME Guideline*
Average Uranium in the Gages Creek Tributary, µg/L	0.70	1.29	0.61	0.87	0.81	**15 (long-term)**
Average Uranium in the Intermittent Drainage Feature, µg/L	3.68	20.04	6.50	11.10	5.84	**33 (short-term)**

µg/g = microgram per litre; CCME = Canadian Council of Ministers of the Environment
*CCME, *Canadian Water Quality Guidelines for the Protection of Aquatic Life* [17]

For all 2022 surface water sampling locations, the total uranium concentrations were below the applicable CCME guidelines. The maximum uranium concentration for surface water samples taken for intermittent drainage locations was 17 µg/L, which is below the CCME's short-term uranium guideline of 33 µg/L [17]. The maximum uranium concentration for all other locations was 1.4 µg/L, which is below the CCME's long-term uranium guideline of 15 µg/L [17].

CNSC staff will continue to oversee Cameco's monitoring at locations around the vicinity of CFM to confirm that uranium concentrations remain at safe levels in surface water.

Soil monitoring

Every 3 years, Cameco collects soil samples at various depths from 23 locations surrounding the CFM facility. Soil samples were last collected in 2022 and analyzed for uranium content. The soil monitoring results for 0-5 cm are shown in table I-16. The 2022 average uranium concentration in soil near the CFM facility is within the range of results observed previously and slightly above the Ontario natural background level of 2.5 µg/g. These results were below the CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18] of 23 µg/g for residential and parkland land use. This is the most restrictive guideline; therefore, no adverse consequences to human and environmental receptors are expected. The maximum concentration of 25.8 µg/g observed in 2022 is from outside the licensed area (but still within Cameco's property) and reflects historical contamination and is not attributable to the current CFM operations. Note that the risk to the environment from an exceedance of a CCME guidance is expected to be minimal due to the conservative assumptions and safety factors that were used to derive the guideline.

Table I-16: Soil monitoring results*, Cameco Fuel Manufacturing, µg/g, 2010–22

Parameter	2010	2013	2016	2019	2022	CCME** Guideline
Average uranium concentration, µg/g (0-5 cm)	5.6	4.7	3.0	3.0	3.6	**23**
Maximum uranium concentration, µg/g (0-5 cm)	21.1	17.4	10.2	10.2	25.8	**23**

µg/g = microgram per gram; CCME= Canadian Council of Ministers of the Environment
*CFM reverted to a 3-year soil monitoring program in 2010.
**CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18].

Gamma monitoring

For the CFM facility, a portion of radiological public dose is due to gamma radiation sources. Consequently, monitoring of gamma radiation effective dose rates at the fenceline of the CFM site is essential to ensuring that levels of potential gamma radiation exposure are maintained ALARA. The gamma radiation effective dose rates for the site are measured with environmental TLDs supplied by a licensed dosimetry service. Gamma monitoring results are shown in table I-17.

In 2022, the maximum quarterly gamma measurements were all below the respective licensed limits for this facility and remain consistent with values from previous years:

- Location 1 measured 0.02 µSv/h (licensed limit is 4.96 µSv/h)
- Location 2 measured 0.07 µSv/h (licensed limit is 0.46 µSv/h)
- Location 12 measured 0.38 µSv/h (licensed limit is 1.35 µSv/h)

Table I-17: Gamma monitoring results, Cameco Fuel Manufacturing, µSv/hr, 2018–22

Location	2018	2019	2020	2021	2022	DRL
1	0.02	0.02	0.01	0.02	0.02	**4.96**
2	0.04	0.04	0.04	0.05	0.07	**0.46**
3	0.00	0.00	0.00	0.00	0.00	**-**
4	0.00	0.00	0.00	0.00	0.00	**-**
5	0.00	0.00	0.00	0.00	0.00	**-**
6	0.00	0.00	0.00	0.00	0.00	**-**
7	0.00	0.00	0.00	0.00	0.00	**-**
8	0.00	0.00	0.00	0.00	0.00	**-**
9	0.05	0.00	0.53	0.05	0.07	**-**
10	0.00	0.00	0.00	0.00	0.00	**-**
11	0.35	0.31	0.33	0.37	0.30	**-**
12	0.36	0.42	0.39	0.41	0.38	**1.35**

These measurements indicate that gamma dose rates are controlled and that the public is protected.

BWXT Nuclear Energy Canada Inc.– Toronto and Peterborough

Atmospheric emissions

To ensure compliance with licence limits, air emissions from the BWXT NEC facilities are filtered and sampled prior to release into the atmosphere. Table I-18 provides BWXT NEC Toronto's annual maximum uranium emissions from 2018 to 2022. Table I-19 provides BWXT NEC Peterborough's annual maximum uranium and beryllium emissions from 2018 to 2022. The annual emissions remained well below the licence limits for both facilities. The results demonstrate that air emissions of uranium and beryllium were being controlled effectively.

Table I-18: Air emission monitoring results, BWXT NEC Toronto, µg/m^3, 2018–22

Parameter	Stack	2018	2019	2020	2021	2022	Licence limit
Uranium	Rotoclone	0.464	0.077	0.204	0.197	0.322	**65**
Uranium	6H-68	0.118	0.111	0.112	0.461	0.086	**47**
Uranium	4H-48	0.086	0.037	0.112	0.072	0.125	**97**
Uranium	Furnace #1	0.112	0.081	0.599	0.224	0.072	**437**
Uranium	Furnace #2/4	0.092	0.103	0.158	0.395	0.322	**55**
Uranium	Furnace #5/6	0.467	0.245	0.908	0.250	0.257	**52**

µg/m^3= microgram per cubic metre

Table I-19: Air emission monitoring results, BWXT NEC Peterborough, µg/m^3, 2018–22

Parameter	Stack	2018	2019	2020	2021	2022	Licence Limit
Uranium	R2 Decan	0.006	0.014	0.003	0.003	0.005	**410**
Beryllium	North	0.001	0.001	0.001	0.003	0.001	**2.6**
Beryllium	South	0.001	0.001	0.001	0.001	0.001	**2.6**
Beryllium	Acid	0.000	0.000	0.000	0.002	0.001	**2.6**

µg/m^3= microgram per cubic metre

Liquid effluent

To ensure compliance with licence limits, wastewater from the BWXT NEC Toronto and Peterborough facilities is collected, filtered, and sampled prior to its release into sanitary sewers. Table I-20 provides BWXT NEC's annual maximum concentrations of uranium and beryllium released to the sanitary sewers from 2018 to 2022. In 2022, the releases continued to be well below the licence limits and the results demonstrate that liquid effluent releases were being controlled effectively.

Table I-20: Liquid effluent monitoring results, BWXT NEC, mg/L, 2018–22

Facility	Parameter	2018	2019	2020	2021	2022	Licence Limit
BWXT NEC Toronto	Uranium	2.95	2.58	2.79	2.55	2.82	**1000**
BWXT NEC Peterborough	Uranium	0.03	0.07	0.37	0.41	0.78	**2500**
BWXT NEC Peterborough	Beryllium	0.0025	0.0018	0.0091	0.0031	0.033	**26**

mg/L = milligram per litre

Uranium in ambient air

BWXT NEC Toronto operates 5 high-volume air samplers to measure airborne concentrations of uranium at points of impingement of stack plumes. The results from these samplers show that the annual average concentration of uranium (among the sampling stations) in ambient air measured around the facility in 2022 was below the minimum detection limit and the results are well below the O.Reg 419/05: Air Pollution – Local Air Quality standard for uranium of 0.03 µg/m^3 [14]. Table I-21 provides air monitoring results for BWXT NEC Toronto (rounded-up values).

BWXT NEC Peterborough does not monitor uranium in ambient air because the atmospheric emissions discharged from the facility already meet the O.Reg 419/05: Air Pollution – Local Air Quality standard for uranium of 0.03 µg/m^3 [14] at the point of release, thus eliminating the need for additional ambient air monitoring.

Table I-21: Uranium in boundary air monitoring results, BWXT NEC Toronto, µg/m^3, 2018–22

Parameter	2018	2019	2020	2021	2022
Average concentration	0.000	0.000	0.000	0.000	0.000

µg/m^3= microgram per cubic metre

Soil monitoring

BWXT NEC conducts soil sampling for uranium at its Toronto facility as part of its environmental program. In 2022, soil samples were taken from 41 locations and analyzed for uranium content. The samples were collected from the BWXT NEC Toronto site (table I-22), from commercial lands (table I-23) located along the south border of the site, and from a nearby residential neighbourhood (table I-24). Due to issues with access to the Canadian Pacific Railway property, the 2022 sampling program also included new sample locations. In 2022, the uranium in soil concentrations ranged from 0.3 µg/g to 28.1 µg/g on industrial/commercial lands. Of the 41 soils sampled, 35 soil samples were below Ontario's background concentrations for uranium of up to 2.5 µg/g [21] and well below the applicable CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18] for uranium for industrial, commercial, and residential/parkland land use.

Table I-22: Uranium in soil monitoring results, BWXT NEC Toronto property, µg/g, 2018–22

Parameter	2018	2019	2020	2021	2022	CCME Guideline*
Average uranium concentration	1.3	1.2	1.3	2.4	0.8	**300**
Maximum uranium concentration**	1.3	1.2	1.3	4.6	1.1	**300**

µg/g = microgram per gram; CCME= Canadian Council of Ministers of the Environment
*CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18].
**Prior to 2021, only one sample was taken, which is why average and maximum value are the same.

Table I-23: Uranium in soil monitoring results, commercial lands, BWXT NEC Toronto, µg/g, 2018–22

Parameter	2018	2019	2020	2021	2022	CCME Guideline*
Average uranium concentration	2.3	1.5	2.9	1.0	6.4	**33**
Maximum uranium concentration	11.9	2.8	17.6	1.0	28.1	**33**

µg/g = microgram per gram; CCME = Canadian Council of Ministers of the Environment
*CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18].

Table I-24: Uranium in soil monitoring results, residential locations, BWXT NEC Toronto, µg/g, 2018–22

Parameter	2018	2019	2020	2021	2022	CCME Guideline*
Average uranium concentration	< 1.0	1.1	1.0	1.0	0.6	**23**
Maximum uranium concentration	< 1.0	1.7	1.0	1.1	2.3	**23**

µg/g = microgram per gram; CCME = Canadian Council of Ministers of the Environment
*CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18].

BWXT NEC conducted soil sampling for beryllium in 2020 around the Peterborough facility (table I-25), as committed in the CNSC licence renewal hearing (Record of Decision). In 2020, soil samples were taken from 21 locations that were selected for consistency with the CNSC's IEMP. Soil sampling for beryllium and uranium (table I-26), which started in 2021 and is now conducted annually, was conducted at 13 locations in accordance with BWXT's documented plan by a third party-party consultant. The minimum detectable concentration of uranium is 1.0 part per million (1.0 µg U/g) and the samples were within this minimum detection limit. The minimum detectable concentration of beryllium is 0.5 parts per million (0.5 µg Be/g) and the samples that were detected ranged from < 0.5 µg/g to 0.53 µg/g. All samples were well below Ontario's background

concentrations of up to 2.5 µg/g for beryllium and well below the applicable CCME soil quantity guideline for the protection of environmental health (4 mg/kg for beryllium) and human health (75 mg/kg for beryllium) [18].

Table I-25: Beryllium in soil monitoring results, institutional or park lands, BWXT NEC Peterborough, µg/g, 2020-2022

Parameter	2020	2021	2022	CCME Guideline*
Average beryllium concentration	0.50	0.50	< 0.50	**4.0**
Maximum beryllium concentration	0.52	0.52	0.53	**4.0**

µg/g = microgram per gram; CCME = Canadian Council of Ministers of the Environment
*CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18].

Table I-26: Uranium in soil monitoring results, institutional or park lands, BWXT NEC Peterborough, µg/g, 2021-2022

Parameter	2021	2022	CCME Guideline*
Average uranium concentration	1.0	< 1.0	**23**
Maximum uranium concentration	1.0	< 1.0	**23**

µg/g = microgram per gram; CCME = Canadian Council of Ministers of the Environment
*CCME, *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* [18].

Gamma monitoring

A portion of radiological public dose from both the BWXT NEC Toronto and Peterborough facilities is due to gamma radiation sources. Consequently, it is necessary to monitor the gamma radiation effective dose rates at the fenceline of the Toronto site and at the Peterborough facility boundary to ensure that levels of potential gamma radiation exposure are maintained ALARA.

In 2022, the annual radiation dose from direct gamma radiation was:

- BWXT Toronto site measured 17.2 µSv
- BWXT Peterborough site measured 11.5 µSv (rounded-up value)

These estimates indicate that the gamma dose from both BWXT facilities is controlled and was well below the 1 mSv (1,000 µSv) per year effective dose limit to a member of the public.

BWXT Medical

Atmospheric emissions

BWXT Medical performs weekly air exhaust stack sampling and continuously monitors process ventilation, exhaust ductwork, and stack emissions using in-situ detectors, samplers, and computerized recording. In 2022, there was 1 detectable airborne release of Co-60 of 1.7E-05 GBq and resulted in a theoretical dose to the public of 0.000000067 mSv, which is incredibly low when compared to the annual public dose limit of 1 mSv. For non-radiological, hazardous substances the emissions from BWXT Medical were well below the limits in its Environmental Compliance Approval from the MECP.

Liquid effluent

BWXT Medical collects wastewater in underground delay tanks and analyzes it before discharging into the sanitary sewer system.

Table I-27 provides BWXT Medical's liquid effluent monitoring results. In 2022, authorized radioactive liquid effluent releases from BWXT Medical remained well below its DRL licence limits.

Table I-27: Liquid effluent monitoring results for release to sewer, BWXT Medical, GBq/year, 2021–22

Parameter	2021	2022	Licence limit (DRL), GBq/year
β < 1 MeV	0.187	0.202	**763**
β > 1 MeV	0.042	0.039	**35,000**
Iodine-125	0.071	0.026	**1,190**
Iodine-131	0.005	0.005	**389**
Molybdenum-99	0.039	0.035	**10,200**
Cobalt-60	0.006	0.006	**35.4**

β < 1 MeV = beta particles less than 1 megaelectronvolt; GBq = gigabecquerels; DRL = derived release limit

Soil sampling

In 2022, soil was sampled around the BWXT Medical facility at 19 locations and there were no gamma-emitting radionuclides detected in the samples.

Gamma monitoring

Gamma radiation from the facility is monitored by BWXT Medical using environmental TLDs. Dosimeters are also placed in residences of BWXT Medical employees located near the facility and the highest residence TLD result in 2022 was 0.105 mSv. The 2022 annual monitoring results show gamma radiation levels at offsite monitoring locations were in the range of natural background, which indicates that BWXT Medical's operations are not contributing to the public's gamma radiation exposure.

SRB Technologies (Canada) Inc.

Atmospheric emissions

SRBT monitors tritium releases from its facility stacks and reports the monitoring data on an annual basis. The monitoring data for 2018 to 2022 is provided in table I-28 and demonstrates that atmospheric emissions from the facility remained well below their regulatory limits.

Table I-28: Atmospheric emissions monitoring results, SRB Technologies, GBq/year, 2018–2022

Parameter	2018	2019	2020	2021	2022	Licence limit
Tritium as HTO	10,741	11,858	9,755	8,387	8,816	**67,200**
Total tritium as HTO + HT	33,180	31,769	25,186	28,729	26,590	**448,000**

GBq = gigabecquerels; HTO = hydrogenated tritium oxide; HT = tritium gas

Liquid effluent

SRBT continues to control and monitor tritium released as liquid effluent from the facility. The monitoring data for 2018 to 2022 is provided in table I-29 and demonstrates that liquid effluent from the facility remained well below their regulatory limits.

Table I-29: Liquid effluent monitoring results for release to sewer, SRB Technologies, GBq/year, 2018–2022

Parameter	2018	2019	2020	2021	2022	Licence limit, GBq/year
Tritium-water soluble	10.02	13.67	5.56	3.07	1.49	**200**

GBq = gigabecquerels

Tritium in ambient air

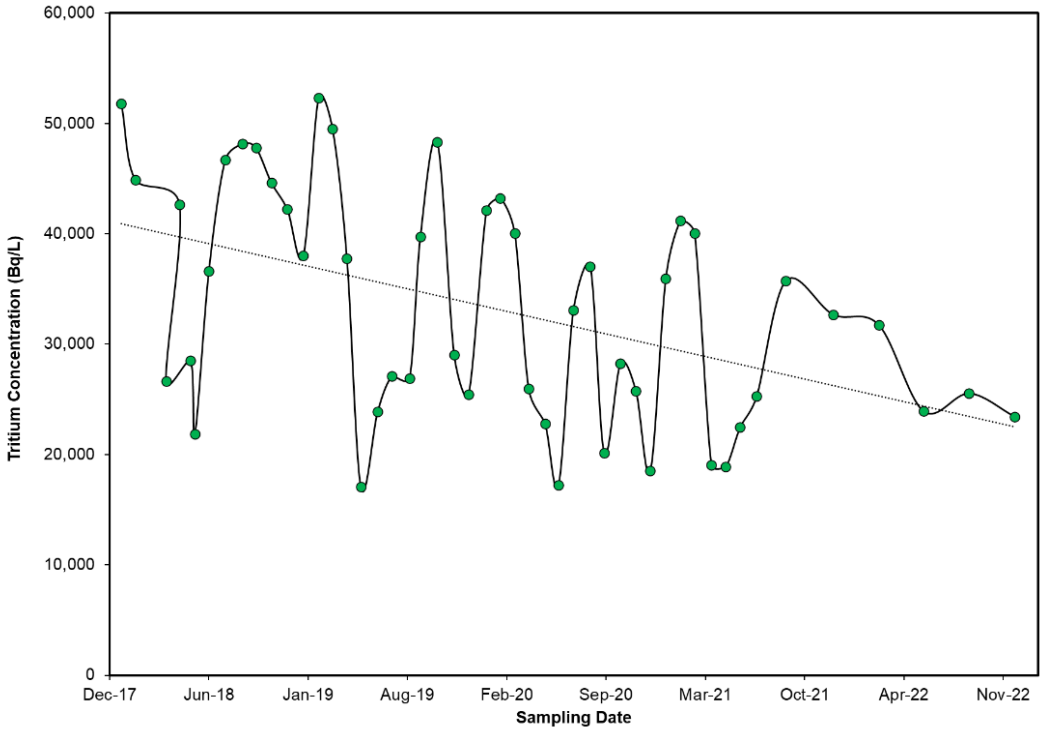
SRBT maintains 40 passive air samplers to monitor tritium in air and 35 of which are located within a 250 m to 2 km radius from the facility. These samplers represent tritium exposure pathways for inhalation and skin absorption and are used to calculate public dose. The 2022 air monitoring results from these samplers demonstrated that tritium levels in ambient air near SRBT remain low.

Groundwater monitoring

SRBT is in compliance with CSA N288.7-15, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [15].

Groundwater is currently sampled at 29 groundwater monitoring wells (sampled on a quarterly basis), 2 nearby business locations (sampled twice annually), and 5 residential drinking water wells (sampled twice annually). From the 2022 sampling results, the highest tritium concentration was reported for monitoring well MW06-10 (26,163 Bq/L). This is the only well where tritium exceeds the Canadian Drinking Water Guideline value of 7,000 Bq/L [19] and it is located directly beneath the area where the active ventilation stacks are found. This well is a dedicated, engineered groundwater monitoring well which is located very near to the facility within a secured area and is not available to be used as a source of water consumption. The elevated tritium concentration in this well is from historical practices before 2006. SRBT continues to minimize tritium emissions during operation. As a result, tritium concentrations in the groundwater continue to show a declining trend, as shown in figure I-1 (Source: SRBT ACR 2022).

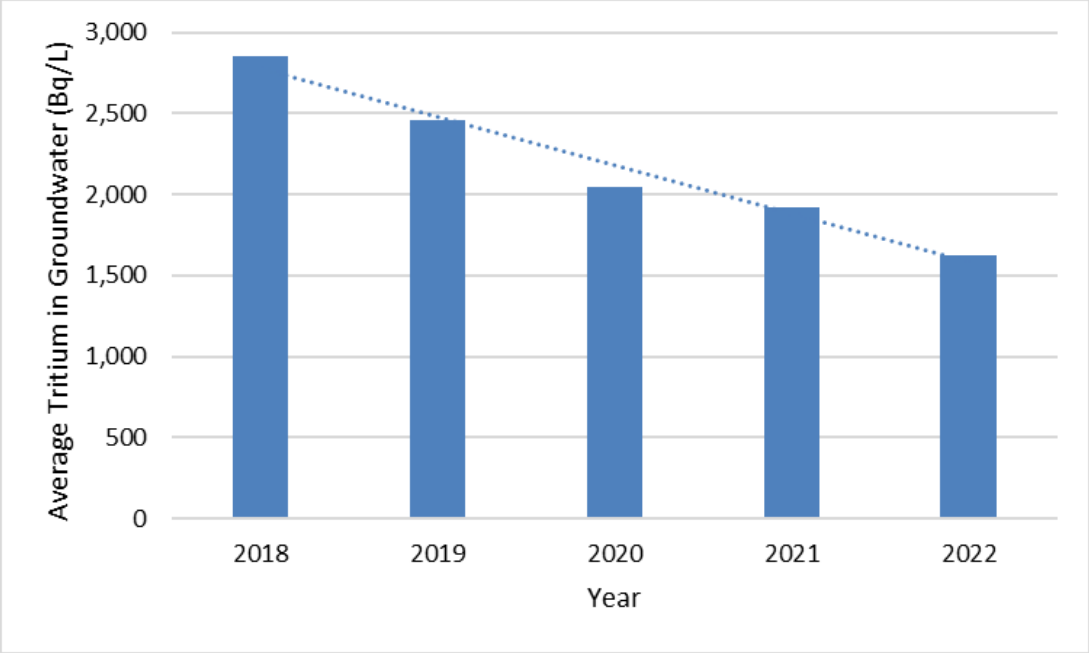
Figure I-1: Tritium Concentrations in MW06-10, 2018-22



Throughout 2022, none of the other monitoring wells at the SRBT site exceeded the Canadian Drinking Water Guideline for tritium of 7,000 Bq/L [19]. Tritium concentrations in all monitoring wells are exhibiting consistently decreasing concentrations in recent years. Figure I-2 shows the average tritium concentrations among all the groundwater monitoring wells around the site in the past 5 years (2018-2022).

Of the 5 nearby residential wells around the site, none are in the groundwater flow pathway. The closest well, RW-2, is 1,100 metres away from SRBT. The maximum tritium concentration for all the residential wells monitored in 2022 was 38 Bq/L.

Figure I-2: Average tritium in groundwater concentrations at SRB Technologies, 2018-22



Other monitoring

SRBT samples and analyzes runoff water from its facility and engages a qualified third party to perform monitoring and analysis of precipitation, surface water, produce, and milk. As part of a special sampling campaign, SRBT also sampled and analyzed tritium in plants that are of interest to Indigenous communities such as mullein, chokecherries, ferns, sumac berries, bulrushes, and raspberry leaves. The 2022 tritium concentrations in these samples continue to be low. This monitoring complements the principal monitoring activities which focus on air and groundwater.

Nordion (Canada) Inc.

Atmospheric emissions

Nordion controls and monitors radioactive material releases from its facility to prevent unnecessary releases of radioisotopes to the atmosphere. Table I-30 provides Nordion's radioactive air emissions monitoring results from 2018 to 2022.

The 2022 monitoring data demonstrates that radioactive air emissions from the facility remained well below the regulatory limits with a very small detectable amount of Co-60 released to the air.

Table I-30: Air emissions monitoring results, Nordion, GBq/year, 2018–22

Parameter	2018	2019	2020	2021	2022	DRL
Cobalt-60	0.002	0.00002	0	0.00004	0.0003	**250**
Iodine-125	0	0	0	0	0	**952**
Iodine-131	0.006	0	0	0	0	**686**
Xenon-133	0	0	0	0	0	**677 million**
Xenon-135	0	0	0	0	0	**102 million**
Xenon-135m	0	0	0	0	0	**69 million**

DRL = derived release limit; GBq = gigabecquerel

Liquid effluent

Nordion collects liquid effluent in delay tanks and analyzes it before discharging into the sanitary sewer system.

Table I-31 below provides Nordion's monitoring results for radioactive liquid emissions from 2018 to 2022. The monitoring data demonstrates that authorized radioactive liquid effluent releases from the facility in 2022 remained below the DRLs.

Table I-31: Liquid effluent monitoring results for release to sewer, Nordion, GBq/year, 2018–22

Parameter	2018	2019	2020	2021	2022	DRL
β < 1 MeV	0.243	0.162	0.226	N/A	N/A	**763**
β > 1 MeV	0.055	0.038	0.057	N/A	N/A	**35,000**
Iodine-125	0.146	0.063	N/A	N/A	N/A	**1,190**
Iodine-131	0.007	0.004	N/A	N/A	N/A	**389**
Molybdenum-99	0.055	0.036	N/A	N/A	N/A	**10,200**
Cobalt-60	0.027	0.020	0.031	0.0046	0.038	**35.4**
Niobium-95	0.0010	0.002	0.0015	0.002	0.002	**3,250**
Zirconium-95	0.0017	0.0019	0.0013	0.002	0.001	**2,060**
Cesium-137	0.0007	0.0007	0.00076	0.001	0.001	**24.8**

β < 1 MeV = beta particles less than 1 megaelectronvolt; GBq = gigabecquerels; DRL = derived release limit

Groundwater monitoring
There are currently 9 groundwater monitoring wells on the Nordion site. Since 2005, Nordion has been monitoring groundwater at least once per year for non-radioactive contaminants in 4 monitoring wells. The monitoring results from 2018 to 2022 demonstrate that there were no significant changes in the groundwater in 2022 compared to previous years, and that contaminant concentrations remain below applicable limits defined by the Ministry of the Environment (MOE) Table 3 standard for non-potable groundwater conditions [16].

Since 2014, Nordion has been monitoring groundwater at least once a year for radioactive contaminants (in particular Co-60, the main radionuclide in airborne emissions) in 5 monitoring wells. The results since then have detected only naturally occurring radionuclides that are not processed at the Nordion facility. These results, which are either below detection limits or at natural background levels, indicate that releases of radioactive and hazardous substances from Nordion's facility have had no measurable impact on groundwater quality. Additionally, groundwater is not used as a potable water source in the vicinity of the site.

Soil sampling
In 2022, Nordion conducted its annual soil sampling campaign and collected 19 soil samples from around the facility. No radionuclides attributable to licensed activities were detected in the soils.

Gamma monitoring

Nordion uses TLDs to monitor environmental gamma radiation from the facility. These devices are placed at locations that cover the points of a compass and are preferentially placed east of the facility to receive prevailing winds. Dosimeters are also placed in the residences of Nordion employees located near the facility and the highest residence TLD result in 2022 was 0.105 mSv. The 2022 annual monitoring results show gamma radiation levels at offsite monitoring locations were in the range of natural background, which indicates that Nordion's operations are not contributing to the public's gamma radiation exposure.

Best Theratronics Ltd.

Effluent and emissions control (releases)
There are no radiological releases (liquid or airborne) from the BTL facility that require controls or monitoring since it uses radioactive sealed sources that are not produced on-site and do not result in any radioactive releases.

BTL safely manages hazardous liquid effluents from routine operations. They are collected, temporarily stored on-site, and regularly removed for disposal by a certified third-party contractor. Lubricating oil for on-site boring and milling machines is recovered and recirculated. Therefore, there are no hazardous waterborne releases into the environment requiring controls or effluent monitoring.

Hazardous airborne emissions from BTL are related to the exhausting of the lead pouring, paint booth, fire torching and sand blasting areas. Engineering controls, such as filters and ventilation, are in place to reduce or eliminate emissions generated during operations. As a result, BTL does not have an effluent monitoring program or an environmental monitoring program.

Assessment and monitoring

BTL does not conduct environmental monitoring around its facility as there are no radiological releases that require controls or monitoring. Hazardous airborne emissions pertain to exhausting associated with the lead pouring area. BTL submits a report on lead and its compounds to the National Pollutant Release Inventory, maintaining annual compliance with the *Toxics Reduction Act*. There were no environmental occurrences in 2022 to report.

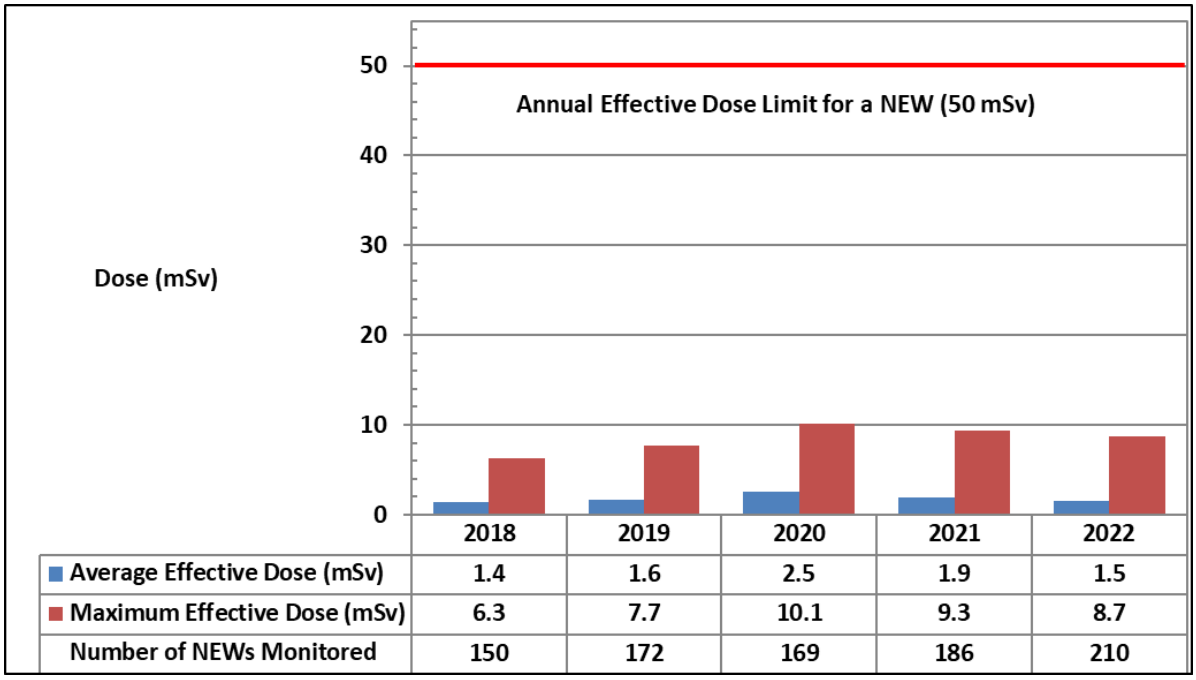
J. Worker Dose Data

This appendix presents information on doses to NEWs and non-NEWs at the UNSPFs.

Blind River Refinery

Figure J-1 provides the average and maximum effective doses for NEWs at BRR between 2018 and 2022. The maximum effective dose received by a NEW in 2022 was 8.7 mSv, which is approximately 17% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period. Average and maximum effective doses over this 5-year period are reflective of the work activities at BRR and influenced by factors such as production levels and number of operating days. The average and maximum effective doses are consistent with previous years.

Figure J-1: Effective dose statistics for NEWs, Blind River Refinery, 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	1.4	1.6	2.5	1.9	1.5
Maximum Effective Dose (mSv)	6.3	7.7	10.1	9.3	8.7
Number of NEWs Monitored	150	172	169	186	210

Average and maximum equivalent dose results for skin and extremities (hands) of NEWs, from 2018 to 2022, are provided in tables J-1 and J-2. In 2022, the maximum individual skin dose received by a NEW at BRR was 34.2 mSv, which is approximately 7% of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period. The maximum individual extremity dose received by a NEW at BRR was 20.2 mSv, which is approximately 4% of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period.

Table J-1: Equivalent (skin) dose statistics for NEWs, Blind River Refinery, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average skin dose	4.1	4.8	5.1	4.4	3.8	**N/A**
Maximum individual skin dose	28.4	29.2	39.1	39.9	34.2	**500**

mSv = millisievert; N/A = not applicable

Table J-2: Equivalent (extremity) dose statistics for NEWs, Blind River Refinery, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average extremity dose	3.5	3.9	3.4	5.2	2.7	**N/A**
Maximum individual extremity dose	14.5	11.9	14.5	27.2	20.2	**500**

mSv = millisievert; N/A = not applicable

The general classification system for inhaled compounds by their solubility or retention in the human body classifies compounds as type F (fast), type M (medium), and type S (slow). At BRR, the uranium products have solubilities of types F, M and S. Cameco's Fuel Services Division holds a CNSC dosimetry service licence, which authorizes Cameco to provide in-house internal dosimetry services to BRR. The lung counting program is used for assigning worker doses from routine monitoring assuming a chronic pattern of inhalation intakes of uranium products of type M and S. This is a conservative approach for workers exposed to a combination of chronic and acute (short term) inhalation intakes. The urine analysis program assesses the dose from acute intakes of type F material and is also used for monitoring the toxic effects of uranium.

Workers are placed on either a bi-weekly or a monthly urine sampling schedule. Samples may be collected outside of the routine urine sampling schedule, such as when there is a suspected unplanned intake of uranium or following a specific work activity; these are referred to as non-routine samples. The urine analysis program includes graduated responses to increasing uranium in urine concentrations, with potential chemical toxicity of uranium to the kidneys considered.

At BRR, the following action levels for NEWs have been implemented:

- The action level for bi-weekly urine samples is 65 µg U/L, which is the concentration of uranium in urine that results in a potential dose of 1 mSv and represents the chemical toxicity reference limit of 3 µg U/g kidney tissue, assuming the intake occurred at the mid-point of the sampling period.
- The action level for monthly urine samples is 44 µg U/L, which is set at the concentration of uranium in urine that results in a potential dose of 1 mSv and represents the chemical toxicity reference limit of 3 µg U/g kidney tissue, assuming the intake occurred at the mid-point of the sampling period.

In 2022, 4215 urine samples were analyzed, and no routine sample reached an action level. One non-routine sample above the administrative level of 100 µg U/L was investigated in 2022, and it was determined to be well below the level that would impact kidney function.

Table J-3 provides the distribution of uranium in urine results from workers' urine samples collected over 2018-2022.

Table J-3: Urine analysis results for NEWs, Blind River Refinery, 2018-22

Parameters	2018	2019	2020	2021	2022
Total number of samples analyzed	3432	3671	3795	4192	4215
Number of samples at or above the action level	0	0	0	0	0
Maximum routine sample result (µg U/L)	12.5	20.5	15.7	14.0	12.3
Maximum non-routine sample result (µg U/L)	54	69	45	180	145

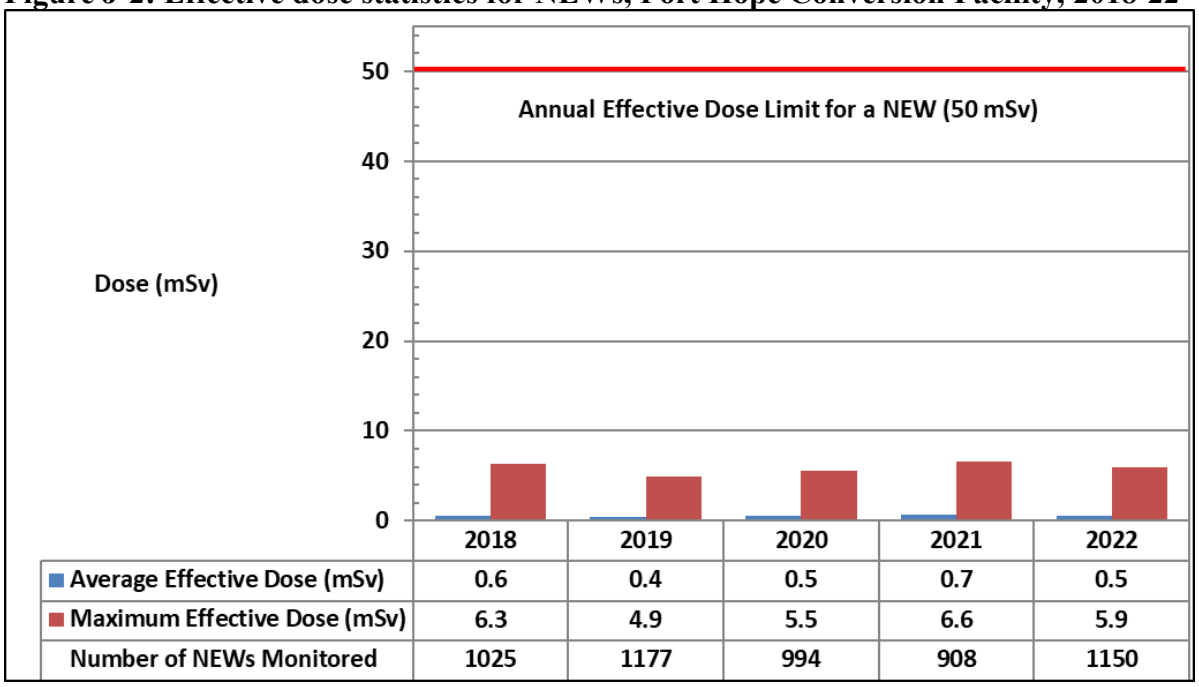
Non-NEWs at the BRR

Site visitors and contractors who are not considered NEWs are issued external dosimetry to monitor their radiological exposures while at BRR. In 2022, the maximum individual effective dose received by a site visitor or contactor who was not a NEW was 0.39 mSv, which is well below the CNSC's regulatory effective dose limit of 1 mSv per calendar year for a person who is not a NEW.

Port Hope Conversion Facility

Figure J-2 provides the average and maximum effective doses for NEWs at PHCF between 2018 and 2022. The maximum individual effective dose received by a NEW in 2022 was 5.9 mSv, which is approximately 12% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period. The average and maximum total effective doses over this 5-year period have remained steady and are reflective of the work activities and production levels at PHCF.

Figure J-2: Effective dose statistics for NEWs, Port Hope Conversion Facility, 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	0.6	0.4	0.5	0.7	0.5
Maximum Effective Dose (mSv)	6.3	4.9	5.5	6.6	5.9
Number of NEWs Monitored	1025	1177	994	908	1150

Average and maximum equivalent dose results for the skin of NEWs, from 2018 to 2022 are provided in table J-4. In 2022, the maximum individual skin dose received by a NEW at PHCF was 12 mSv, which is approximately 2% of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period. The average and maximum skin doses over this 5-year period have been relatively steady.

Table J-4: Equivalent (skin) dose statistics for NEWs, Port Hope Conversion Facility, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average skin dose	0.7	0.5	0.5	0.7	0.5	**N/A**
Maximum individual skin dose	14.9	20.1	17.0	16.3	12.0	**500**

mSv = millisievert; N/A = not applicable

At PHCF, uranium products have solubilities of types F, M and S. Cameco's Fuel Services Division holds a CNSC dosimetry service licence, which authorizes Cameco to provide in-house internal dosimetry services to PHCF. The lung counting program is used for assigning worker doses from routine monitoring assuming a chronic pattern of inhalation intakes of uranium products of type M and S. This is a conservative approach for workers exposed to a combination of chronic and acute (short term) inhalation intakes. The urine analysis program primarily focuses on assessing the dose from acute intakes of type F material and is also used for monitoring the toxic effects of uranium.

The routine urine sampling frequency ranges from daily to monthly, depending on the work group. Samples may also be collected outside of the routine urine sampling schedule, such as when there is a suspected unplanned intake of uranium or following a specific work activity; these are referred to as post-shift (non-routine) urine samples. The urine analysis program includes graduated responses to increasing uranium in urine concentrations, with potential radiation doses and chemical toxicity of uranium to the kidneys considered.

At PHCF, the following action levels for NEWs have been implemented:

- The action level for bi-weekly urine samples is 65 µg U/L, which is the concentration of uranium in urine that results in a potential dose of 0.5 mSv and represents the chemical toxicity reference limit of 3 µg U/g kidney tissue, assuming the intake occurred at the mid-point of the sampling period.
- The action level for monthly urine samples is 25 µg U/L, which is set at the concentration of uranium in urine that results in a potential dose of 0.4 mSv and represents the chemical toxicity reference limit of 3 µg U/g kidney tissue, assuming the intake occurred at the mid-point of the sampling period.
- The action level for daily urine samples is 80 µg U/L, which is set at the concentration of uranium in urine that results in a potential dose of 0.10 mSv and represents a potential kidney burden of 0.98 µg U/g kidney tissue, assuming the intake occurred within 24 hours of the sample being taken.
- The action level for all post-shift (non-routine) urine samples is strictly for monitoring for potential kidney toxicity, and is 500 µg U/L, which represents a potential kidney burden of 0.25 µg U/g kidney tissue, assuming the intake occurred within 12 hours of the sample being taken.

Additionally, an action level of 40 µg U/L has been set for daily urine samples submitted by persons not considered as NEWs. This concentration of uranium in urine results in a potential dose of < 0.05 mSv and represents a potential kidney burden of 0.49 µg U/g kidney tissue, assuming the intake occurred within 24 hours of the sample being taken.

In 2022, 46,531 urine samples were analyzed, and no sample reached an action level. Table J-5 provides the distribution of uranium in urine results from workers' (NEWs and persons not considered as NEWs) urine samples collected over 2018-2022.

Table J-5: Urine analysis results for NEWs, Port Hope Conversion Facility, 2018-22

Parameters	2018	2019	2020	2021	2022
Total number of samples analyzed	34900	44952	28761	28855	46531
Number of samples at or above the action level	0	0	0	0	0
Maximum routine sample result (µg U/L)	24	60	9.6	14	18
Maximum non-routine sample result (µg U/L)	160	400	390	120	82

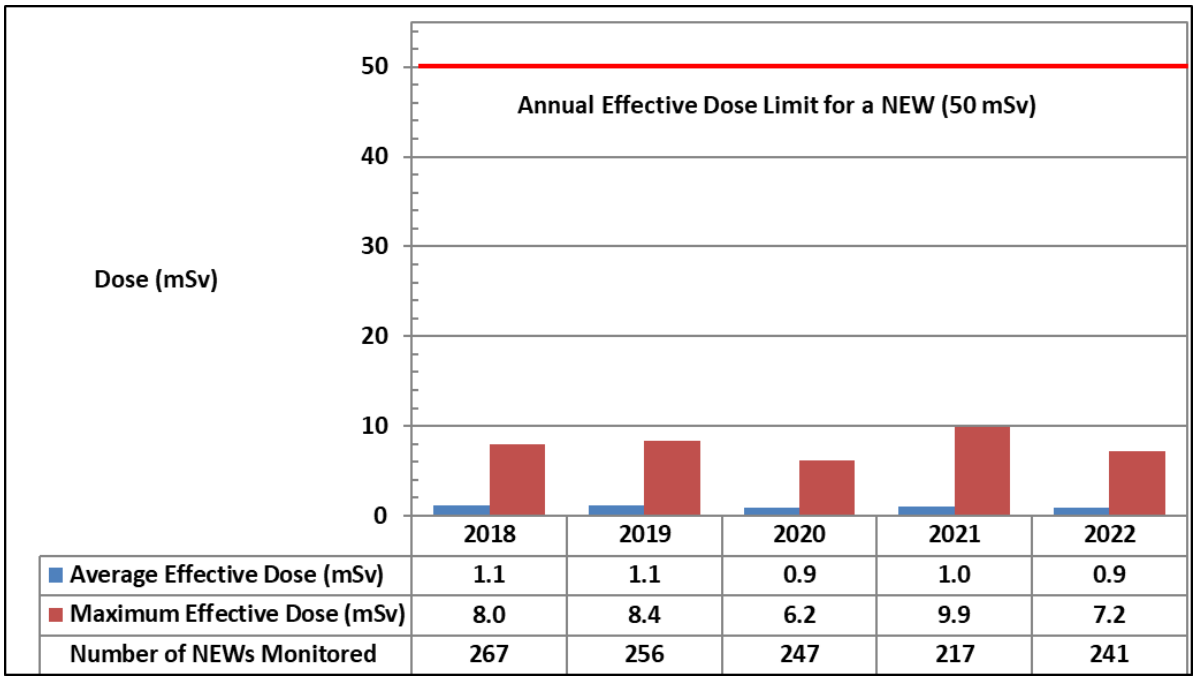
Non-NEWs at the PHCF

Cameco employees, site visitors and contractors whose work activities do not require NEW status may be issued whole-body dosimeters and may participate in the internal dosimetry program to monitor their radiological exposures while at PHCF. In 2022, the maximum individual effective dose received by a person who is not a NEW was 0.02 mSv, which is well below the CNSC's regulatory effective dose limit of 1 mSv per calendar year for a person who is not a NEW.

Cameco Fuel Manufacturing Inc.

Figure J-3 provides the average and maximum effective doses for NEWs at CFM between 2018 and 2022. The maximum individual effective dose received by a NEW in 2022 was 7.2 mSv, which is approximately 14% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period. The average total effective doses over this 5-year period have remained steady.

Figure J-3: Effective dose statistics for NEWs, Cameco Fuel Manufacturing, 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	1.1	1.1	0.9	1.0	0.9
Maximum Effective Dose (mSv)	8.0	8.4	6.2	9.9	7.2
Number of NEWs Monitored	267	256	247	217	241

Average and maximum equivalent dose results for the skin and extremities (hands) of NEWs, from 2018 to 2022, are provided in tables J-6 and J-7. In 2022, the maximum skin dose received by a NEW at CFM was 47.4 mSv, which is approximately 9% of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period. The maximum extremity dose received by a NEW at CFM was 39.4 mSv, which is approximately 8% of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period. The average and maximum equivalent doses have been steady or decreasing over this 5-year period.

Table J-6: Equivalent (skin) dose statistics for NEWs, Cameco Fuel Manufacturing, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average skin dose	3.4	3.1	3.1	3.5	2.8	**N/A**
Maximum individual skin dose	59.0	56.9	55.3	40.9	47.4	**500**

mSv = millisievert; N/A = not applicable

Table J-7: Equivalent (extremity) dose statistics for NEWs, Cameco Fuel Manufacturing, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average extremity dose	15.8	18.4	17.9	8.4	7.0	**N/A**
Maximum individual extremity dose	57.1	90.8	65.6	41.9	39.4	**500**

mSv = millisievert; N/A = not applicable

At CFM, the input to the pellet manufacturing process is ceramic grade UO_2. UO_2 has a solubility of type S, which clears slowly from the body, and has a retention time in the body of years. The lung counting program is used for assigning worker doses from routine monitoring, assuming a chronic pattern of inhalation intakes. This is a conservative approach for workers exposed to a combination of chronic and acute (short term) inhalation intakes. Cameco's Fuel Services Division holds a CNSC dosimetry service licence, which authorizes Cameco to provide in-house internal dosimetry services to CFM.

To complement the lung counting program, routine biweekly urine samples are collected from workers for monitoring of acute inhalation or accidental ingestion of UO_2. Samples may be collected outside of the routine urine sampling schedule, such as following non-routine work or an elevated air monitoring result in a work area. The urine analysis program at CFM includes graduated responses to increasing uranium in urine concentrations. Cameco developed tables of urine excretion rates for various monitoring intervals and corresponding concentration levels for uranium compounds, which may indicate that the chemical toxicity reference limit of 3 µg U/g of kidney tissue has been exceeded.

At CFM, an action level of 10 µg U/L is implemented for all urine samples. This translates to a range of 0.008 to 0.435 µg U/g of kidney tissue, well below the chemical toxicity reference limit of 3 µg U/g of kidney tissue.

In 2022, 1564 urine samples were analyzed, and no sample reached the action level.

Table J-8 provides the urine analysis results for NEWs at CFM during from 2018-2022. As shown, there have been no exceedances of CFM's action level for urine analysis samples over these years.

Table J-8: Urine analysis results for NEWs, Cameco Fuel Manufacturing, 2018-22

Parameters	2018	2019	2020	2021	2022
Total number of samples analyzed	1799	1689	1685	1565	1564
Number of samples at or above the action level	0	0	0	0	0
Maximum sample result (µg U/L)	4.8	3.1	2.0	1.5	2.2

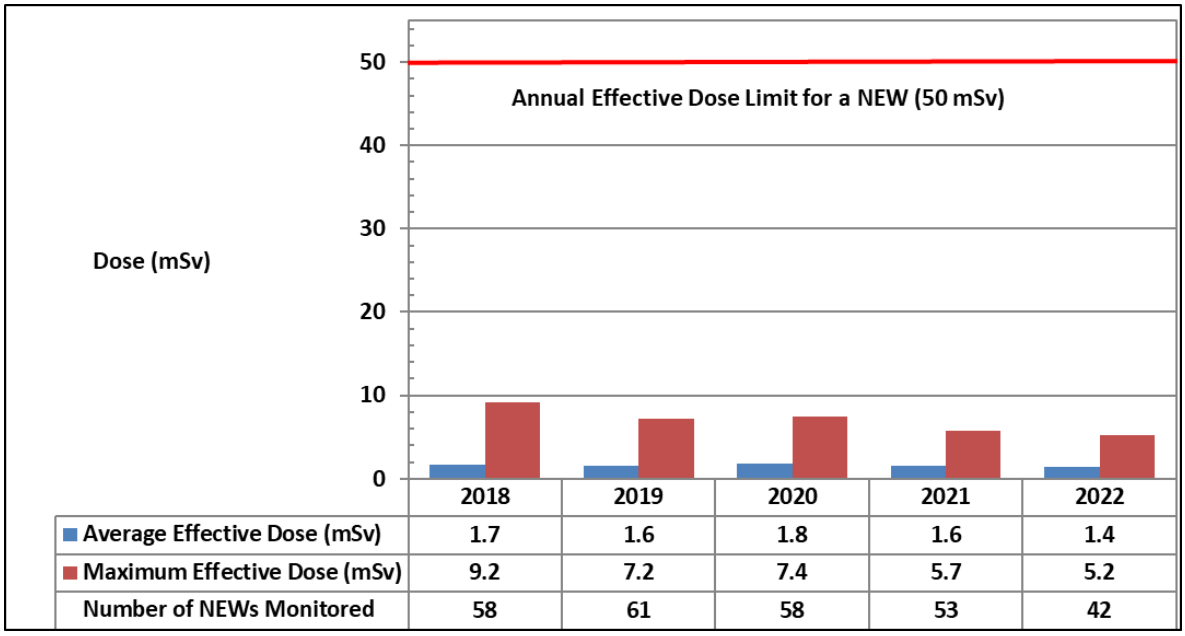
Non-NEWs at CFM

Visitors and contractors that are not considered as NEWs are issued dosimeters to monitor their radiological exposures while at CFM. In 2022, there were no measurable doses recorded on dosimeters issued to persons who are not NEWs.

BWXT Nuclear Energy Canada Inc. Toronto and Peterborough

Figure J-4 provides the average and maximum effective doses for NEWs at BWXT NEC's Toronto facility between 2018 and 2022. The maximum effective dose received by a NEW in 2022 at the Toronto facility was 5.2 mSv, or approximately 10% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period.

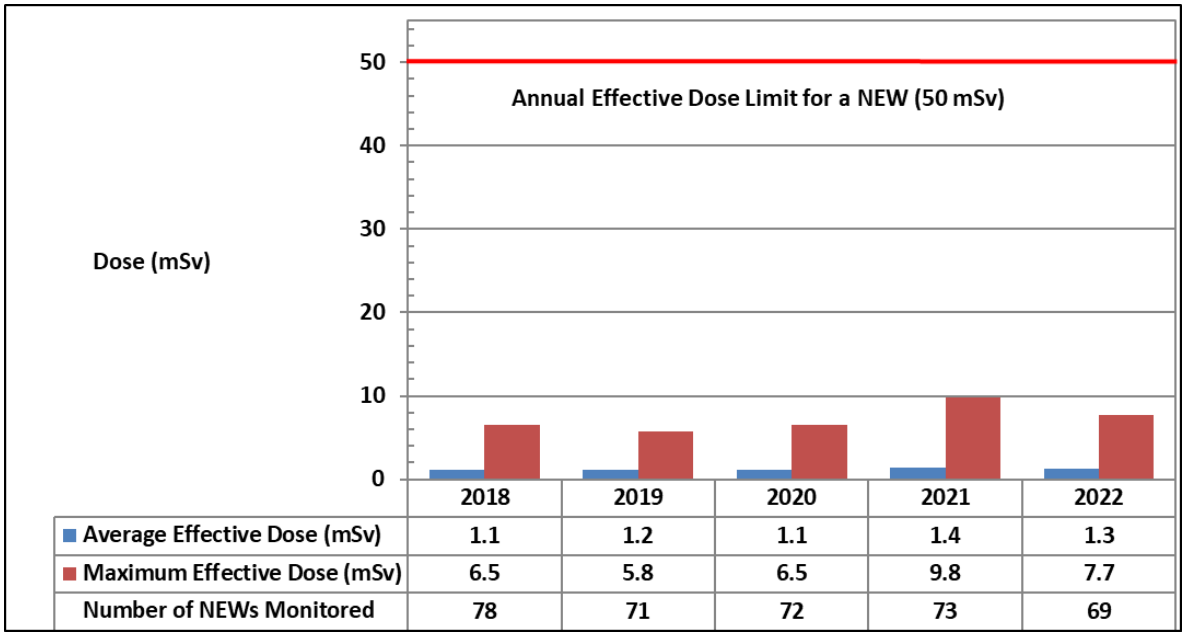
Figure J-4: Effective dose statistics for NEWs, BWXT NEC Toronto, 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	1.7	1.6	1.8	1.6	1.4
Maximum Effective Dose (mSv)	9.2	7.2	7.4	5.7	5.2
Number of NEWs Monitored	58	61	58	53	42

Figure J-5 provides the average and maximum effective doses for NEWs at BWXT NEC's Peterborough facility between 2018 and 2022. The maximum effective dose received by a NEW in 2022 at the Peterborough facility was 7.7 mSv, or approximately 15% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period.

Figure J-5: Effective dose statistics for NEWs, BWXT Peterborough, 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	1.1	1.2	1.1	1.4	1.3
Maximum Effective Dose (mSv)	6.5	5.8	6.5	9.8	7.7
Number of NEWs Monitored	78	71	72	73	69

Annual average and maximum equivalent doses to the skin and extremities (hands) of NEWs from 2018 to 2022 are provided in tables J-9 through J-12.

In 2022, the maximum individual equivalent skin dose at the Toronto facility was 28.7 mSv and 21.7 mSv at the Peterborough facility.

Table J-9: Equivalent (skin) dose statistics for NEWs, BWXT NEC Toronto, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average skin dose	8.9	8.1	8.9	7.9	5.8	**N/A**
Maximum individual skin dose	58.4	39.8	39.1	37.2	28.7	**500**

mSv = millisievert; N/A = not applicable

Table J-10: Equivalent (skin) dose statistics for NEWs, BWXT NEC Peterborough, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average skin dose	2.9	3.0	2.8	3.6	3.5	**N/A**
Maximum individual skin dose	17.9	17.4	19.0	30.9	21.7	**500**

mSv = millisievert; N/A = not applicable

In 2022, the maximum individual equivalent extremity dose at the Toronto facility was 68.6 mSv and it was 52.0 mSv at the Peterborough facility.

Table J-11: Equivalent (extremity) dose statistics for NEWs, BWXT NEC Toronto, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average extremity dose	24.6	20.7	25.4	22.2	21.1	**N/A**
Maximum individual extremity dose	83.3	79.7	115.5	66.1	68.6	**500**

mSv = millisievert; N/A = not applicable

Table J-12: Equivalent (extremity) dose statistics for NEWs, BWXT NEC Peterborough, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average extremity dose	14.3	11.3	18.8	23.7	15.6	**N/A**
Maximum individual extremity dose	46.1	29.4	43.2	59.0	52.0	**500**

mSv = millisievert; N/A = not applicable

Across the 2 facilities, the maximum individual equivalent doses to the skin and the extremities were received by NEWs at the Toronto facility and were approximately 6% and 14% (respectively) of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period. Over the past 5 years, average equivalent extremity and skin doses have been relatively stable at both facilities. The reason for the consistently lower skin and extremity doses at the Peterborough facility is the low likelihood of direct pellet handling by workers, as opposed to the Toronto facility where this practice is a necessary part of the process. At the Peterborough facility, except in the end cap welding station, all pellets are shielded in zirconium tubes, bundles, or boxes.

BWXT's facilities handle ceramic grade UO_2. UO_2 has a solubility of type S, and clears slowly from the body, with a retention time in the body of years. The measurement of uranium in the urine is used as a screening method for assessing whether inhalation of airborne UO_2, or accidental ingestion has occurred. At the Toronto facility, workers are placed on a routine weekly or monthly urine sampling schedule. Workers at the Peterborough facility are on a routine quarterly urine sampling schedule. Samples may be collected outside of the routine urine sampling schedules, such as following non-routine work or an elevated air monitoring result in a work area.

An action level of 10 µg U/L is implemented for all urine samples. This translates to a range of 0.008 to 0.3 µg U/g of kidney tissue at BWXT Toronto, and a range of 0.008 to 0.732 µg U/g of kidney tissue at BWXT Peterborough, well-below the chemical toxicity reference limit of 3 µg U/g of kidney tissue.

At BWXT Toronto in 2022, 1332 urine samples were analyzed, and no sample reached the action level.

Table J-13 provides the distribution of uranium in urine results from workers' urine samples collected from 2018-2022 at BWXT Toronto.

Table J-13: Urine analysis results for NEWs, BWXT NEC Toronto, 2018-22

Parameters	2018	2019	2020	2021	2022
Total number of samples analyzed	1600	1594	1646	1499	1332
Number of samples at or above the action level	0	0	0	0	0
Maximum sample result (µg U/L)	3.5	3.8	4.0	2.7	2.7

At BWXT Peterborough in 2022, 105 urine samples were analyzed, and no sample reached the action level.

Table J-14 provides the distribution of uranium in urine results from workers' urine samples collected from 2018-2022 at BWXT Peterborough.

Table J-14: Urine analysis results for NEWs, BWXT NEC Peterborough, 2018-22

Parameters	2018	2019	2020	2021	2022
Total number of samples analyzed	108	88	86	103	105
Number of samples at or above the action level	0	0	0	0	0
Maximum sample result (µg U/L)	< 0.1	0.1	0.4	0.1	0.2

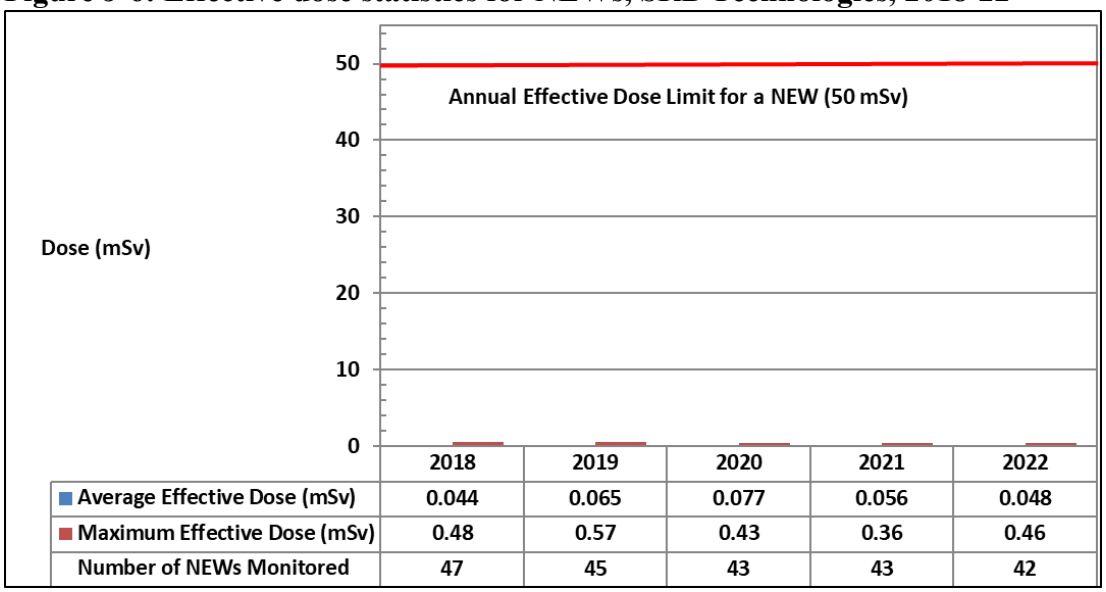
Non-NEWs at BWXT NEC

For both the Peterborough and Toronto facilities, visitors and contractors are all considered non-NEWs and are not directly monitored. Doses are estimated based on in-plant radiological conditions and occupancy factors, to ensure that radiation doses are controlled well-below the CNSC's regulatory effective dose limit of 1 mSv per calendar year for a person who is not a NEW.

SRB Technologies (Canada) Inc.

Figure J-6 provides the average and maximum effective doses for NEWs at SRBT from 2018 to 2022. The maximum effective dose received by a NEW in 2022 was 0.46 mSv, this is below 1% of the CNSC regulatory effective dose limit of 50 mSv in a 1-year dosimetry period. Over the past 5 years, annual effective doses at SRBT have remained stable and very low, with slight variations due to production volumes.

Figure J-6: Effective dose statistics for NEWs, SRB Technologies, 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	0.044	0.065	0.077	0.056	0.048
Maximum Effective Dose (mSv)	0.48	0.57	0.43	0.36	0.46
Number of NEWs Monitored	47	45	43	43	42

Due to the uniform distribution of tritium in body tissues, equivalent skin doses are essentially the same as the effective whole-body dose provided in figure J-6 and are therefore not reported separately. For this same reason, extremity doses are not separately monitored for workers at SRBT.

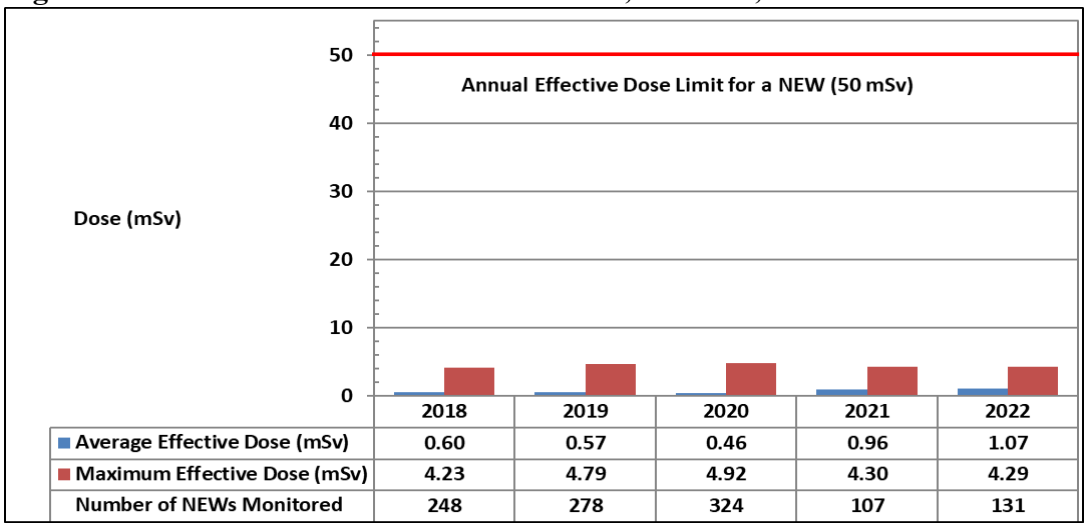
Non-NEWs at SRBT

While contractors are not identified as NEWs, since they do not perform radiological work, their radiological exposures are monitored while they are at the SRBT facility to ensure that their doses remain ALARA and below the CNSC's regulatory dose limit of 1 mSv per calendar year for a person who is not a NEW. In 2022, no contractors received a recordable dose that resulted from work activities performed at the facility.

Nordion (Canada) Inc.

Figure J-7 provides the average and maximum effective doses to NEWs at Nordion from 2018 to 2022. In 2018, Nordion sold its medical isotope business to BWXT Medical who operated as a contractor until receiving their own licence in November 2021. The cobalt-60 operations drove the maximum doses at Nordion, so the trending there is consistent. The average effective dose was increased in 2021 as the lower doses from the medical isotope operation were no longer included. Nordion reported that the maximum effective dose received by a NEW in 2022 was 4.29 mSv, approximately 8.6% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period. Average and maximum effective doses have been relatively stable over these years.

Figure J-7: Effective dose statistics for NEWs, Nordion, 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	0.60	0.57	0.46	0.96	1.07
Maximum Effective Dose (mSv)	4.23	4.79	4.92	4.30	4.29
Number of NEWs Monitored	248	278	324	107	131

As the only isotope now used at Nordion is cobalt-60, the equivalent doses to the skin are deemed equal to the effective doses found above in figure J-7.

Annual average and maximum equivalent doses to the extremities (hands) of NEWs from 2018 to 2022 are provided in table J-15. In 2022, the maximum equivalent extremity dose for a NEW in the active area was 4.29 mSv. This dose represents approximately 1% of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period.

Table J-15: Equivalent (extremity) dose statistics for NEWs, Nordion, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average extremity dose	0.96	1.14	0.93	1.56	1.52	**N/A**
Maximum individual extremity dose	9.08	20.93	16.48	7.73	4.29	**500**

mSv = millisievert; N/A = not applicable

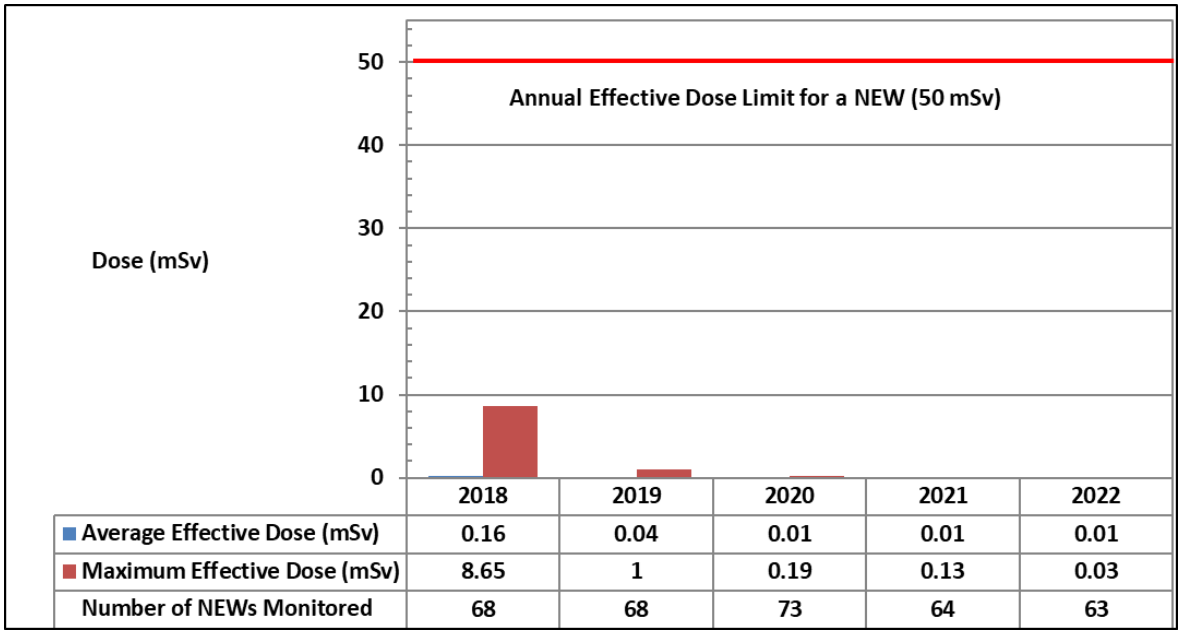
Non-NEWs at Nordion

At Nordion, there may be occasions where workers who are classified as non-NEWs enter the active area but do not perform any radiological work. Nordion monitors non-NEWs as required and provides relevant training to ensure that their doses are kept ALARA. In 2022, Nordion monitored 40 non-NEWs with the maximum effective dose of 0.29 mSv, which is well-below the CNSC's regulatory effective dose limit of 1 mSv per calendar year for a person who is not a NEW.

Best Theratronics Ltd.

At BTL, employees are classified as NEWs if they are expected to have a reasonable probability of receiving an annual occupational dose greater than 1 mSv. Figure J-8 provides the average and maximum effective doses for NEWs at BTL between 2018 and 2022. In 2022, the maximum effective dose received by a NEW at BTL was less than 0.03 mSv, or less than approximately 0.6% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period. Over the past 5 years, annual effective doses at BTL have remained stable and very low, with slight variations due to production volumes.

Figure J-8: Effective dose statistics for NEWs, Best Theratronics Ltd., 2018-22



	2018	2019	2020	2021	2022
Average Effective Dose (mSv)	0.16	0.04	0.01	0.01	0.01
Maximum Effective Dose (mSv)	8.65	1	0.19	0.13	0.03
Number of NEWs Monitored	68	68	73	64	63

The higher than normal maximum effective and equivalent doses (skin and hands) in 2018 were due to an unplanned upset condition that resulted in an action level exceedance.

Annual average and maximum equivalent doses to the extremities (hands) of NEWs from 2018 to 2022 are provided in table J-16. The maximum equivalent extremity dose for a NEW in 2022 was 0.13 mSv, which is approximately 0.03% of the CNSC's regulatory equivalent dose limit of 500 mSv in a 1-year dosimetry period. Except for the 2018 action level exceedance, over the past 5 years, average equivalent doses to the extremities have remained very low.

Table J-16: Equivalent (extremity) dose statistics for NEWs, Best Theratronics Ltd., 2018-22

Dose Data (mSv)	2018	2019	2020	2021	2022	Regulatory Limit (mSv/year)
Average extremity dose	1.41	0.22	0.15	0.06	0.02	**N/A**
Maximum individual extremity dose	13.51	2.51	2.4	0.47	0.13	**500**

mSv = millisieverts; N/A = not applicable

The equivalent doses to the skin of NEWs are equal to the effective doses due to the nature of exposure, as provided in figure J-8.

Non-NEWs at BTL
BTL workers identified as non-NEWs, such as administrative staff, are not permitted in controlled areas, and are therefore not occupationally exposed to radiation.

BWXT Medical

BWXT Medical took over the medical isotope facility at Nordion as a contractor in 2018. In November 2021, BWXT Medical received their own licence to perform this work. At BWXT Medical, employees are classified as NEWs if they are expected to have a reasonable probability of receiving an annual effective dose greater than 1 mSv. In 2022, the maximum effective dose received by a NEW at BWXT Medical was 3.10 mSv, or approximately 6.2% of the CNSC's regulatory effective dose limit of 50 mSv in a 1-year dosimetry period.

Table J-17: Effective dose statistics for NEWs, BWXT Medical, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average effective dose	N/A	N/A	N/A	0.15	0.22	**N/A**
Maximum individual effective dose	N/A	N/A	N/A	2.41	3.10	**50**
Number of NEWs monitored	N/A	N/A	N/A	266	291	**N/A**

mSv = millisieverts; N/A = not applicable

Annual average and maximum equivalent dose results for skin and extremities (hands) of NEWs in 2022 are provided in tables J-18 and J-19. The maximum equivalent skin dose for 2022 was 3.13 mSv, and the maximum equivalent extremity dose for a worker in the active area was 9.87 mSv. These doses represent approximately 0.6% and 2.0%, respectively, of the CNSC's regulatory equivalent dose limits of 500 mSv in a 1-year dosimetry period.

Table J-18: Equivalent (skin) dose statistics for NEWs, BWXT Medical, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average skin dose	N/A	N/A	N/A	0.15	0.17	**N/A**
Maximum individual skin dose	N/A	N/A	N/A	2.44	3.13	**500**

mSv = millisievert; N/A = not applicable

Table J-19: Equivalent (extremity) dose statistics for NEWs, BWXT Medical, 2018-22

Dose data (mSv)	2018	2019	2020	2021	2022	Regulatory limit (mSv/year)
Average extremity dose	N/A	N/A	N/A	0.56	0.63	**N/A**
Maximum individual extremity dose	N/A	N/A	N/A	12.58	9.87	**500**

mSv = millisievert; N/A = not applicable

Non-NEWs at BWXT Medical

At BWXT Medical, all contractors are classified as non-NEWS. BWXT Medical monitors non-NEWs as required and provides relevant training to ensure that their doses are kept ALARA. In 2022, 161 non-NEWs (including contractors and employees) were monitored. This large number of contractors is due to construction activities in the medical isotope facility. BWXT Medical reported that the maximum effective dose received by a non-NEW was 0.36 mSv, which is 36% of the CNSC's regulatory effective dose limit of 1 mSv per calendar year for a person who is not a NEW.

K. Health and Safety Data

This appendix contains information on lost-time injury (LTI) statistics for LTIs incurred as a result of a licensed activity at the UNSPFs. An LTI is an injury that takes place at work where the worker is unable to return to work for a period of time. The accident severity rate measures total number of days lost to injury for every 200,000 person-hours worked. Severity = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000. The accident frequency rate measuring the number of LTIs for every 200,000 person-hours worked at the site. Frequency = [(# of injuries in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

Table K-1: LTI statistics for BRR, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	0	0	0	0	0
Severity rate	0	0	0	0	0
Frequency rate	0	0	0	0	0

Table K-2: LTI statistics for PHCF, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	2	0	0	0	0
Severity rate	7.58	0	0	0	0
Frequency rate	0.49	0	0	0	0

Table K-3: LTI statistics for CFM, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	0	0	0	0	0
Severity rate	0	0	0	0	0
Frequency rate	0	0	0	0	0

Table K-4: LTI statistics for BWXT NEC Toronto, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	0	0	0	0	0
Severity rate	0	0	0	0	0
Frequency rate	0	0	0	0	0

Table K-5: LTI statistics for BWXT NEC Peterborough, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	0	0	0	0	0
Severity rate	0	0	0	0	0
Frequency rate	0	0	0	0	0

Table K-6: LTI statistics for SRBT, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	0	0	0	0	0
Severity rate	0	0	0	0	0
Frequency rate	0	0	0	0	0

Table K-7: LTI statistics for Nordion, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	0	2	0	0	1
Severity rate	0	4.15	0	0	33.88
Frequency rate	0	0.69	0	0	0.65

Table K-8: LTI statistics for BTL, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	2	2	0	0	0
Severity rate	8.21	5.47	0	0	0
Frequency rate	0.68	1.37	0	0	0

Table K-9: LTI statistics for BWXT Medical, 2018–22

Statistic	2018	2019	2020	2021	2022
LTI	N/A	N/A	N/A	1	1
Severity rate	N/A	N/A	N/A	1.17	9.65
Frequency rate	N/A	N/A	N/A	0.39	0.37

L. Reportable Events

Facility	Number of events
BRR	1
PHCF	5
CFM	3
BWXT NEC Toronto	1
BWXT NEC Peterborough	4
SRBT	0
Nordion	5
BTL	0
BWXT Medical	8
TOTAL	**27**

M. Indigenous Nations, Communities and Organizations that have Traditional and/or Treaty Territories within proximity to UNSPF

BRR
• Mississauga First Nation • Métis Nation of Ontario (Region 4) • Sagamok Anishnawbek Nation • Serpent River First Nation • Thessalon First Nation

PHCF, CFM, BWXT NEC Toronto/Peterborough
• Williams Treaties First Nations, which include: - Alderville First Nation - Curve Lake First Nation - Hiawatha First Nation - the Mississaugas of Scugog Island First Nation - the Chippewas of Beausoleil First Nation - the Chippewas of Georgina Island First Nation - the Chippewas of Rama First Nation • Mississaugas of the Credit First Nation • Métis Nation of Ontario (Region 6 and 8) • Mohawks of the Bay of Quinte

SRBT, Nordion, BTL, BWXT Medical
• Algonquin Anishinabeg Nation Tribal Council • Algonquin Nation Secretariat • Algonquins of Barriere Lake • Algonquins of Ontario • Algonquins of Pikwàkanagàn First Nation • Conseil de la Première Nation Abitibiwinni • Kebaowek First Nation • Kitcisakik First Nation • Kitigan Zibi Anishinabeg • Conseil de la Nation Anishnabe de Lac Simon • Long Point First Nation • Métis Nation of Ontario (Regions 5 and 6) • Mohawks of the Bay of Quinte • Timiskaming First Nation • Wahgoshig First Nation • Wolf Lake First Nation

N. Summary of engagement in relation to CNSC's Terms of Reference for Long-term Engagement and Associated Workplans in 2022

Mississaugas of Scugog Island First Nation (MSIFN)-CNSC Long-term Engagement Terms of Reference

As committed to with the Mississaugas of Scugog Island First Nation (MSIFN) as part of the Terms of Reference (ToR) for long-term engagement with the CNSC, the update below was prepared in collaboration with MSIFN representatives.

In September 2021, CNSC staff started discussions with MSIFN to establish a formal long-term relationship with the community, and ToR were signed between MSIFN and the CNSC in March 2022. The ToR ensures that MSIFN is provided with adequate and meaningful funding, support and capacity to participate in consultation and engagement activities required throughout the year. As part of the ToR, a yearly work plan is developed between the CNSC and MSIFN, which provides information on the scope of work, detailed activities, and timelines associated with work items for collaboration and engagement. In 2022, the work plan included:

- Learning about and engaging in the CNSC's Independent Environmental Monitoring Program (IEMP)
- Collaborative annual reporting to the Commission and to MSIFN Chief and Council
- Updates and discussions on specific projects and ongoing operations of licensed nuclear facilities of interest
- Enhancing information sharing and communication between the CNSC and MSIFN members
- Emergency management and preparedness

In 2022, MSIFN and CNSC staff continued to meet monthly and work collaboratively to make progress on a number of the agreed upon initiatives in the work plan. In addition, in October 2022, MSIFN hosted CNSC staff in their community for a lunch and meeting with their leadership. The in-person meeting was an important step for building and strengthening the relationship, advancing project-specific discussions, and enhancing CNSC staff's understanding of MSIFN priorities and areas of concern. CNSC staff and MSIFN are planning on organizing another in-person meeting and event in the MSIFN community and territory in 2023.

Specifically in relation to the facilities in this ROR CNSC staff and MSIFN had regular discussions regarding the Port Hope Conversion Facility, Cameco Fuel Manufacturing Facility licence renewal application, and BWXT NEC Toronto and Peterborough. CNSC staff and MSIFN also met to discuss MSIFN's interest in participating in the 2022 IEMP sampling campaign planned near the BWXT NEC site in Toronto. Although MSIFN was unable to participate in the sampling activities due to scheduling

conflicts and the weather, CNSC staff look forward to MSIFN's participation in future sampling campaigns.

Kebaowek First Nation (KFN)-CNSC Long-term Engagement Terms of Reference

As committed to with Kebaowek First Nation (KFN) as part of the long-term relationship arrangement 'the Arrangement" with the CNSC, the update below was prepared in collaboration with KFN representatives.

In 2022, CNSC staff and KFN representatives started discussions to establish an Arrangement for a long-term relationship. The Arrangement was signed on September 29, 2022, providing a formalized structure for ongoing dialogue on CNSC-regulated facilities and activities where KFN has identified concerns in relation to a project's construction or existing operations on their rights, interests, culture, current and traditional uses of their territory.

As part of the Arrangement, a yearly work plan is being developed between the CNSC and KFN that provides information on the scope of work, detailed activities, and timelines associated with work items for collaboration and engagement. The work plan includes activities that CNSC staff and KFN may be working to implement throughout 2023 and beyond, including:

- learning more about and potentially participating in the CNSC's IEMP
- collaborative annual reporting to the Commission and to the KFN Chief and Council
- updates and discussions on specific projects and ongoing operations of licensed nuclear facilities of interest
- enhanced information sharing and communication between the CNSC and KFN members
- opportunities to comment and review policies and regulations including those related to nuclear safety, non-proliferation and Indigenous engagement

The following facilities covered in this ROR are of interest in the to be developed work plan:

- Best Theratronics Ltd.
- Nordion (Canada) Inc.
- BWXT Medical Canada
- SRB Technologies

CNSC staff and KFN are committed to continuing to strengthen the relationship through ongoing, respectful dialogue and the sharing of knowledge information and perspectives that help CNSC staff and KFN learn from each other. CNSC staff will also continue to have discussions on areas of interest and concern related to CNSC-regulated nuclear activities of interest to KFN.

Algonquins of Pikwakanagan First Nation (AOPFN)-CNSC terms of reference for long-term relationship

As committed to with AOPFN as part of the ToR for long-term engagement with the CNSC, the update below was prepared in collaboration with AOPFN representatives.

In 2022, CNSC staff and AOPFN representatives started discussions to establish ToR for long-term relationship. The ToR was signed on November 30, 2022, providing a formalized structure for ongoing dialogue on CNSC-regulated facilities and activities of interest in the AOPFN traditional territory. As part of the ToR, a yearly work plan was developed between the CNSC and AOPFN that provides information on the scope of work, detailed activities, and timelines associated with work items for collaboration and engagement. The work plan includes activities that CNSC staff and AOPFN will be working to implement throughout 2023 and beyond, including:

- participation in the CNSC's IEMP
- collaborative annual reporting to the Commission and to the AOPFN Chief and Council
- updates and discussions on specific projects and ongoing operations of licensed nuclear facilities of interest
- enhanced information sharing and communication between the CNSC and AOPFN members
- emergency management and preparedness

The following facilities covered in this ROR are of interest in the work plan:

- Best Theratronics Ltd.
- Nordion (Canada) Inc.
- BWXT Medical Canada
- SRB Technologies

CNSC staff and AOPFN are committed to continuing to strengthen the relationship through ongoing, respectful dialogue to share knowledge, information on culture and history, and perspectives that help CNSC staff and AOPFN learn from each other. CNSC staff will also continue to have discussions on areas of interest and concern related to CNSC-regulated nuclear activities of interest to AOPFN.

Métis Nation of Ontario-CNSC Long-term Engagement Terms of Reference

As committed to with the Métis Nation of Ontario (MNO) as part of the ToR for long-term engagement with the CNSC, the update below was prepared in collaboration with MNO representatives.

Following the licence renewal hearing for the Bruce Nuclear Generating Station in 2018, a ToR was agreed upon and signed on December 18, 2019, between CNSC staff and the MNO, which formally documents the engagement with their nation. As the MNO is a province-wide organization, a specific engagement plan under the ToR was also signed in December 2019 with MNO Region 7, which is the consultation committee region that includes the Bruce site to address their areas of interest.

In 2022, the engagement plan included:

- participation in the CNSC's IEMP
- sharing information on NWMO's Adaptive Phase Management Initiative
- sharing information on SMRs
- CNSC to support MNO capacity building through professional development workshops

Communication with MNO citizens

- Updates on Cameco Blind River Refinery, Cameco Port Hope Conversion Facility, Cameco Fuel Manufacturing Inc., BWXT Nuclear Energy Canada Inc., SRB Technologies (Canada) Inc., Nordion (Canada) Inc., Best Theratronics Ltd., BWXT Medical Ltd

Curve Lake First Nation-CNSC Long-term Engagement Terms of Reference

For long-term engagement with the CNSC, the update below was prepared in collaboration with CLFN representatives.

In 2020, CNSC staff started discussions with CLFN to establish a formal long-term relationship with the community, and a ToR for long-term engagement was signed between the CLFN and CNSC in February 2021. This ToR ensures that CLFN is provided with adequate and meaningful funding, support, and capacity to participate in consultation and engagement activities required throughout the year. As part of the ToR a yearly work plan is developed between the CNSC and CLFN, which provides information on the scope of work, detailed activities, and timelines associated with work items for collaboration and engagement.

In 2022 the work plan included:

- ToR maintenance and updates
- participation in the CNSC's IEMP
- updates and discussions on specific projects and ongoing operations of existing nuclear facilities of interest
- co-jurisdictional matters of significance (i.e., *Fisheries Act* authorization, emergency preparedness and thermal emissions from nuclear generation stations)
- information, communication, and other topics (i.e., REGDOC updates, feedback on CNSC reporting and processes, PFP opportunities)
- developing a plan for a Curve Lake First Nation Indigenous Knowledge Study

In 2022, due to capacity constraints and other priorities CLFN and CNSC were not able to initiate discussions on developing a plan for an Indigenous Knowledge Study. However, it is CLFN and CNSC's commitment to develop a plan for a Curve Lake Indigenous Knowledge Study in 2023. Specifically, CLFN and CNSC staff are planning to initiate discussions on the scope and approach to a Territory wide study of Indigenous Knowledge and Land Use Study as it relates to CNSC regulated facilities and activities. Discussions will include the specific funding and capacity needs in order for CLFN to be able to meaningfully participate and complete these important studies and research. CLFN and CNSC staff will also continue to foster and create a safe ethical space for Indigenous knowledge to be collected and shared.

In 2022, CLFN and CNSC staff continued to meet monthly and work collaboratively to make progress on a number of the agreed upon initiatives in the work plan. Through routine monthly meetings and interactions, CLFN and CNSC have developed a good working level relationship; one that has been more conducive to open and direct communications.

Topics of discussion included updates and discussions related to the BWXT NEC (Toronto and Peterborough), Port Hope Conversion Facility, and the Cameco Fuel Manufacturing licence renewal.

In 2022, CLFN and CNSC staff worked collaboratively on communication products (such as a KI Pill information sheet and pamphlet for the Cameco Fuel Manufacturing Environmental Protection Review Report) to improve how information is shared with CLFN community members.

In October 2022, CLFN hosted CNSC staff in their community for a lunch and meeting with their leadership. CLFN also shared their knowledge during a tour of the Petroglyphs Provincial Park. These activities were invaluable for building and strengthening the relationship, advancing project-specific discussions and enhancing CNSC staff cultural awareness and understanding. CNSC staff and CLFN are planning on organizing another in-person event in the CLFN community and territory in 2023.

In 2022, CLFN provided feedback through their intervention on the 2021 ROR and continue to do so through ongoing discussions. CNSC staff have made a number of improvements to reports and documentation based on the feedback, such as including land acknowledgements for each facility and creating a separate Indigenous consultation and engagement section. CNSC staff and CLFN are working together to discuss and address the common themes raised in CLFN's interventions.

CNSC staff and CLFN continue to be committed to strengthening the relationship through on-going respectful dialogue to share knowledge, information on culture, history and perspectives that help CNSC staff and CLFN learn from each other. CNSC staff will also continue to have discussions regarding areas of interest and issues or concerns related to existing CNSC-regulated nuclear activities of interest to CLFN.

O. Participant Funding Recipients for the 2022 UNSPFs Regulatory Oversight Report

Recipients
Algonquins of Pikwakanagan First Nation
Hiawatha First Nation
Nuclear Transparency Project

Further information on the CNSC's participant funding program can be found on the CNSC website.

P. Summary table of the status of issues, concerns, and requests from intervenors in the 2021 UNSPFs ROR

In direct response to the Commission's action from the 2021 RORs, CNSC staff have established an internal CNSC issues, concerns, and comments tracking table for each intervening Indigenous Nation or Community in the 2021 UNSPFs ROR to track and organize the requests concerns and comments submitted in their interventions. These tables also summarize and track CNSC's efforts to respond to and address intervenor requests concerns and comments, where feasible. In the 2021 CNL ROR hearing, the Commission noted the concerns raised by several intervenors that comments and recommendations made regarding past RORs had not been addressed directly by CNSC staff. As a result, the Commission expects to be updated on the status of CNSC staff's efforts to address and track intervenor recommendations across all RORs, including the UNSPFs ROR, moving forward. The Commission has directed CNSC staff to provide an update on whether and how comments and recommendations made by Indigenous Nations and communities in particular have been, or will be, addressed, including where there are disagreements.

The purpose of this appendix is to provide a summary of information and data from the CNSC's issues tracking tables to the Commission. The tables below provide an overview of the issues raised in interventions in relation to the previous year's ROR, and the proposed path forward to address them. Table A outlines the number of specific issues and concerns raised by each intervenor and their related themes, as well as CNSC responses and proposed path forward. Table B provides an overview of the key thematic categories raised by each intervenor and the total number of times each theme or topic was raised by all intervenors in their interventions. Tracking this thematic information will provide a baseline to help direct CNSC staff to focus their efforts in future engagements and consultations to areas that generate the most concerns. This is a new ROR initiative and will continue taking shape moving forward as CNSC staff begin tracking trends in intervention topics and track progress with Indigenous Nations and communities as well as repeat public intervenors.

Table A provides details regarding the number of specific issues and concerns raised in the interventions by Indigenous Nations and in relation to the 2021 UNSPFs ROR, the number of thematic categories the issues and concerns are grouped by, and the status of the CNSC's approach to responding to and addressing each issue, concern or request raised in the interventions to date.

CNSC staff are committed to responding to and following up with the intervenors below with regards to their interventions and working collaboratively to identify options for a path forward to address the comments, where possible. For Indigenous Nations and communities that have a ToR for long-term engagement with the CNSC, requests, concerns and comments raised in relation to the ROR have been integrated into the engagement work plan and regular meetings with each Indigenous Nation or community, including sharing the specific issues and concerns tracking table with each Indigenous Nation and community in order to verify the data and discuss a path forward for meaningfully addressing their comments.

In addition, CNSC staff have followed up with the other public intervenors, including those Indigenous Nations and communities who the CNSC does not currently have a ToR for long-term engagement with, and with recurring public intervenors in order to follow up on or set a path forward on their comments and issues.

Table A. Issues and concerns raised in interventions from the 2021 UNSPFs ROR tracking and response table

2021 UNSPFs ROR Intervenors	Number of requests/ concerns/ comments raised in 2021 ROR intervention	Requests/ concerns/ comments responded to by CNSC staff*	Notes
Kebaowek First Nation	9 (falling within 8 main subject/categories)	9	The issues, concerns and recommendations raised by Kebaowek First Nation in their intervention for the 2021 UNSPFs ROR were addressed and discussed with Kebaowek First Nation through an issues tracking table designed by CNSC staff to track the issues and regular meetings and the associated workplan in relation to the CNSC-Kebaowek First Nation arrangement for long-term engagement. Examples of the themes and issues raised include consultation and engagement, and nuclear waste and waste transportation.
Algonquins of Pikwakanagan First Nation	17 (falling within 9 main subject/categories)	17	The issues, concerns and recommendations raised by AOPFN in their intervention for the 2021 UNSPFs ROR are being addressed and discussed with AOPFN through an issues tracking table developed by CNSC staff and regular meetings and the associated workplan in relation to the CNSC-AOPFN ToR for long-term engagement. Examples of the themes, issues raised include consultation and engagement, and improvements to ROR processes and ROR content.

Curve Lake First Nation	16 (falling within 5 main subject/categories)	16	The issues, concerns and recommendations raised by Curve Lake First Nation in their intervention for the 2021 UNSPFs ROR are being addressed and discussed with Curve Lake First Nation through an issues tracking table developed by CNSC staff and regular meetings and the associated workplan in relation to the CNSC- Curve Lake First Nation ToR for long-term engagement. Examples of the themes, issues raised include environmental monitoring and CNSC regulatory oversight activities in relation to proponents.

** "Responded to" refers to the number of requests/concerns/comments that CNSC staff have provided dispositions to, responded to directly, recorded internally, or have a mechanism with which to have a specific meeting and discussions to address intervenor concerns, comments and recommendations.*

Table B provides an overview of the key thematic categories raised in the interventions in relation to the 2021 UNSPFs ROR and the number of times each theme or topic was raised in total across all interventions. The categories included in table B have been ordered from most frequently raised to least.

Table B. Key themes raised by intervenors

Requests/concerns/comments category in the intervention for the 2021 UNSPFs ROR	Number of times the topic category was raised across 2021 UNSPFs ROR interventions	Number of intervenors who raised the topic in intervention
Improvements to ROR process and ROR content (e.g., requests related to improving accessibility, providing additional information or clarification in specific sections of the report, providing information about the performance rating system and improving the format of the report)	13	3
CNSC's Consultation and Engagement activities (Indigenous and Stakeholder) (e.g., suggestions for improvements to the approach to consultation and engagement and request for meaningful responses to issues raised)	12	3

CNSC Regulatory Oversight Activities in Relation to Proponents (e.g., suggestions for strengthening regulations and engagement requirements for proponents)	5	3
Environmental Monitoring (e.g., requests for more environmental testing)	3	2
Indigenous Knowledge (e.g., requests to clarify how Indigenous Knowledge has been considered and incorporated)	3	2
Participant Funding Program (e.g., requests for more funding to support participation in regulatory activities)	1	1
Impacts on Indigenous Rights (e.g., concerns about lack of consent from Indigenous Nations and communities in the initial establishment of nuclear operations on traditional territories)	3	2
Licensee Engagement and Consultation (e.g., request for additional engagement on topics of interest)	2	2
Nuclear Waste and Waste Transportation (e.g., concern about impacts from increased amounts of waste)	3	2
CNSC's Implementation of the United Nations Declaration on the Rights of Indigenous Peoples (e.g., Requests for CNSC to fully implement UNDRIP principles)	2	2

Conclusion

CNSC staff take the issues and concerns raised by intervenors seriously and CNSC staff will continue to work with each intervenor identified in table A who has raised issues and concerns on identifying approaches to addressing the different topics areas, requests and comments raised as appropriate. Furthermore, the CNSC is committed to continuously improving the quality of data included in RORs, and the ROR reporting process. CNSC acknowledges that the 2 main themes of issues raised in the 2021 UNSPFs ROR were "improvements to the ROR process and ROR content, and CNSCs Consultation and Engagement activities", and has made it a priority to further discuss and address these issues, where feasible. As part of this commitment, CNSC staff have included appendices in all 2022 RORs with information on the issues and concerns raised by intervenors and the status of the CNSC's work to follow-up, respond to and address each intervention as appropriate, and are working towards the continued expansion and enhancement of reporting to the Commission on issues tracking and engagement efforts.

The CNSC is dedicated to continuous improvement, and actively works to identify meaningful ways and approaches for addressing the concerns, comments and recommendations made by intervenors identified in the RORs, where appropriate. In instances where issues and concerns are raised that the CNSC and the intervenor may disagree, the CNSC is open to having dialogue and working towards finding solutions and building consensus around key issues within the CNSC's mandate and authority.