Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

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ORIGINAL/ORIGINAL

CMD: 20-H2

Date signed/Signé le : 20 DECEMBER 2019

A Licence Renewal

BWXT Nuclear Energy Canada Inc.

Application to renew licence for the Toronto and Peterborough Facilities

Commission Public Hearing

Scheduled for:

March 2 to 6, 2020

Submitted by:

CNSC Staff

Un renouvellement de permis

BWXT Nuclear Energy Canada Inc.

Demande de renouvellement de permis pour les installations de Toronto et Peterborough

Audience publique de la Commission

Prévue le :

2 au 6 mars 2020

Soumis par :

Le personnel de la CCSN

e-Doc 5963958 (WORD)
e-Doc 6032464 (PDF)

Canada

Summary

This CMD presents information about the following matters of regulatory interest with respect to two requests from BWXT Nuclear Energy Canada Inc. (BWXT):

- Request to renew licence FFOL-3620.01/2020 to operate its two facilities for a period of 10 years, with authorization to conduct pelleting operations at the Peterborough facility.
- Request to accept a revised financial guarantee of approximately $48.1 million through two proposed instruments: a letter of credit for $2 million and a surety bond for approximately $46.1 million.

CNSC staff recommend that the Commission take the following actions:

- Renew the licence held by BWXT to operate its two facilities for a period of 10 years, with authorization to conduct pelleting operations at the Peterborough facility.
- Accept the revised financial guarantee of approximately $48.1 million through two proposed instruments: a letter of credit for $2 million and a surety bond for approximately $46.1 million.

The following items are attached:

- Environmental protection review report
- Proposed licence FFL-3620.00/2030
- Draft licence conditions handbook
- Current licence FFOL-3620.01/2020

Résumé

Le présent CMD contient de l'information sur les questions d'ordre réglementaire suivantes concernant deux demandes de BWXT Nuclear Energy Canada Inc. (BWXT) :

- Demande de renouvellement du permis FFOL-3620.01/2020 permettant à BWXT d'exploiter ses deux installations pour une période de 10 ans, avec l'autorisation d'effectuer des opérations de fabrication de pastilles de combustible à Peterborough.
- Demande d'acceptation d'une garantie financière révisée au montant d'environ 48,1 millions de dollars dans deux instruments proposés : une lettre de crédit de 2 millions de dollars et un cautionnement d'environ 46,1 millions de dollars.

La Commission pourrait considérer prendre les mesures suivantes :

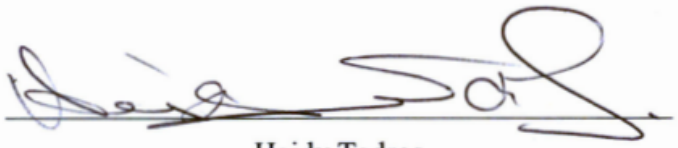
- Renouveler le permis de BWXT lui permettant d'exploiter ses deux installations pour une période de 10 ans, avec l'autorisation d'effectuer des opérations de fabrication de pastilles de combustible à Peterborough.
- Accepter la garantie financière révisée d'environ 48,1 millions de dollars dans deux instruments proposés : une lettre de crédit de 2 millions de dollars et un cautionnement d'environ 46,1 millions de dollars.

Les pièces suivantes sont jointes :

- le rapport d'examen de la protection de l'environnement
- le permis proposé FFL-3620.00/2030
- l'ébauche du manuel des conditions de permis
- le permis actuel FFOL-3620.01/2020

Signed/signé le

20 December 2019



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EXECUTIVE SUMMARY

BWXT Nuclear Energy Canada Inc. (BWXT) operates two fuel fabrication facilities located in Toronto and Peterborough, Ontario, under a single Class IB operating licence, FFOL-3620.01/2020. Both facilities supply fuel bundles for use at Ontario Power Generation's Pickering and Darlington nuclear generating stations. The Toronto facility manufactures natural and depleted uranium dioxide fuel pellets. The Peterborough facility manufactures fuel bundles using the natural and depleted uranium dioxide pellets from the Toronto facility and zircalloy tubes manufactured in house. Under the current licence, the Peterborough facility operates a fuel services business that provides reactor services, including the manufacturing and maintenance of equipment for use in nuclear power plants.

Pursuant to section 24 of the *Nuclear Safety and Control Act* (NSCA), the Canadian Nuclear Safety Commission (CNSC) issued licence FFOL-3620.01/2020 to GE-Hitachi Nuclear Energy Canada Inc. in December 2010 and subsequently transferred the licence to BWXT in December 2016. Since 2012, CNSC staff have presented the licensee's compliance performance to the Commission annually through the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilitie*s. As directed by the Commission, CNSC staff provided a mid-term review of the licence in November 2016.

In November 2018, BWXT applied to the CNSC to renew its operating licence [1]. In its application, BWXT requested a 10-year licence to continue operating the Toronto and Peterborough facilities, with authorization to conduct pelleting operations at the Peterborough facility. BWXT has not requested any changes to its operating limits for the possession (1500 Mega grams) and processing (150 Mega grams/month) of uranium at the Peterborough facility. As such, the requested change is within the currently licensed operating limits that govern the Peterborough facility's overall safety case. BWXT has not requested any changes to the Toronto facility's operations as part of this licence renewal.

CNSC staff conducted a sufficiency check to ensure that BWXT submitted all required information, and subsequently completed technical assessments of BWXT's submissions, an environmental protection review and a review of BWXT's financial guarantee. CNSC staff present the following conclusions:

1. BWXT is qualified to carry on the activities requested in its renewal application.
2. BWXT's request for authorization to conduct pelleting operations at the Peterborough facility is acceptable, as the requested activities are within this facility's current operating limits. BWXT has the required management system programs and resources in place to implement pelleting operations at the Peterborough facility. The hazards associated with the proposed activities are well characterized and controlled, and BWXT's operations would remain protective of the public and the environment.
3. In carrying on its authorized activities, BWXT has made and will continue to make adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

4. BWXT's proposed financial guarantee of approximately $48.1 million is a credible cost estimate, and the financial guarantee instruments (a letter of credit for $2 million and a surety bond for approximately $46.1 million) are acceptable.

CNSC staff recommend that the Commission take the following actions:

1. Issue a 10-year nuclear fuel facility licence to BWXT with the proposed licence conditions, and authorize the conduct of pelleting operations and the delegation of authority as set out in the CMD.
2. Accept the proposed financial guarantee of approximately $48.1 million through two proposed instruments, a letter of credit for $2 million and a surety bond for approximately $46.1 million, and direct BWXT to provide the original instruments within 90 days of the issuance of a decision on this matter.

This CMD has two parts. Part One presents a summary of CNSC staff's assessment of BWXT's licence application and past performance since 2011. Part Two provides the documentation pertaining to this hearing, including a licence change table, the proposed licence and the current licence. A draft licence conditions handbook is also included for information only. Referenced documents in this CMD are available to the public upon request.

PART ONE

This CMD is presented in two parts.

Part One includes:

1. An overview of the matter being presented;
2. Overall conclusions and recommendations;
3. General discussion pertaining to the safety and control areas that are relevant to this submission;
4. Discussion about other matters of regulatory interest; and
5. Addenda material that supports this CMD (items 1 through 4).

Part Two of this CMD provides all available information pertaining to the current and proposed licence, including:

1. Proposed licence FFL-3620.00/2030;
2. Draft licence conditions handbook; and
3. Current licence FFOL-3620.01/2020.

1. OVERVIEW

1.1 Background

BWXT Nuclear Energy Canada Inc. (BWXT) operates two Class IB nuclear facilities to manufacture nuclear reactor fuel bundles for use at Ontario Power Generation's Pickering and Darlington nuclear generating stations under a single nuclear fuel facility operating licence, FFOL-3620.01/2020 [12].

BWXT's Toronto facility is located at 1025 Lansdowne Avenue, Toronto, Ontario and produces natural and depleted uranium dioxide (UO_2) fuel pellets. BWXT's Peterborough facility is located at 1160 Monaghan Road, Peterborough, Ontario and manufactures nuclear fuel bundles using the natural and depleted UO_2 pellets manufactured at the Toronto facility and zircalloy tubes manufactured in-house. Under the current licence, the Peterborough facility also operates a fuel services business involved with the manufacturing and maintenance of equipment for use in nuclear power plants.

Licensing History

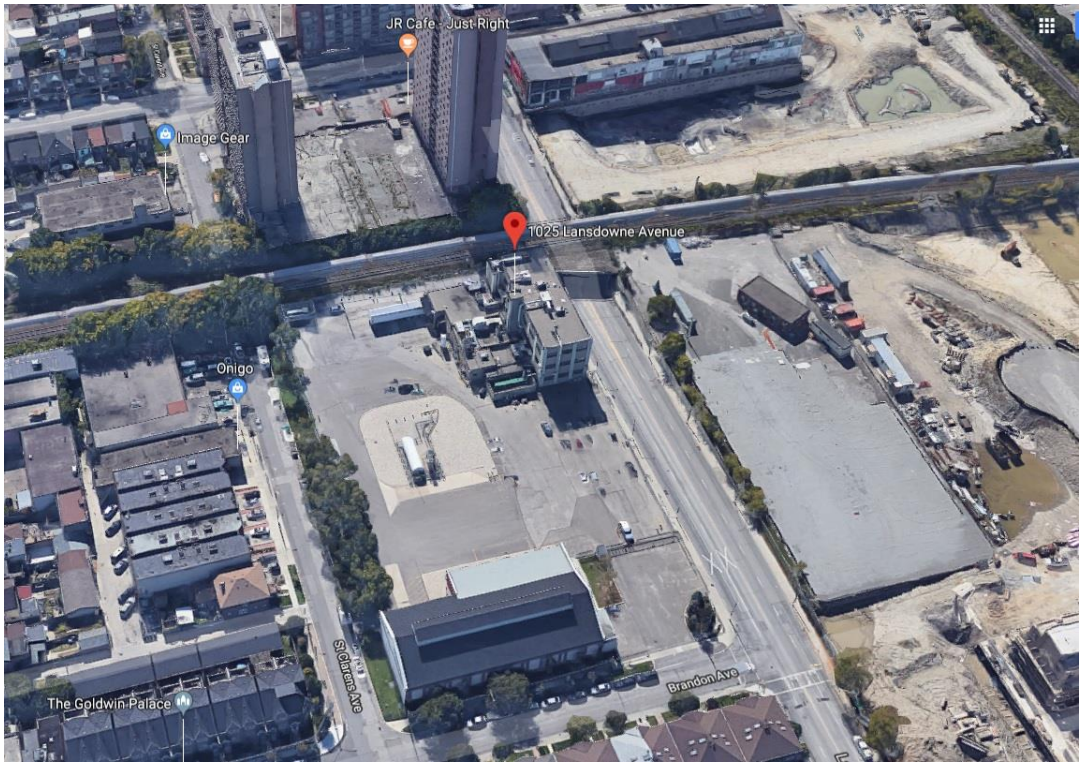
Pursuant to Section 24 of the *Nuclear Safety and Control Act* (NSCA), the Commission granted the current licence, FFOL-3620.01/2020, to GE Hitachi Nuclear Energy Canada Inc. (GEH-C) in December 2010 for a 10-year term. Prior to 2010, the Toronto and Peterborough facilities operated under separate Class IB licences. During the 2010 licence renewal, CNSC staff proposed that the Commission amalgamate the licences for the Toronto and Peterborough facilities. Both facilities operate under a single management system, which provides greater consistency for the governance of licensed activities and facilitates efficient regulatory oversight. The Commission accepted staff's recommendation and issued a single Class IB licence to GEH-C for the Toronto and Peterborough facilities [14].

In December 2016, the Commission authorized the transfer of licence FFOL-3620.01/2020 to BWXT. The details of the licence transfer are described in CMD 16-H113 [4] and the Commission's associated Record of Decision [5]. The current licence expires on December 31, 2020. There have been no amendments to the licence subsequent to its transfer to BWXT in 2016. In November 2018, BWXT submitted an application [1] requesting the renewal of its current operating licence with authorization to conduct pelleting operations at the Peterborough facility.

Toronto Facility – Location and Operations

The Toronto facility, which has been producing nuclear fuel pellets for nuclear reactors since 1965, consists of two buildings. The first building is used to conduct pellet production processes, and the second building is used to store, segregate and ship waste arising from the licensed activities. The facility is located at the intersection of DuPont Street and Lansdowne Avenue, immediately surrounded by residential homes and high-rise buildings, as shown in Figure 1.

Figure 1: Aerial view of the BWXT Toronto facility



BWXT's pellet production processes at the Toronto facility include processing natural and depleted ceramic grade UO_2 powder into solid UO_2 pellets. The facility is licensed to possess up to 700 Mega grams (Mg) of uranium. The UO_2 powder used for the manufacturing of pellets comes from Cameco Corporation's Port Hope Conversion Facility in Port Hope, Ontario. The UO_2 powder is transported by road to the Toronto facility in Type 1 industrial packages, in accordance with the *Packaging and Transportation of Nuclear Substances Regulations*.

Once received, the UO_2 powder is transferred to special containers to be mixed with a lubricating agent (zinc stearate). This mixture is then processed by pressing the UO_2 powder to form solid cylindrical pellets. The solid pellets are sintered in a high temperature furnace under a hydrogen atmosphere, and grinded to the required dimensions. Finally, the pellets are stacked, sorted and inspected for quality and contamination before being transported to the Peterborough facility in Type 1 industrial packages. The activities at the Toronto facility have remained the same throughout the current licence period with some modifications to increase automation and improve the control of air emissions.

Peterborough Facility – Location and Operations

The Peterborough facility is located in central Peterborough on Monaghan Road, surrounded by residential buildings and a public school as shown in the Figure 2.

Figure 2 – Aerial view of the BWXT Peterborough facility

The Peterborough facility has been assembling fuel bundles for Canadian CANDU reactors since 1965. The facility is licensed to possess up to 1500 Mg of uranium. The assembly operation involves inserting the UO_2 pellets manufactured at the Toronto facility into zircalloy tubes, welding end caps to each tube, and machining the ends of these tubes to form a fuel element. The fuel elements are assembled into fuel bundles by welding end plates to the fuel elements. Completed bundles are inspected for quality, packaged, and transported in approved packaging to Ontario Power Generation's Pickering and Darlington nuclear generating stations.

BWXT manufactures the zircalloy tubes in-house. This manufacturing involves sub-operations that coat the tubes with graphite. Beryllium coated spacers are welded to the tubes to facilitate the assembly of the fuel bundles.

The Peterborough facility has a reactor services business that involves designing, commissioning, servicing and repairing nuclear reactor components associated with reactor maintenance, fuel loading, and reactor inspections/testing. The activities at the Peterborough facility have remained the same throughout the current licence period with some modifications to increase automation.

The Toronto and Peterborough facilities are licensed to process natural and depleted UO_2. The risks associated with the licensed activities are mainly due to conventional industrial hazards and radiological hazards from the natural and depleted UO_2. The risk of nuclear criticality does not exist when handling or processing natural and depleted UO_2. CNSC staff have, and will continue to conduct ongoing regulatory oversight and compliance verification activities for the current licence period. In accordance with its licence, BWXT submits annual

compliance reports detailing regulatory performance each year. CNSC staff reported on BWXT's satisfactory compliance performance in December 2019 at a public Commission meeting on the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities: 2018.*

1.2 Highlights

BWXT's Licence Application Requests

In November 2018, BWXT submitted an application [1] for the renewal of its licence, with authorization to conduct pelleting operations at the Peterborough facility. The proposed pelleting operations at the Peterborough facility are within BWXT's current operating limits for the possession and processing of uranium. CNSC staff assessed all aspects of BWXT's licence renewal application for the renewal of FFOL-3620.01/2020 for a 10-year period. BWXT is requesting the following:

- To operate the Toronto facility for the production of natural and depleted uranium fuel pellets with no changes to currently authorized activities.
- To manufacture fuel bundles at the Peterborough facility.
- To produce at the Peterborough facility, natural and depleted uranium fuel pellets, an activity that BWXT is currently licensed to carry on at the Toronto facility.
    - BWXT has not requested changes to its operating limits for possession and processing of uranium for the Peterborough facility, hence the requested change is within the currently licensed operating limits that govern the overall safety of the Peterborough facility.
- To process contaminated equipment from off-site nuclear facilities at the Peterborough facility.
- To possess, process, use, transfer, package, manage and store the nuclear substances and equipment that are associated with the requested activities.
- To update its financial guarantee to $48,137,867 through two financial guarantee instruments: a $2,000,000 letter of credit for putting the facility in a safe shutdown state and a $46,137,867 surety bond for the remainder of the decommissioning costs.

CNSC Staff Assessment of BWXT's Licence Application Requests

CNSC staff assessed BWXT's renewal application with the requested authorization for pelleting operations at the Peterborough facility under subsection 24(4) of the NSCA. This assessment determined whether BWXT is qualified and capable of performing the activities to be authorized by the Commission. This assessment also determined whether BWXT, in carrying on these actions, will continue to make adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and the implementation of measures required to uphold international obligations to which Canada has agreed.

Technical Assessment

BWXT has a common management system for both facilities. Therefore, CNSC staff assessed the currently licensed activities, programs, and procedures for each Safety and Control Area (SCA) to verify that BWXT meets all regulatory requirements and expectations for this renewal.

CNSC staff also assessed BWXT's request for the authorization to conduct pelleting operations at the Peterborough facility. This activity is currently authorized at the Toronto facility. The current licence also allows for designing, commissioning, servicing and repairing nuclear reactor components, and building modifications. CNSC staff assessed the associated programs and procedures at the Peterborough facility, and found them to be safe. BWXT has not requested any changes to its operating limits for possession and processing of uranium at the Peterborough facility. Hence, CNSC staff conclude that conducting pelleting operations at the Peterborough facility will remain within the overall safety case for the Peterborough facility.

The hazards associated with the licensed activities at BWXT's two facilities are well characterized and controlled by the licensee and the licensee has consistently met the CNSC's regulatory requirements. CNSC staff compliance verification has shown that BWXT continues to mitigate any potential hazards associated with its authorized activities through effective safety and control measures, and took into consideration any changes to hazards that would be associated with the conduct of pelleting operations at the Peterborough facility, (e.g. uranium in powdered form). BWXT continues to demonstrate its ability to carry on its licensed activities safely and in a manner that protects human health and the environment.

CNSC staff assessed the BWXT application and the potential effects of conducting pelleting operations at the Peterborough facility. CNSC staff conclude that BWXT is qualified and capable of performing the licensed activities it has requested at Toronto and Peterborough as per subsection 24(4) of the NSCA. The summary of results from CNSC staff's technical assessments is provided in Section 3 of this CMD.

Environmental Protection Review

As part of the assessments of this renewal application, CNSC staff also considered the potential impact of BWXT's request on human health and the environment. BWXT has submitted a revised ERA [3] that considers the potential impacts of conducting pelleting operations on the public and the environment at the Peterborough facility. The ERA considers the potential impacts of current operations at Peterborough in conjunction with the addition of the pelleting operations and conservatively assessed impacts to the public and the environment.

The two facilities process natural and depleted UO_2 and the primary risks associated with the licensed activities are mainly due to conventional industrial hazards and radiological hazards of the UO_2. UO_2 releases from the facility to the environment are controlled in accordance with the conditions of the operating licence. These releases typically amount to less than 0.1 kilograms of uranium to

the atmosphere and less than 1.0 kilograms of uranium in liquid effluents released annually. Releases of non-nuclear hazardous substances, like beryllium, from the facility into the environment is controlled, in accordance with the requirements prescribed in the Certificates of Approval for air emissions issued by the Ministry of the Environment, Conservation and Parks (MECP) and CNSC regulatory requirements. CNSC staff required BWXT to establish licence limits for uranium emissions (as detailed in sec 3.9.2) based on operating experience and public feedback. The licensee has submitted updated licence release limits for uranium as part of this renewal. CNSC staff have assessed and accepted the release limits for the Toronto and Peterborough, as they are protective of the health of the public and the environment.

CNSC staff reviewed the ERA and determined that the information submitted by the licensee is sufficient for CNSC staff to conduct an Environmental Protection Review (EPR) under the NSCA for this licence renewal. The EPR concluded that uranium releases from the Peterborough facility might increase to be similar to uranium releases at the Toronto facility, due to the addition of pelleting operations. CNSC staff concluded that the risks attributable to the radiological and non-radiological releases from the Peterborough facility are very low and no adverse effects to human health and non-human biota are expected. BWXT has made and will continue to make adequate provision for the protection of the environment and the health of persons during the conduct of the proposed activities. The results of the EPR are included in Appendix D.

Facility Specific Licence Conditions

CNSC staff's technical assessments identified that the licensee must incorporate additional environmental monitoring (that is currently present only at the Toronto facility) prior to implementing any pelleting operations at the Peterborough facility. If authorized, CNSC staff will confirm that BWXT's implementation of pelleting operations at the Peterborough facility are within the operating limits and overall safety case authorized by its licence. To ensure that these requirements are met and that CNSC staff maintain adequate regulatory oversight of these changes, the following facility-specific licence conditions are proposed for the Commission's consideration and decision:

- Licence condition 15.1 requires that the licensee shall submit and implement an updated environmental monitoring program at the Peterborough facility prior to the commencement of production of fuel pellets as described in paragraph (iv) of Part IV of this licence; and
- Licence condition 15.2 requires that the licensee shall submit a commissioning report related to production of fuel pellets as described in paragraph (iv) of Part IV of this licence, that is acceptable to the Commission, or a person authorized by the Commission.

Section 4.8 of this CMD lists the delegation of authority associated with licence condition 15.2. The draft licence conditions handbook (LCH) associated with the proposed licence provides compliance verification criteria to determine whether the conditions listed in the licence are met. The LCH provides details associated

with each licence condition, such as applicable standards or regulatory documents; regulatory interpretation; compliance verification criteria; version-controlled documents; licensee's written notification documents; and guidance. This structure allows BWXT to make incremental changes, update its documentation, and implement the conduct of pelleting operations in a phased manner, as requested in its application. CNSC staff update the Commission of any changes to the LCH as well as any facility-specific changes and program documentation updates through the Regulatory Oversight Reports presented to the Commission at public proceedings.

Licence Period

CNSC has a standardized licence and LCH framework, which provides for effective regulatory oversight of this facility. This includes the required periodic review of the authorized safety case every 5 years, revisions to the ERA and safety analysis, and continuous improvement through prior notification of updated regulatory requirements. BWXT is required by its licence to report on its compliance performance annually through its Annual Compliance Reports including changes to its operations. CNSC staff verify compliance through desktop reviews, inspections and event reviews. In addition, CNSC staff report compliance performance of BWXT to the Commission in public meetings, through the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities* that ensures adequate oversight of the licensee.

Therefore, CNSC staff recommend that the Commission accept BWXT's request for a 10-year licence with the authorization to conduct pelleting operations at the Peterborough facility, with the proposed facility specific licence conditions 15.1 and 15.2. CNSC staff also conclude that a single Class IB licence remains a valid and efficient instrument for regulatory oversight. Both facilities operate under a single management system that provides greater consistency for governance of the licensed activity. A single licence reduces administrative burden and facilitates efficient regulatory oversight.

Financial Guarantee

As part of the licence renewal, BWXT proposed a new financial guarantee of $48,137,867 through two financial instruments: a $2,000,000 letter of credit for putting the facility in a safe shutdown state and a $46,137,867 surety bond for the remainder of the decommissioning costs. CNSC staff conclude that the cost estimate is credible and the financial guarantee instruments are acceptable.

1.3 Overall Conclusions

CNSC staff have concluded the following with respect to paragraphs 24(4)(*a*) and (*b*) of the NSCA:

1. BWXT is qualified to carry on the activities requested in the renewal application;

2. BWXT's request for authorization to conduct pelleting operations at the Peterborough facility is acceptable, as the requested activities are within this facility's current operating limits;
3. In carrying on the authorized activities, BWXT has made and will continue to make adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and measures required to implement international obligations to which Canada has agreed; and
4. The proposed approximately $48.1 million financial guarantee, through two proposed instruments; a letter of credit in the amount for $2-million and a surety bond in the amount for approximately $46.1-million surety bond, is a credible cost estimate, and the financial guarantee instruments are acceptable.

1.4 Overall Recommendations

Based on above conclusions, CNSC staff recommend that the Commission:

1. Issue a 10-year nuclear fuel facility licence to BWXT with the proposed licence conditions and authorize the conduct of pelleting operations and the delegation of authority as set out in the CMD; and
2. Accept the proposed financial guarantee of $48,137,867, through two financial instruments, a letter of credit for $2,000,000 and a surety bond for $46,137,867, and direct BWXT to provide the original instruments within 90 days of the issuance of a decision on this matter.

2. MATTERS FOR CONSIDERATION

2.1 Environmental Assessment

CNSC staff reviewed BWXT's application for licence renewal in the contexts of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), as this was the Federal legislation that applied at the time the application was received, i.e. prior to the coming into force of the *Impact Assessment Act of Canada, 2019* (IAAC, 2019). CNSC staff determined that CEAA 2012 does not apply because the activities proposed in the application are not captured in its associated *Regulations Designating Physical Activities*. It should be noted that the proposed activities are also not contained in the *Physical Activities Regulations* of the IAAC, 2019. CNSC staff conduct Environmental Protection Reviews for all licence applications with potential environmental interactions, in accordance with its mandate under the NSCA. The EPR found in Appendix D of this CMD provides a background of past environmental protection reviews and assessments for the BWXT Toronto and Peterborough facilities.

In 2007, GEH-C (predecessor proponent to BWXT) proposed to manufacture Low Enriched Uranium fuel bundles at the Peterborough facility. Under the *Canadian Environmental Assessment Act* 1992 (CEAA 1992), it was determined that a screening type Environmental Assessment (EA) would be required for this project. After the Commission's consideration of the screening report, an EA decision was made, stating that upon taking into account the implementation of mitigation measures and public input, the proposed project would not likely cause significant adverse environmental effects. Following the positive EA decision, the project proponent withdrew the application and canceled the project.

For this licence renewal application, CNSC staff conducted an EPR under the NSCA and associated regulations. The EPR included an assessment of the licence application request for renewal of currently licenced activities along with the authorization for conduct of pelleting operations in Peterborough. Appendix D contains the results of this assessment.

Based on the EPR, CNSC staff have concluded that BWXT, in carrying on the activities that the proposed licence will authorize, has made and will continue to make adequate provision for the protection of the environment and the health of persons.

2.2 Relevant Safety and Control Areas

CNSC staff's regulatory oversight is performed in accordance with a standard set of SCAs. SCAs are a group of technical topics in specific areas of regulatory interest used across all CNSC regulated facilities and activities to assess, verify, and report on licensee regulatory requirements and performance.

For the purposes of this CMD, the technical topics and specific areas of regulatory interest under each SCA were limited to those reviewed and assessed as part of CNSC's overall regulatory oversight of BWXT as a uranium processing facility

and based on BWXT's licence application. BWXT has fully implemented programs for pelleting operations, and hence CNSC staff considered them in the context of the request to conduct pelleting operations at Peterborough facility. Appendix C of this CMD contains a list of all specific areas applicable to BWXT under each SCA. SCAs are subdivided into specific areas that define their key components. Further details are provided in Appendix C.

In addition, CNSC staff assess the licensee's ongoing performance in each applicable SCA according to the following ratings: FS – fully satisfactory, SA-satisfactory, BE – below expectations and UA – unacceptable.

Table 1 provides the overall rating level associated with each SCA as assessed by staff for BWXT's application. This CMD provides an evaluation of the licensee's programs and processes in place, proposed amendment and compliance performance of the BWXT over the current licence period.

Table 1: SCAs relevant to the BWXT licence renewal and CNSC staff's overall rating for the licence period 2011 – 2019

Functional Area	Safety and Control Area	Overall Rating Level[1]
Management	Management System	SA
	Human Performance Management	SA
	Operating Performance	SA
Facility and Equipment	Safety Analysis	SA
	Physical Design	SA
	Fitness for Service	SA
Core Control Processes	Radiation Protection	SA
	Conventional Health and Safety	SA
	Environmental Protection	SA
	Emergency Management and Fire Protection	SA
	Waste Management	SA
	Security	SA
	Safeguards and Non-Proliferation	SA
	Packaging and Transport	SA

CNSC staff assessment of BWXT's application in each of the SCAs in Table 1 is discussed in section 3 of this CMD.

[1] This represents an overall rating level for the current licence period (from January 2011 up to December 2019).

2.3 Other Matters of Regulatory Interest

Table 2 identifies other matters of regulatory interest that are relevant to this CMD.

Table 2: Other matters relevant to this CMD

OTHER MATTERS OF REGULATORY INTEREST	
Area	**Relevant to this CMD?**
Indigenous Consultation and Engagement	Yes
Other Consultation	Yes
Cost Recovery	Yes
Financial Guarantees	Yes
Improvement Plans and Significant Future Activities	Yes
Licensee's Public Information Program	Yes
Nuclear Liability Insurance	No

"Other matters" of regulatory interest are discussed in detail in section 4 of this CMD.

2.4 Regulatory and Technical Basis

BWXT's licence application entails the operations of a uranium fuel fabrication facility and is classified as a Class IB facility under the NSCA. The regulatory and technical basis for the matters discussed in this CMD come directly from the NSCA and associated regulations, which include *Class I Nuclear Facilities Regulations* (CINFR), *General Nuclear Safety and Control Regulations* (GNSCR) as well as other regulatory requirements associated with the NSCA.

Further information regarding the regulatory and technical basis for the matters under consideration in this CMD is provided in Appendix B of this CMD.

3. GENERAL ASSESSMENT OF SCAS

This section contains CNSC staff's assessments of BWXT, based on a comprehensive review of BWXT's application and supporting documents that outline the safety and control measures in place through its programs, resources, and BWXT's past compliance performance. All SCAs are applicable for this assessment and the relevant applicable specific areas are provided in Appendix C of this CMD.

3.1 Management System

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

The following specific areas that comprise this SCA are discussed as relevant to the licence renewal application including:

- Management system and organization;
- Performance assessment, improvement and management review;
- Change management and records management; and
- Safety culture.

3.1.1 Trends

The following table indicates the overall rating trends for the Management System over the current licence period:

MANAGEMENT SYSTEM				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
The Management System SCA at BWXT met applicable CNSC requirements, and received a "satisfactory" rating during all years of the licence period.				

3.1.2 Discussion

BWXT is required to implement and maintain a management system in compliance with CSA standard N286-12, *Management System Requirements for Nuclear Facilities* (CSA N286-12). In January 2015, CNSC staff notified the licensee (GEH-C) of the requirement to comply with CSA N286-12. The licensee completed a detailed gap analysis and fully implemented CSA N286-12 in August 2016. CNSC staff assessed BWXT's management system including policies and procedures, organizational responsibilities, workflow, use of experience and record keeping practices. The management system contains procedures and work

instructions, which contain details related to work planning and control, work verification, non-conformance processes, and personnel training on all aspects of licensed activities. CNSC staff confirm that the documents submitted as part of licence renewal under this SCA meet the requirements as outlined in CSA N286-12.

In 2016 and 2018, CNSC staff completed desktop reviews of BWXT's compliance to CSA N286-12 and conducted three onsite meetings promoting safety culture and human performance. CNSC staff conducted three planned compliance inspections in 2014, 2017 and 2019. CNSC staff also conducted one compliance inspection in October 2017 in response to a specific event on beryllium occupational exposure exceedance as reported in an Event Initial Report (EIR) to the Commission in CMD 17-M53. All enforcement actions associated with these inspections are closed to the CNSC's satisfaction. Based on the technical assessment of BWXT's licence application, supporting documents and the licensee's compliance performance, CNSC staff conclude that BWXT's management system is acceptable and compliant with regulatory requirements.

3.1.3 Summary

The following section presents a summary of CNSC staff's assessment of BWXT's past performance, challenges and proposed improvements.

3.1.3.1 Past performance

Management System and Organization

CNSC staff determined that BWXT has a management system that meets the requirements of CSA N286-12. CNSC staff regularly assess the compliance of BWXT documents and programs through desktop reviews, planned compliance verification inspections and reactive compliance verification activities.

Onsite verification activities conducted in 2014 and 2017 included areas of maintenance, calibration, problem identification/resolution, change and design control, document and records control, procurement (specifically for purchasing and vendor qualification), the internal audit program, management self-assessments, and annual reviews. All inspection findings were of low risk significance.

In October 2017, CNSC staff conducted a compliance inspection in response to a beryllium occupational exposure limit exceedance event reported as an EIR to the Commission in CMD 17-M53. The inspection included compliance verification of the following management system areas: purchasing, item receiving inspections, and worker training. During a planned follow up inspection in March 2019, CNSC staff verified BWXT's procedures for dealing with purchase orders, supplier acceptability, receiving inspections, vendor performance, storage, and handling. CNSC staff are satisfied with how BWXT addressed all inspection findings.

CNSC staff assessed BWXT's organizational structure. Personnel roles and responsibilities are well defined and documented, and in compliance with section

15 of the GNSCR. CNSC staff's compliance verification conducted during the current licence period identified no issues concerning the licensee's organizational structure and individual responsibilities of positions with oversight on licensed activities.

Performance Assessment, Improvements and Management Review

BWXT's management team conducts periodic management reviews, to analyze the previous year's performance when compared with its plans, assess compliance with standards, assess the effectiveness of BWXT's management system and consider any trends. CNSC staff assessed these management reviews as part of compliance verification activities and found them acceptable.

BWXT also conducts internal assessments to confirm conformance and effectiveness of its licensed programs and associated documentation. BWXT completes internal assessments on a three-year frequency and tracks resulting actions in a database that it maintains. Over the current licence period, CNSC staff performed one inspection on BWXT's internal assessment program and confirmed that the program met requirements.

Change Management and Records Management

BWXT's design and change control procedure ensures that changes are tested, reviewed and approved before implementation and that changes are controlled and carried out according to its change control documentation. CNSC staff verified that these procedures cover any changes to facility layout, equipment, processes including updating of procedures and provide a documented approach to the assessment of risk and hazards related to any change.

BWXT's records management process encompasses the control of documents, which includes the development, validation, approval of documents and the tracking of associated changes. CNSC staff confirmed that documents and procedures are available for use in the location of the activity, and BWXT removes outdated or expired documents in a timely manner. Over the current licence period, BWXT's change management program and records management program met CNSC requirements.

Safety Culture

BWXT's management system documents state its commitment to fostering a healthy safety and security culture including expectations for work habits and the conduct of operations, including a sense of urgency in resolving safety issues, having a questioning attitude, and the use of human performance tools.

In June 2019, BWXT notified CNSC staff that it was in full compliance of the requirements set out in REGDOC 2.1.2, *Safety Culture.* CNSC staff have participated in three onsite meetings at both facilities during the last licencing period to discuss safety culture, human performance and CNSC regulatory framework improvements in this specific area. CNSC staff use onsite meetings for information exchange between the licensee and the CNSC to better explain

regulatory requirements and understand licensee implementation of programs. In the most recent onsite meeting, CNSC staff observed that BWXT uses electronic billboards outside the production area to promote recent operating experience (OPEX) and recognize "nice catches" made by workers. CNSC noted that this is a good practice to improve safety awareness.

3.1.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this SCA, through regulatory oversight activities, with focus on compliance with CSA N286-12 and REGDOC 2.1.2, *Safety Culture*.

3.1.3.3 Proposed Improvements

BWXT is in the process of improving its design change control and vendor management programs as part of identified improvements. CNSC staff will monitor the implementation of these improvements over the next licence period.

3.1.4 Conclusion

CNSC staff conclude that BWXT continues to maintain and implement a documented management system in accordance with CNSC regulatory requirements.

3.1.5 Recommendation

One standardized licence condition is included in the proposed licence for this SCA. Licence condition 1.1 requires BWXT to implement and maintain a management system. Compliance verification criteria for this licence condition are included in the draft LCH.

3.2 Human Performance Management

Human Performance Management covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry on their duties.

This CMD covers the following specific areas of Human Performance Management:

- Personnel training;
- Human performance program; and
- Fitness for duty.

Historically, the regulatory focus for BWXT in this SCA covered the specific area of Personnel Training only. However, as part of this licence renewal, CNSC staff completed a technical assessment covering other specific areas in the Human Performance Management SCA such as Human Performance Program and fitness for duty along with the specific area of Personnel Training.

3.2.1 Trends

The following table indicates the overall rating trends for the Human Performance Management over the current licence period:

TRENDS FOR HUMAN PERFORMANCE MANAGEMENT				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT has comprehensive policies, processes and procedures that support worker performance. The overall rating for the specific area Personnel Training is "satisfactory".				

3.2.2 Discussion

The regulatory requirements in the Human Performance Management SCA are obtained from the GNSCR paragraphs 12(1)(a) and (b) and the CINFR section 6 and 14.

Personnel Training

REGDOC-2.2.2, *Personnel Training* sets out CNSC requirements and guidance for licensees regarding the development and implementation of a systematic approach to training (SAT) based training system. A training system ensures that workers through the process of performance-based assessment and program evaluation have attained required knowledge, skills and safety-related attributes. The SAT is a proven training methodology which enables training to be analyzed, defined, designed, developed, implemented, evaluated, documented and managed in order meet and react quickly to changes in operational and organizational requirements.

CNSC staff verified that BWXT's training system processes and procedures demonstrated compliance with REGDOC-2.2.2. CNSC staff are satisfied with BWXT's progress regarding the implementation of its SAT based training system and complies with the published regulatory requirements.

Human Performance Program

BWXT's management system supports worker performance by encouraging workers to identify human performance improvements, assessing human factors in safety events and near misses, identifying ergonomics issues in the workplace, and ensuring workers are fit for duty when they report to work. BWXT has also developed operator procedures to support human actions credited in their safety analysis reports.

BWXT's conduct of operations establishes clear standards for communications, housekeeping, and cleanliness at its Toronto and Peterborough facilities and emphasizes their impact on plant safety. For example, shift turnovers include

cross-shift communication of work progress and peer checks prior to equipment restart, following maintenance or extended shutdowns.

Fitness for Duty

BWXT has a program to maintain an alcohol and drug free workplace. The program sets clear expectations for supervisors and employees including prevention, reporting, assessment and testing, rehabilitation, aftercare, and confidentiality.

3.2.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.2.3.1 Past Performance

Personnel Training

CNSC staff conducted several document reviews and compliance verification activities including onsite inspections in 2014 and 2017 focused on Personnel Training.

In January 2014, CNSC staff conducted a Type II focused training inspection to evaluate training programs for both the Toronto and Peterborough facilities. At the time, the licensee was implementing a SAT based program. CNSC staff concluded during a progress update meeting that the licensee was committed to addressing the identified gaps that resulted in ten recommendations to align the licensees program to CNSC regulatory requirements and staff were satisfied with the licensee progress. The licensee implemented the ten recommendations and submitted an updated program document for CNSC staff review, which was acceptable.

In May 2017, CNSC staff conducted an inspection focused on BWXT's compliance with REGDOC 2.2.2, *Personnel Training* and its implementation of the SAT based training programs. CNSC staff identified minor deficiencies of low risk significance. BWXT addressed the deficiencies in accordance with a corrective action plan, which was accepted by CNSC staff.

CNSC staff continue to monitor the training programs at BWXT through desktop reviews of annual compliance reports and ongoing regulatory oversight activities. Based on the above assessment, CNSC staff conclude that BWXT's performance in the specific area of Personnel Training has been satisfactory.

3.2.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this area through regulatory oversight activities including onsite inspections and desktop reviews of BWXT's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.2.3.3 Proposed Improvements

BWXT is required to ensure that new and revised training documentation related to any changes in operations are covered under its SAT based training system. CNSC staff continue to monitor the implementation of the updated training documentation over the next licence period.

3.2.4 Conclusion

CNSC staff conclude that BWXT has implemented and maintained effective programs for the specific area Personnel Training and have programs in place under the SCA Human Performance Management.

3.2.5 Recommendation

One standardized licence condition is included in the proposed licence for this SCA. Licence condition 2.1 requires BWXT to implement and maintain a training program. Compliance verification criteria for this licence condition are included in the draft LCH. REGDOC 2.2.2, *Personnel Training* is included as Compliance Verification Criteria (CVC) in the draft LCH.

3.3 Operating Performance

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

The specific areas that comprise this SCA at the BWXT site include:

- Conduct of licensed activity;
- Procedures; and
- Reporting and trending.

3.3.1 Trends

The following table indicates the overall rating trends for the Operating Performance over the current licence period:

TRENDS FOR OPERATING PERFORMANCE				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
The licensee has maintained an operating program in accordance with CNSC requirements over this licence period. BWXT continues to be rated SA in this SCA.				

3.3.2 Discussion

BWXT is required through its regulations to ensure policies, programs, methods and procedures are in place for the safe operation and maintenance of its licensed

nuclear facilities. The occupational and industrial safety aspects of BWXT's operations are regulated under the *Canada Labor Code* and its associated *Canada Occupational Health and Safety Regulations*. REGDOC 3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills*, is also a governing document dealing with reporting.

Verification of the licensee's compliance with the requirements of this SCA are included as part of CNSC's compliance activities ranging from desktop reviews of annual reports, reviews of event reports, related corrective actions and on-site inspections. CNSC staff confirmed through these compliance verification activities that BWXT has implemented and maintained an effective operating program in order to ensure licensed activities are conducted safely and in compliance with regulatory requirements.

3.3.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.3.3.1 Past Performance

Conduct of Licensed Activity

The conduct of licensed activity at the licenced facilities is prescribed by BWXT's management system through operating procedures and work instructions. These governing documents describe how each facility is operated safely, as reflected by the accepted safety analysis and ensure that the impact from licensed activities to the public and the environment remains low.

CNSC staff confirm through compliance activities that safety assessments for all licensed activities are completed using BWXT's documented management evaluation process for operational reviews. This includes non-routine work or deviations with extensive use of Job Hazard Analysis (JHA) and prescribed checklists to assess impact and taking appropriate mitigation measures to ensure safe operations. Issuance of hot work permits is also a standard practice for work involving fire hazards.

BWXT also has a defined OPEX program with regular management reviews and documentation of events, incidents and near misses with regular review of the facility safety analysis to ensure maintenance of defence in depth.

Since 2011, CNSC staff carried out a number of compliance verification activities on BWXT's operations, including onsite inspections, review of management system documents, annual compliance reports and event reports. CNSC staff's on-site verification activities in this SCA focus on adherence to published procedures by licensee personnel and the proper use of JHAs and fire permits for temporary work and working with fire hazards. This also includes verification of proper authorization and adequate management oversight.

In accordance with the current LCH, BWXT continues to provide CNSC staff with information regarding the operating performance of both facilities in annual compliance reports submitted to CNSC staff. CNSC staff evaluated the

information provided in these reports to ensure BWXT remains in compliance with regulatory requirements.

Procedures

BWXT's management system consists of high-level program documents supported by lower level procedures and work instructions. BWXT maintains a comprehensive suite of procedures across all programs at both facilities.

CNSC staff review procedural-level documents as part of ongoing compliance verification activities to ensure proper maintenance of procedures to reflect actual practices as well as procedural adherence by BWXT personnel. Subsequent to the licence transfer in December 2016, CNSC staff verified that there were no changes to the licensee's operational organization, licensed activities or management system documents other than the change of ownership. If the Commission grants authorization to BWXT's request to add pelleting operations at the Peterborough facility, any updating of procedures to account for the addition of pelleting operations is required to be under the proposed facility specific licence condition 15.2.

Based on these reviews, CNSC staff conclude that BWXT adequately maintains its procedures and there were no significant changes to operating procedures with the potential to affect the safe operation of both facilities.

Reporting and Trending

In 2019, CNSC staff notified BWXT to implement REGDOC 3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills* upon notification in 2019. Prior to the implementation of REGDOC3.1.2, detailed requirements for reporting unplanned situations or events were included in BWXT's LCH and were based on section 29 of the GNSCR. BWXT has complied with the requirements for submission of these reports throughout the licence period. Table 3 lists the number of events reported to the CNSC by the licensee over the licence period.

Table 3: Number of reported events by BWXT (2010-2019)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total	0	1	1	2	3	4	5	3	3

CNSC staff review all reported events to identify if there are any regulatory concerns and report significant events to the Commission at public meetings of the Commission. Reported events include conventional injuries, small spills, fire sprinkler malfunctions and action level exceedances.

One event arising out of the conduct of licensed activity was the beryllium occupational exposure limit exceedances reported in August 2017 by BWXT. This reportable event was the result of the discovery that BWXT personnel were using incorrect respirator cartridges/filters in the powered air purifying respirators while performing non-routine work at the Peterborough facility. CNSC staff

reported this event to the Commission in October 2017 as an EIR in CMD 17-M53 and in the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2017* [7]. BWXT submitted a final event report that included the root causes and the corrective actions taken to prevent a recurrence of this type of event.

CNSC staff issued a request to BWXT under subsection 12(2) of the GNSCR to review the licensee's operations for improvements taken, or to be taken, to minimize beryllium air concentrations in the affected work areas in the future. CNSC staff also conducted an unplanned, reactive inspection in response to the event, which confirmed that BWXT has responded to the event as per requirements and, the root causes and associated corrective actions taken were appropriate.

In accordance with REGDOC 3.1.2, BWXT continues to provide information on its operating performance by submitting annual compliance reports CNSC staff reviewed these reports and are satisfied with BWXT's performance during this licence period.

3.3.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this SCA through regulatory oversight activities including on-site inspections and desktop reviews of relevant program documentation. CNSC staff will focus on procedural adherence and maintenance of the operating limits and safety envelope with compliance verification focus on the safe conduct of licensed activities.

3.3.3.3 Proposed Improvements

If the Commission grants approval for BWXT to conduct pelleting operations at the Peterborough facility, CNSC staff expect BWXT to focus its efforts in ensuring safe operations while implementing new equipment and processes and update procedures related to pelleting operations under a facility specific licence condition 15.2.

3.3.4 Conclusion

Based on CNSC staff assessments of BWXT's application, supporting documents and past performance, CNSC staff conclude that BWXT continues to implement and maintain an effective operating program for both facilities in accordance with regulatory requirements.

3.3.5 Recommendation

Two licence conditions are included in the proposed licence for this SCA. Licence condition 3.1 requires BWXT to implement and maintain an operating program, which includes a set of operating limits. Licence condition 3.2 requires BWXT to implement and maintain a program for reporting to the Commission or a person authorized by the Commission. Compliance verification criteria for both licence conditions are included in the draft LCH.

3.4 Safety Analysis

The Safety Analysis SCA covers the 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 preventative measures and strategies in reducing the effects of such hazards.

This CMD covers the following specific areas of Safety Analysis:

- Deterministic safety analysis; and
- Hazard analysis.

3.4.1 Trends

The following table indicates the overall rating trends for the Safety Analysis SCA over the past five years:

TRENDS FOR SAFETY ANALYSIS				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT's Safety Analysis Reports (SAR) effectively identify facility hazards and Structures, Systems and Components (SSC) relied upon for safety to control or mitigate these hazards. BWXT's Fire Hazard Analysis reports demonstrate compliance with the requirements of the National Fire Protection Association, NFPA-801 *Fire Protection for Facilities Handling Radioactive Materials* (NFPA-801), the *National Building Code of Canada* (NBCC) and the *National Fire Code of Canada* (NFCC).				

3.4.2 Discussion

The *Class I Nuclear Facilities Regulations* (CINFR), section 5(f) requires that an application to construct a Class I nuclear facility include a preliminary SAR and Section 6(c) requires that an application for a licence to operate include a final SAR. A safety analysis must include an analysis of the postulated sequences and consequences of conditions that could arise from initiating events and associated hazards.

The BWXT licence renewal application included updated SARs for the Toronto and the Peterborough facilities. These provide descriptions of the facility and building layouts, processes, operating limits, and scenarios based on hazards and postulated initiating events. In addition, the SARs provide an assessment of potential consequences and demonstrate the safety case through defence in depth.

CNSC staff evaluated the information provided in the SARs for both the Toronto and the Peterborough facilities and determined that BWXT has adequately

assessed the hazards associated with licensed activities and has demonstrated an adequate level of protection over a broad range of operating conditions.

BWXT has not requested any changes to its operating limits at the Peterborough facility. Modifications and operations associated with the implementation of the pelleting operations at the Peterborough facility must remain within the current operating limits. CNSC staff included a facility specific licence condition 15.2, detailed in section 3.5.5, that requires BWXT to submit a commissioning report related to the production of fuel pellets. Prior to beginning operations, the commissioning report must be reviewed and accepted by the Commission, or a person authorized by the Commission. CNSC staff will verify that the pelleting activity remains within the licensing basis and will update the Commission on this condition through the *Regulatory Oversight Report on Uranium and Nuclear Substance Processing Facilities*.

CNSC staff conclude based on its review of the submitted application and supporting documents that the radiological and non-radiological risks associated with BWXT's operations at the Toronto and Peterborough facilities are very low. BWXT remains in compliance with regulatory requirements for the Safety Analysis SCA.

3.4.3 Summary

The following subsections provide a summary of the licensee's past performance, challenges and proposed improvements.

3.4.3.1 Past Performance

BWXT has conducted several related assessments to ensure the safety of its operations as part of the development of safety analysis. These studies have included earthquake risk analysis, assessment for aircraft impacts, flooding risk analysis and potential transport related events due to proximity of the railway line near its Toronto facility. Aspects of these accident conditions that have potentially severe consequences have also been analyzed using probabilistic approaches to demonstrate safety in very unlikely scenarios. Storage and handling of liquid hydrogen, combustible liquids, fire, handling of uranium compounds (natural and depleted) and transportation are the top identified areas analyzed to ensure preventive and mitigation measures are in place for adequate protection of the environment and the health and safety of persons due to the operation of these facilities.

During the current licence period, CNSC staff conducted one compliance inspection for this SCA, to verify the implementation of the safety analysis program, the maintenance of barriers listed as SSCs relied upon for safety, and the validation of operating limits and conditions. There were no inspection findings associated with this SCA.

BWXT maintains an acceptable Fire Hazard Analysis (FHA) for both the Toronto and Peterborough facilities. The FHA reports demonstrate compliance with the requirements of the NFPA-801, the NBCC and the NFCC. CNSC staff require

that BWXT review its SAR at a minimum of every five years for accuracy and validity. This document was revised in 2019 as part of the licence application. CNSC staff's assessment of the BWXT's SAR concluded that it meets regulatory requirements.

3.4.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this area through regulatory oversight activities including on-site inspections and desktop reviews of BWXT compliance reporting and revisions to relevant program documentation pertaining to this SCA

3.4.3.3 Proposed Improvements

CNSC staff are in the process of developing REGDOC-2.4.4: *Safety Analysis for Class 1B facilities*. Further improvements to the safety analysis program and safety analysis is expected once this regulatory document is published and implemented with clear requirements for conduct of safety analysis, periodic reviews, clear regulatory expectations on SAR documentation and application of the graded approach .

3.4.4 Conclusion

BWXT has a process in place to identify and evaluate potential high risk safety hazards associated with the operation of these facilities. CNSC staff assessed BWXT's documentation and analyses under the Safety Analysis SCA and found that it meets regulatory requirements.

3.4.5 Recommendation

Standardized licence condition 4.1 is included in the proposed licence for the SCA Safety Analysis. This licence condition requires BWXT to implement and maintain a safety analysis program as per prevailing guidance, which currently is IAEA document *SSR-4: Safety of Nuclear Fuel Cycle Facilities*. Compliance verification criteria for this licence condition are included in the draft LCH.

3.5 Physical Design

This SCA relates to activities that impact on the ability of systems, components and structures to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

The specific areas that comprise this SCA at BWXT facilities include:

- Design governance;
- Site characterization;
- Facility design;
- Structure design; and
- System design.

3.5.1 Trends

The following table indicates the overall rating trends for the Physical Design SCA over the current licence period:

TRENDS FOR PHYSICAL DESIGN				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
The licensee has maintained a physical design program in accordance with CNSC requirements over this licence period. BWXT continues to be rated SA in this SCA.				

3.5.2 Discussion

BWXT is required to implement and maintain a physical design program such that the design of facilities and changes made to its facilities are managed and within the licence basis. The requirements under this SCA are provided by national codes and standards including the NBCC and NFCC for structural design and the *Technical Standards and Safety Act, 2000* as well as CSA standard B51-09*: Boiler, pressure vessel and pressure piping code* (B51-09) for systems and components including pressure retaining component design. BWXT is also required to maintain an authorized inspection agency agreement, which currently is the Technical Standards and Safety Authority (TSSA) for appropriate third party review and certification of its pressure retaining components.

CNSC staff verified BWXT's compliance with regulatory requirements and that all operational changes are assessed, managed and documented through implementing and maintaining a change control program and related procedures under its management system. BWXT is required to notify the CNSC of any major equipment changes that involve commissioning activities under its change control program with justification that these changes are within its licence basis. In addition, BWXT is required to notify the CNSC of significant changes to its fire protection program and submit an accompanying third party assessment of the potential impact of these changes.

If the Commission accepts BWXT's request to authorize the conduct of pelleting operations at the Peterborough facility, the changes are expected to be related to modifying its facility, equipment and SSCs to include the additional operations within its overall safety envelope. Pelleting operations are currently licensed at the Toronto facility and thus within BWXT's current capabilities. However, implementing pelleting at the Peterborough facility requires CNSC staff's review to ensure all safety and control measures are in place before operations begin. CNSC staff will also need to confirm compliance with the licence basis. Because of this, CNSC staff included licence condition 15.2 to ensure adequate regulatory oversight of this change.

CNSC staff confirm that BWXT has implemented and maintained an adequate physical design program with appropriate change control. CNSC staff conclude that BWXT's physical design measures meet regulatory requirements and when design changes are made, the licensee has adequate resources in place to ensure safety and manage them within the licence basis.

3.5.3 Summary

The following sections provide a summary of the licensee's past performance, challenges and proposed improvements.

3.5.3.1 Past Performance

Modifications to the licensed facility including changes or alterations to facility, equipment or process are managed under BWXT's design change control to ensure compliance with the licence, LCH, applicable national codes, and CSA standards.

BWXT carried out Code Compliance Reviews (CCR), in accordance with applicable requirements. Prior to the implementation of any proposed modification with the potential to impact protection from fire, BWXT submits the proposed modification for third-party review having specific expertise with such reviews for a CCR. CNSC staff review the results of these third party CCRs as part of regular compliance oversight. Throughout the licence term, CNSC staff have reviewed several third party CCRs submitted by BWXT and are satisfied with the depth and scope of these reviews that ensure safety. BWXT continues to implement and maintain its fire protection program in accordance with the current licence and associated compliance verification criteria as outlined in the LCH.

During the current licence period, BWXT maintained an authorized inspection agency agreement with the TSSA. The TSSA provides design registration services, quality system accreditation and authorized inspection services in accordance with the requirements of B51-09. BWXT pressure boundary systems are operated and controlled in compliance with B51-09.

Through document reviews and on-site inspections, CNSC staff monitor BWXT's implementation of physical design SCA requirements in accordance with CNSC regulatory requirements.

Based on above capabilities and past performance of carrying on its pelleting operations at the Toronto facility, CNSC staff are satisfied with the licensee's overall performance in this SCA, and confirm that the licensee is capable to carry on the proposed activities including the conduct of pelleting operations safely at the Peterborough facility.

3.5.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation, and the third party reviews of design modifications to the facilities.

3.5.3.3 Proposed Improvements

BWXT has a strong physical design program with significant capabilities in engineering design, project execution, commissioning of equipment and change control. No improvements within this SCA are proposed.

3.5.4 Conclusion

Based on CNSC staff assessments of BWXT's application, supporting documents and past performance, CNSC staff conclude that BWXT continues to implement and maintain programs for pressure boundary and facility design in accordance with regulatory requirements.

3.5.5 Recommendation

Two standardized licence conditions are included in the proposed licence for this SCA. Licence condition 15.1 requires BWXT to implement and maintain a design program. Licence condition 15.2 requires BWXT to implement and maintain a pressure boundary program. CVC for both licence conditions are included in the draft LCH.

CNSC staff recommend the inclusion of a facility-specific licence condition for this SCA to ensure adequate oversight of the changes related to pelleting operations. Licence condition 15.2 requires that the licensee shall submit a commissioning report related to production of fuel pellets as described in paragraph (iv) of Part IV of this licence, that is acceptable to the Commission, or a person authorized by the Commission.

3.6 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.

The specific areas that comprise this SCA include:

- Equipment fitness for service / equipment performance;
- Maintenance;
- Aging management; and
- Periodic inspection and testing.

3.6.1 Trends

The following table indicates the overall rating trends for the Fitness for Service over the current licence period:

TRENDS FOR FITNESS FOR SERVICE				
OVERALL COMPLIANCE RATINGS				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
The licensee has maintained a Fitness for Service program in accordance with CNSC requirements over this licence period. BWXT continues to be rated SA in this SCA.				

3.6.2 Discussion

BWXT is required to implement and maintain a fitness for service program to cover activities that affect the physical condition of systems, components and structures to ensure that they remain effective over time. Specific aspects of CSA N286-12 are also applicable for this SCA.

BWXT's management system documents detail its preventative maintenance, aging management, periodic inspection and testing requirements for equipment. BWXT maintains dedicated enterprise wide resource management software "maintenance connections" as well as a Critical to Safety (CTS) program dedicated to handle all identified critical to safety equipment and ensure adequate documentation that demonstrates fitness for service as per regulatory requirements.

CNSC staff confirm that BWXT has a fitness for service program in place to ensure fitness of all machinery equipment, radiation measuring and monitoring equipment and emergency response systems. The program is supported by detailed procedures on preventative maintenance, measuring and testing of equipment and new equipment validation. CNSC staff conclude based on its assessment of BWXT's governing documents for the conduct of maintenance, and on-site verification activities, that BWXT's fitness for service program meets regulatory requirements.

3.6.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.6.3.1 Past Performance

The CNSC requires BWXT through its regulations to have processes in place to maintain all equipment as well as SSCs. Scheduled preventative maintenance and periodic inspections are automatically scheduled as well any associated corrective

maintenance from the periodic inspections are handled through the maintenance connections software. The performance of the maintenance program and periodic inspections are monitored, through key performance indicators that are regularly reviewed at the management operational review meetings.

BWXT has policies and procedures in place to assess risk and plan appropriate maintenance of all equipment required in carrying on its licensed activities. BWXT has also a critical to safety (CTS) program to ensure the safety of workers, protection of the environment, and regulatory compliance is maintained appropriately. BWXT has three distinct groups of CTS items: equipment and infrastructure identified as barriers in the facility SAR, respiratory Personal Protective Equipment (PPE) and instrumentation generating data to demonstrate regulatory compliance.

During the current licence period, CNSC staff verified through compliance activities that BWXT continues to implement its fitness for service program through preventive maintenance, measurement and testing of equipment and the validation of new equipment. CNSC staff conducted one focused inspection of this SCA in February 2016, and several desktop reviews. CNSC staff also verified during several on-site general inspections that in-service inspections of safety related structures are carried out by BWXT (as per its management programs), safety related equipment is maintained in good working order, and components requiring calibration are tested at the required frequency. As part of the follow-up to the beryllium exposure event discussed in section 3.3, CNSC staff conducted a reactive inspection specific to BWXT's CTS program and determined that BWXT's program is adequate.

Based on CNSC inspection results and reviews, CNSC staff conclude that BWXT has met and will continue to meet the regulatory requirements related to this SCA.

3.6.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this SCA through regulatory oversight activities including on-site inspections and desktop reviews of relevant program documentation.

3.6.3.3 Proposed Improvements

The current programs at BWXT for this SCA is considered adequate and no improvements within this SCA are proposed.

3.6.4 Conclusion

There are no challenges to with BWXT's implementation of this SCA. Based on CNSC staff assessments of BWXT's application, supporting documents and past performance, CNSC staff conclude that BWXT continues to implement and maintain effective fitness for service programs in accordance with regulatory requirements.

3.6.5 Recommendation

One standardized licence condition is included in the proposed licence for this SCA. Licence condition 6.1 requires BWXT to implement and maintain a fitness

for service program. Compliance verification criteria for this licence condition are included in the draft LCH.

3.7 Radiation Protection

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

The specific areas that comprise the Radiation Protection SCA include:

- Application of ALARA;
- Worker dose control;
- Radiation protection program performance;
- Radiological hazard control; and
- Estimated dose to the public.

3.7.1 Trends

The following table indicates the overall rating for the RP SCA over the current licence period:

RADIATION PROTECTION				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT has implemented and maintained an effective RP program as required by the *Radiation Protection Regulations*. No worker or member of the public received a radiation dose in excess of regulatory limits as a result of the licensed activities conducted at BWXT during the current licence period.				

3.7.2 Discussion

The RPR require licensees to establish an RP program, through the implementation of a number of controls, including management control over work practices, personnel qualification and training, control of occupational and public exposures to radiation, and planning for unusual situations. The RPR also prescribe dose limits for workers and members of the public.

BWXT has implemented and continues to maintain a RP program [8] that ensures contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. A detailed assessment by specific areas is provided below in section 3.7.3.

Overall, based on the review of BWXT's application, supporting documents and compliance verification activities, CNSC staff evaluated the most recent calendar

year (2018) as "Satisfactory". This assessment is based upon a detailed review of BWXT's annual compliance report, a technical review of the licensee's RP program submitted with its application, and on-site inspections conducted at the two licensed facilities. CNSC staff assessed BWXT as qualified to conduct the activities proposed in its licence application under section 24 of the NSCA.

3.7.3 Summary

The following subsection presents a summary of the licensee's past performance, challenges and proposed improvements.

3.7.3.1 Past Performance

Application of ALARA

This specific area reviews BWXT's efforts towards maintaining radiation doses to persons as low as reasonably achievable (ALARA), social and economic factors taken into account. BWXT's commitment to the ALARA principle has been demonstrated through the RP program implemented at both the Toronto and Peterborough facilities, which was developed in line with the CNSC Regulatory Guide G-129 Revision 1, *Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"*.

As required by the *Radiation Protection Regulations* (RPR), BWXT implements RP measures to keep radiation exposures and doses to persons ALARA, taking into account social and economic factors. Annually, BWXT establishes RP Program goals and initiatives for worker dose reductions through their ALARA Committee. The Committee also meets quarterly at a minimum, to discuss dose and internal audit results, as well as employees' RP-related concerns. BWXT uses a combination of action levels, staff training and qualification, and dose management tools (work planning and management oversight) to ensure radiation doses to workers are controlled and kept ALARA. Engineered and administrative controls such as shielding, automated fuel bundle assembly, as well as mandatory use of PPE in designated respirator-use areas (applicable at the Toronto facility) are also used to ensure protection of workers.

CNSC staff are satisfied with BWXT's efforts in applying the ALARA principle to keep doses to persons ALARA over the current licence period.

Worker Dose Control

This specific area reviews BWXT's efforts to control occupational exposures to radiation and to report on radiation doses received by workers. During the current licence period, no worker at BWXT received an effective or equivalent dose that exceeded the corresponding regulatory dose limits pursuant to RPR.

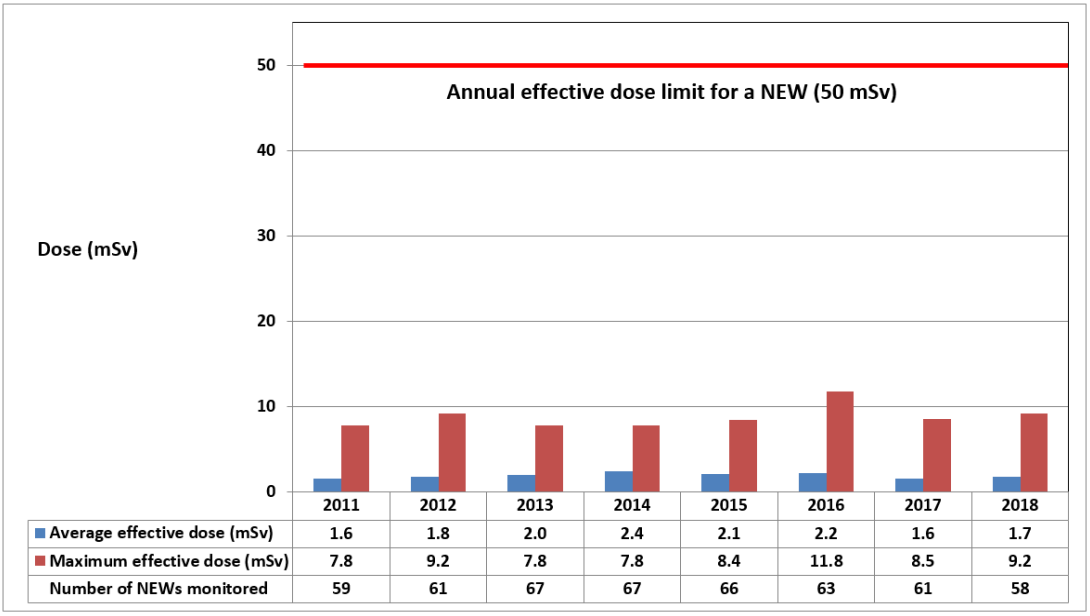
Radiological exposures associated with work activities at BWXT are due to alpha, beta and gamma radiation emitted by natural uranium. Exposures to workers can result from beta or gamma radiation sources outside the body, or alpha, beta or gamma radiation taken into the body, as the result of inhalation, ingestion or absorption of uranium through the skin. The primary hazard is radiation dose to

the lungs from UO_2, which is an insoluble form of uranium. BWXT's dosimetry program includes assessment and monitoring techniques that account for both external and internal exposures and corresponding dose assignment. The total effective dose assignment for workers are the sum of the external whole body dose as measured by a dosimeter, and the internal dose determined by calculations as described below.

External dosimetry at BWXT is implemented using thermo luminescent dosimeters sensitive to gamma and beta radiation, which are used to measure external whole body and skin doses. Monitoring of exposures to the skin of the hands is performed using ring-type personal dosimeters depending on the work being performed. BWXT uses a CNSC licensed dosimetry service provider for external dosimetry.

Internal dosimetry at the Toronto facility is calculated by measuring the concentration of uranium in air at several designated workstations along with the time spent by workers performing licensed activities. Air samplers (filter paper connected to a pump with a known airflow) are located as close as possible to the source term, and in the workers' breathing zones and are used to collect uranium in air continuously and are measured every 24 hours. The internal doses are calculated and assigned to a given worker by multiplying the measured uranium in air concentrations with the worker's occupancy time and a dose conversion factor.

Figure 3: Annual Effective Doses to NEWs at BWXT Toronto, 2011 – 2018



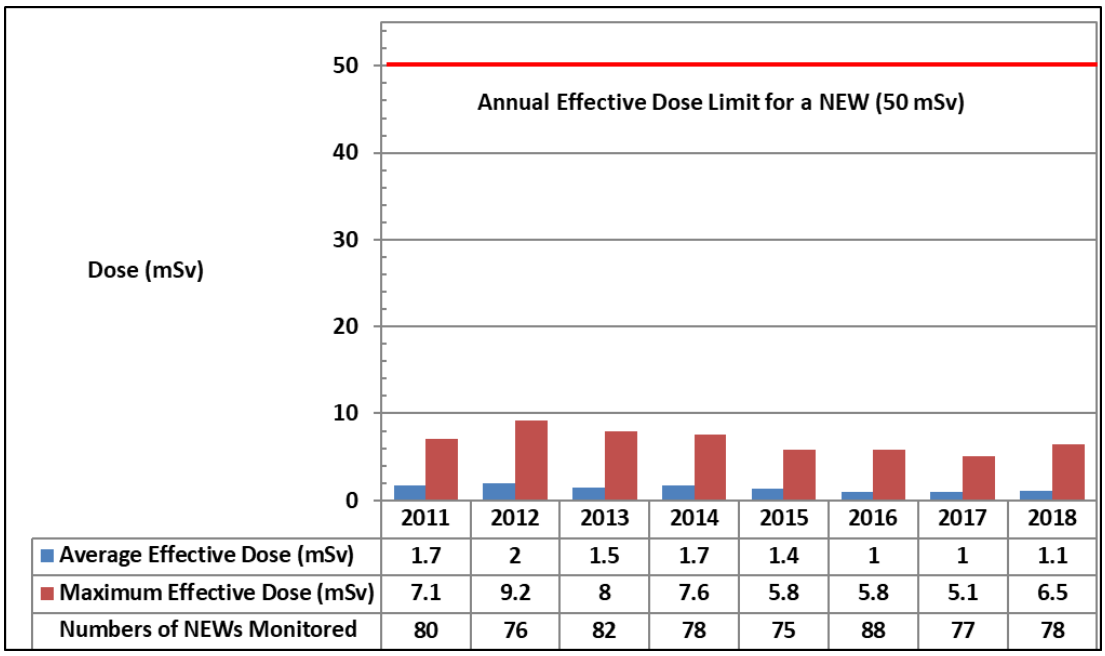
	2011	2012	2013	2014	2015	2016	2017	2018
Average effective dose (mSv)	1.6	1.8	2.0	2.4	2.1	2.2	1.6	1.7
Maximum effective dose (mSv)	7.8	9.2	7.8	7.8	8.4	11.8	8.5	9.2
Number of NEWs monitored	59	61	67	67	66	63	61	58

All workers that are involved in the processing and handling of UO_2 are Nuclear Energy Workers (NEWs) and covered under the licensee's RP program. At both the Toronto and Peterborough facilities, non-NEWs (i.e. administrative personnel) and contractors (non-NEWs) are not directly monitored. Doses are estimated based on facility radiological conditions and occupancy factors. This ensures that

radiation doses are controlled well below the CNSC regulatory dose limit for the public (1 mSv/year) for a person who is not a NEW. Figure 3 above presents the annual effective doses of all NEWs monitored at BWXT Toronto over the current licence period (2011 to 2018) and Figure 4 presents the annual effective doses of all NEWs monitored at BWXT Peterborough over the current licence period (2011 to 2018).

Overall, the maximum and average doses for all components of the effective dose to persons have been stable during the current licence period.

Figure 4: Annual Effective Doses to NEWs at BWXT Peterborough, 2011 – 2018



	2011	2012	2013	2014	2015	2016	2017	2018
Average Effective Dose (mSv)	1.7	2	1.5	1.7	1.4	1	1	1.1
Maximum Effective Dose (mSv)	7.1	9.2	8	7.6	5.8	5.8	5.1	6.5
Numbers of NEWs Monitored	80	76	82	78	75	88	77	78

Radiation Protection Program Performance

This specific area reviews the effectiveness of BWXT's RP program in protecting the health and safety of persons, including performance against objectives, goals and targets, and continuous improvement initiatives.

CNSC staff compliance verification activities of the RP SCA over the current licence period included inspections, and desktop reviews of quarterly and annual compliance reports. CNSC staff conducted focused RP inspections at BWXT in 2011, 2013, 2015, 2016, and 2019. CNSC staff's assessment of BWXT's RP program performance identified minor deficiencies and several opportunities for improvement.

The primary area of improvement was a result of CNSC's, November 2015, RP inspection, in which CNSC staff discovered that the licensee was making an internal dose calculation error. This error occurred because the licensee's internal dosimetry calculations were performed and recorded manually in a database. This database was verified by CNSC staff as acceptable during the 2013 inspection. However, in 2015, BWXT implemented a software program for calculating

internal dose. During its 2015 inspection, CNSC staff verified the formula that was being used by BWXT to calculate internal doses to workers at the Toronto facility, and found that the program was not applying the accepted formula in the CNSC-approved RP program. In February 2016, BWXT submitted updated internal dose values for personnel at the Toronto facility. CNSC staff accepted BWXT's corrective action plan and verified the calculations as acceptable.

In April 2016, CNSC staff analyzed the doses reported in BWXT's annual compliance report, and found discrepancies remained within the software program used to calculate internal doses to workers. BWXT performed an evaluation of their internal dose calculation system, which uncovered rounding errors due to the method by which doses were summed. When the revised doses submitted to the CNSC were reviewed, CNSC staff decided to conduct a reactive inspection to verify every aspect of the internal dose assessment and assignment process. CNSC staff selected BWXT Toronto employees at random and manually calculated their internal dose, through a four step process, and found the results to be comparable to the outputs of the newly revised BWXT software program. CNSC staff concluded that BWXT had taken all appropriate actions to mitigate the errors and discrepancies in their internal dose assessment and assignment process.

As a result of CNSC actions, BWXT implemented several improvements to its RP program and adequately addressed all enforcement action items raised during inspections over the current licence period.

Radiological Action Levels

Licensees are required to establish action levels for radiological exposures as part of their RP programs. If an action level is reached, it triggers the licensee to notify the CNSC and, if applicable, take action to restore the effectiveness of the program. The BWXT RP program includes urinalysis and facility contamination monitoring.

In 2012, there was one action level exceedance reported for the Toronto facility. A worker exceeded the 350 mSv extremity dose action level with an extremity dose of 357 mSv. This represents 71 percent of the regulatory annual equivalent dose limit of 500 mSv. The licensee performed an investigation and implemented corrective actions by improving the scrap material handling process, to keep worker extremity exposures are kept ALARA. In addition, the Toronto facility implemented a control level set well below its action level for extremity exposures, acting as an early detection mechanism. CNSC staff were satisfied with the licensee's corrective actions.

In 2013, there was one action level exceedance reported for the licensee's Toronto facility, pertaining to a worker's biweekly urinalysis result of 13.5 µg of U/L (micrograms of uranium per liter of urine), which was above the action level of 10 µg U/L. An investigation into the incident was conducted and corrective actions were implemented. The corrective actions included modifications to existing policies and work instructions, as well as improved training with respect to

respirator cleaning and storage. CNSC staff deemed the corrective actions taken by the licensee to be acceptable.

In 2014, there was one action level exceedance reported for the Peterborough facility, pertaining to a quarterly whole body licensed dosimetry measurement of 6.24 mSv, which was above the action level of 4 mSv per quarter. However, once the investigation into the incident concluded, it was determined that the action level was not exceeded and that the majority of the dose was non-personal due to improper storage of the dosimeter in an area of elevated dose rate instead of the designated badge rack. CNSC staff approved a dose change to the worker's official dose of record in the National Dose Registry from 6.24 mSv to 0.9 mSv.

In 2016, there was one action level exceedance at the Toronto facility, pertaining to a biweekly urinalysis result of 13 µg/L, which exceeded the 10 µg/L action level. BWXT provided the CNSC with an investigation report and identified six corrective actions. These included the documentation and implementation of the expectation for workers to provide urine samples at the start of shifts to reduce potential for sample contamination, and formalizing routine swipe testing of respirators. BWXT determined that the likely cause for the elevated urinalysis result was due to a contaminated sample but did not rule out exposure due to ingestion. CNSC staff calculated the committed effective dose that would result from ingestion to be approximately 0.2 mSv, which represents a very small fraction of the annual dose limit for a NEW.

Radiation Protection Program Improvements

As a result of CNSC's compliance verification activities and as part of its continual improvement activities, BWXT revised its RP program documents during the current licence period.

Several RP related improvements were implemented to strengthen BWXT's RP program. These included routine updates to RP work instructions, the development of a non-NEW dose control program, a full review of the internal dose assignment program at the Toronto facility, the updating of deviation acceptance criteria of workstation airflows (which are used to calculate internal dose) at the Toronto facility, and, the development of criteria at both facilities for providing dosimeters to NEWs from other nuclear sites.

CNSC staff assessed BWXT's RP program and determined that the program adequately meets the regulatory requirements.

Radiological Hazard Control

This specific area presents CNSC staff's assessment of BWXT's efforts to control and monitor radiological hazards established to prevent unnecessary radioactive releases and radiation exposures.

Radiation contamination controls established at BWXT control and minimize the spread of radioactive contamination. Methods of contamination control include the use of a radiation zone control program and monitoring using surface contamination swipes to confirm the effectiveness of the program. Throughout the

current licencing period, the number of swipe locations and results above BWXT's internal control levels has remained relatively constant, and no adverse trends were identified in monitoring results at the BWXT facilities.

Overall, CNSC staff are satisfied that radiological hazards have been adequately controlled at BWXT during the current licence period.

Estimated Dose to the Public

This section provides a discussion of the estimated radiation doses received by the public from BWXT facilities. Both the Toronto and Peterborough facilities have very little annual releases of any radioactive material into the environment. Both facilities monitor for the presence of gamma radiation above natural background by environmental dosimeters placed at the plant boundaries. The Toronto facility also has receiving environment air samplers to measure releases from the facility. Since the inception of this monitoring program, all the measured doses at the Peterborough plant boundary have been below detectable limits. The 2011-2018 annual doses to the critical receptor (public) surrounding the Toronto facility are shown in Table 4. The public dose is well below the CNSC regulatory dose limit for a member of the public of 1 mSv/year.

Table 4: Public dose to a critical receptor at BWXT-Toronto

Annual public doses to a critical receptor (mSv)							
2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
0.0006	0.0011	0.0006	0.0055	0.0101	0.0007	0.0175	0.0004

3.7.3.2 Regulatory Focus

CNSC staff will continue to monitor BWXT's performance for the RP SCA through onsite inspections and ongoing assessments of annual compliance reporting and revisions to BWXT's written notification documentation.

3.7.3.3 Proposed Improvements

There are no major changes anticipated in the near future for the RP SCA. If the Commission approves the licence renewal with the amendment to conduct the pelleting operations to Peterborough, CNSC staff will review the licensee submissions under the proposed facility specific Licence Condition 15.2 to confirm the monitoring program and its effectiveness.

3.7.4 Conclusion

CNSC staff assessed BWXT's RP program and processes and found them to be acceptable. CNSC staff are satisfied that BWXT's has applied the ALARA principle to keep doses to persons ALARA over the current licence period. CNSC staff conclude that BWXT's overall performance for this SCA is satisfactory and that BWXT is qualified to carry on the authorized activities, as requested in the licence application for this SCA.

3.7.5 Recommendation

One standardized licence condition is included in the proposed licence for the RP SCA. Licence condition 7.1 requires BWXT to implement and maintain a RP program, which includes a set of action levels. As part of this licence condition, BWXT is required to notify the Commission within seven days of becoming aware that an action level has been exceeded. Compliance verification criteria for this licence condition are provided in the draft LCH.

3.8 Conventional Health and Safety

The Conventional Health and Safety SCA relates to the implementation of a program to manage workplace safety hazards and to protect workers.

The specific areas that comprise this SCA include:

- Performance;
- Practices; and
- Awareness.

3.8.1 Trends

The following table indicates the overall rating trends for the Conventional Health and Safety SCA over the current licence period:

TRENDS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
The licensee has maintained a conventional health and safety program that meets the requirements of the NSCA and is in accordance with CNSC requirements over this licence period. BWXT continues to be rated SA in this SCA.				

3.8.2 Discussion

BWXT is obligated under the NSCA and its associated regulations to have policies, programs, methods and procedures in place for the safe operation and maintenance of its facilities. In addition to the NSCA and its associated regulations, BWXT's activities must comply with the *Canada Labour Code*, and the associated *Canada Occupational Health and Safety Regulations*. BWXT's occupational health and safety program applies to all work performed by BWXT employees and contractors.

CNSC inspectors routinely verify BWXT's conventional health and safety program at both facilities, to observe workers' compliance with requirements related to workplace safety, proper use of PPE, use of signage and barriers along with the general housekeeping of the facility. All general inspections by CNSC staff during the current licence period included walkdowns of the facilities.

Based on the above, CNSC staff conclude that BWXT's Conventional Health and Safety SCA met all applicable regulatory requirements and CNSC expectations.

3.8.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.8.3.1 Past Performance

Practices

BWXT has implemented several improvements to its Conventional Health and Safety program. At the Peterborough facility, improvements included introducing a single Environmental Health and Safety permit system for improved hazard assessment, a standard methodology for chemical sweeps and, updated training for overhead cranes, fall arrest, fuel shop hazard awareness, and the creation of a critical to safety and quality list. At the Toronto facility, improvements were made to the emergency response respirator training programs, and to operator training.

BWXT continues to maintain three committees under its Conventional health and safety program: the Health and Safety Policy Committee, the Workplace Safety Committee, and the Ergonomics Committee.

Due to the activities conducted at BWXT, chemical hazards and associated safety are of particular concern. BWXT has established Occupational Exposure Limits (OEL) for exposure to hazardous substances within the facility.

A potential chemical hazard related to the Peterborough facility operation is worker exposure to beryllium. Engineered controls (room ventilation), safe work procedures, protective clothing and the use of full-face respirators as PPE control this hazard. To ensure worker safety, the room where the operations takes place is monitored through area monitors and personal air monitors. CNSC staff verify through compliance activities that the above procedures and controls are in place and ensure worker safety for routine work in the facility.

For non-routine work, or high-risk activities, such as cleaning, maintenance and spillage handling, when airborne beryllium levels are expected to be above the occupational exposure level, work is performed under a work permit system. This includes the identification of hazards, appropriate training and the use of PPE like Powered Air Purifying Respirators with cartridges / filters specific for the type of hazard present.

CNSC staff are satisfied with the BWXT's past performance in the Conventional Health and Safety SCA and that BWXT continues to meet regulatory expectations.

Awareness

CNSC staff confirm that BWXT has an Environmental Health and Safety program that promotes conventional health and safety through the provision of information, training, instructions, and supervision.

CNSC staff observed BWXT's use of electronic billboards outside the production area to promote safety awareness and operating experience by recognizing "nice catches" made by workers. CNSC noted that this is a good practice to improve safety awareness. CNSC staff review the minutes of BWXT's Workplace Safety Committee, which meets monthly as required by the *Canada Labour Code*.

The BWXT Environmental Health and Safety program clearly outlines the roles and responsibilities of BWXT management and employees. Management is responsible to review and approve safety rules and procedures and establish health and safety performance goals. Employees are responsible for using all safety devices provided and reporting any environmental, health or safety concerns to their supervisor or the environmental health and safety management staff.

BWXT delivers safety-related training courses to its employees and contractors. These courses encompass the safety areas of general health and safety knowledge, radiation protection, fire protection, regulatory requirements and job/task-specific safety training related to hot work, beryllium safety, lock out/tag-out, and the use of a Workplace Hazardous Materials Information System, which provides information on the safe use of hazardous materials. CNSC staff are satisfied with BWXT's promotion of health and safety awareness.

Performance

BWXT uses several key performance indicators to assess performance of the licensed facilities. Some of the indicators include first aid, medical consultations, near misses, number of workplace inspections and safety issues reported.

The key performance indicators typically reported to the Commission for conventional health and safety are the number of lost-time injuries (LTI) that occur per year, LTI severity and LTI frequency. A LTI is defined as an injury that takes place at work, and results in the worker being unable to return to work and carry on their duties for a period of time. The LTI frequency and LTI severity are both based on 100 full time workers (100 FTE = 200,000 hours worked). Lost time injury statistics for the BWXT's facilities in Toronto and Peterborough are outlined in Table 5 and Table 6 respectively.

Table 5 – Lost-time injury statistics, BWXT Toronto, 2010 to 2019

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lost-time injuries[1]	0	1.00	0	1.00	0	0	0	0	0
Severity rate[2]	0	16.00	0	3.55	0	0	0	0	0
Frequency rate[3]	0	2.00	0	1.77	0	0	0	0	0

1 An injury that takes place at work and results in the worker being unable to return to work for a period of time.
2 The accident severity rate measures the total number of days lost to injury for every 200,000 person-hours worked at the site. Severity = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.
3 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 6 – Lost-time injury statistics, BWXT Peterborough, 2010 to 2019

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lost-time injuries[1]	0	0	0	0	0	0	0	0	0
Severity rate[2]	0	0	0	0	0	0	0	0	0
Frequency rate[3]	0	0	0	0	0	0	0	0	0

1 An injury that takes place at work and results in the worker being unable to return to work for a period of time.
2 The accident severity rate measures the total number of days lost to injury for every 200,000 person-hours worked at the site. Severity = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.
3 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.

One significant event reported during this licence period was a beryllium occupational exposure limit exceedances reported in August 2017 by BWXT. CNSC staff reported this event to the Commission in October 2017 as an Event Initial Report (EIR) in CMD 17-M53 and in the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2017* [7]. Additional details can be found in section 3.3 in this CMD.

CNSC staff are satisfied that BWXT's implementation of its conventional health and safety program during the current licence period is acceptable and CNSC staff conclude that BWXT's overall performance for this SCA is satisfactory and that BWXT is qualified to carry on its activities, as requested in the licence application for this SCA.

3.8.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation.

3.8.3.3 Proposed Improvements

No improvements to this SCA are proposed.

3.8.4 Conclusion

Based on CNSC staff assessments of BWXT's application, supporting documents and past performance, CNSC staff conclude that BWXT continues to implement and maintain an effective conventional health and safety program in accordance with regulatory requirements and CNSC expectations.

3.8.5 Recommendation

One standardized licence condition is included in the proposed licence for this SCA. Licence condition 8.1 requires BWXT to implement and maintain a conventional health and safety program. Compliance verification criteria for this licence condition are included in the draft LCH.

3.9 Environmental Protection

The Environmental Protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.

This CMD covers the following specific areas of the Environmental Protection SCA:

- Effluent and emissions control (releases);
- Environmental management system (EMS);
- Assessment and monitoring;
- Protection of the public; and
- Environmental risk assessment (ERA).

3.9.1 Trends

The following table indicates the overall rating trends for the Environmental Protection over the current licence period:

ENVIRONMENTAL PROTECTION				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
FS	SA	SA	SA	SA

Comments

BWXT has developed, implemented and maintained an effective environmental protection program at the Peterborough and Toronto facilities that protects the environment and the public in accordance with CNSC regulatory requirements.

During the current licence period, releases to the environment were well below the release limits specified in the CNSC licence. CNSC staff monitor BWXT's implementation of the environmental protection program through compliance verification activities.

BWXT's environmental protection program is in compliance with the requirements of CSA standard N288.4-10, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, CSA standard N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, and CSA standard N288.6, *Environmental risk assessments at Class I nuclear facilities and Uranium mines and mills*.

3.9.2 Discussion

CNSC regulations require that every licensee takes all reasonable precautions to protect the environment and control the release of nuclear and hazardous substances into the environment. To do this, BWXT is required to establish a program to control releases of nuclear and hazardous substances and to assess the effects of these releases on the environment. BWXT is also required to have an environmental protection policy and maintain implementing procedures. Listed below are the environmental protection regulatory documents and standards that BWXT must implement under its licence for the proposed licence period:

- REGDOC-2.9.1 (2017), *Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.1*;
- CSA N288.1 (2014), *Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities*;
- CSA N288.4-10 (2010), *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*;
- CSA N288.5-11(2011), *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*;

- CSA N288.6-12 (2012), *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills*; and
- CSA N288.8-17 (2017), *Establishing and implementing action levels for releases to the environment from nuclear facilities*.

BWXT is required to abide by all provincial and federal requirements for the handling of nuclear and other hazardous substances. Releases of hazardous substances from the facilities to the environment is controlled by BWXT in accordance with CNSC regulatory requirements as well as requirements prescribed in the Environmental Compliance Approvals issued by the MECP.

As part of the licence renewal application, BWXT has proposed concentration based release limits [10] at identified release points at the Toronto and Peterborough facilities. The release limits are based on uranium and beryllium discharges to water and air. The release limits were derived by calculating Exposure Based Release Limits (EBRLs) and technology based performance targets for uranium and beryllium discharges to water.

Technology-based performance targets for uranium and beryllium discharges to water were established and incorporated as objectives into BWXT's Environmental Management System (EMS) to demonstrate continuous improvement and pollution prevention. The targets were established by assessing the treatment systems and control measures in place to control releases of nuclear and hazardous substances to the environment.

For releases to water, BWXT calculated EBRLs by deriving the release limit based on the Canadian Council of Ministers of the Environment (CCME) – Protection of Aquatic Life Guidelines, the annual flows released by the Toronto and Peterborough municipal Waste Water Treatment Plants (WWTP), and the average annual treated water discharged from the Toronto and Peterborough facilities, respectively. Additionally, BWXT established EBRLs for releases to water from the Peterborough facility to support pelleting operations at the Peterborough facility.

For releases to air, BWXT harmonized with the provincial air quality standards under Ontario Regulation 419/05 *Air Pollution – Local Air Quality* and calculated EBRLs by deriving release limits that apply at the stack, based on meeting the applicable air quality standards at the Point-of-Impingement (POI).

CNSC staff have assessed and accepted the release limits for the Toronto and Peterborough facilities listed in Table 7 and Table 8, as they are protective of the health of the public and the environment.

BWXT has also established action levels that are lower than the facilities' release limits. These action levels ensure that release limits will not be exceeded and, if reached, provide early indication of a potential loss of control of the environmental protection program.

Table 7: Exposure based release limits – Toronto

Parameter	Medium	Licence release limit (annual average)
Uranium	Water	1 g/L (weekly composite)
	Air – Furnace Exhaust 1	437 μg/m^3
	Air – Furnace Exhaust 2/4	55 μg/m^3
	Air – Furnace Exhaust 5/6	52 μg/m^3
	Air- Rotoclone	65 μg/m^3
	Air – 6H68	47 μg/m^3
	Air – 4H48	97 μg/m^3

Table 8: Exposure based release limits – Peterborough

Parameter	Medium	Licence release limit
Uranium	Water	0.14 g/L (weekly composite)
	Air	410 μg/m^3 (annual average)
Beryllium	Water	26 mg/L (individual sample)
	Air	2.6 μg/m^3 (weekly sample)

It should be noted that the addition of pelleting operations has no impact on the calculation of the proposed limits. The proposed limits were derived by calculating EBRLs and technology based performance targets for uranium and beryllium discharges to water.

During the current licence period, CNSC staff verified BWXT's performance with respect to environmental protection by completing desktop reviews of BWXT's reports/submissions and routine compliance inspections. CNSC staff conducted four inspections that focused on environmental protection during the current licence period. CNSC staff are satisfied with how BWXT has addressed all enforcement actions arising out of these inspections. The results of these inspections along with compliance verification desktop reviews allowed CNSC staff to conclude that the implementation of the environmental protection programs at BWXT meets CNSC regulatory requirements and expectations.

3.9.3 Summary

A detailed analysis of all aspects of environmental protection including performance data provided in Appendix D contains the EPR report conducted under the NSCA for this licence renewal application, including the potential impacts that would result from BWXT's pelleting operations at the Peterborough facility. The following subsections summarize an overview of the licensee performance during the licence period in the various specific areas.

3.9.3.1 Past Performance

Effluent and Emissions Control

BWXT has environmental and radiation protection programs by which it controls and monitors liquid and airborne releases to the environment. These programs are based on N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills.*

Atmospheric Emissions

BWXT has valid Environmental Compliance Approvals issued by the MECP for air emissions that requires each facility to maintain emission summaries and dispersion modelling reports to demonstrate compliance. BWXT monitors uranium and beryllium air emissions from the stacks at the Peterborough facility and uranium air emissions from the Toronto facility. Beryllium air emissions from the Peterborough facility during the current licence period have resulted in negligible discharges to the environment. Additional information on atmospheric emissions is provided in the EPR provided in Appendix D.

Uranium air emissions from the Toronto and Peterborough facilities are provided in Table 9. Uranium emission levels at the Peterborough facility are expected to increase (to a level similar to those of the Toronto facility) if pelleting operations are authorized. The results demonstrate that uranium air emissions are effectively controlled and BWXT emissions have remained consistently below the facilities' operating limits during the current licence period.

Table 9: Uranium air emissions at BWXT (2011 – 2018)

Parameter	Toronto - Uranium discharged to air (kg/year)	Peterborough - Uranium discharged to air (kg/year)
Facility Licence Operating Limit	0.76	0.55
2011	0.01385	0.000011
2012	0.01724	0.000005
2013	0.01036	0.000013
2014	0.01090	0.000003
2015	0.01080	0.000003
2016	0.01080	0.000004
2017	0.00744	0.000002
2018	0.00628	0.000002

Liquid Effluent Discharges

BWXT monitors uranium and beryllium effluent from the Peterborough facility and uranium effluent from the Toronto facility. To ensure compliance with licence limits, wastewater is collected, treated/filtered, and sampled prior to its release into municipal sanitary sewers. Throughout the current licence period, Beryllium concentrations in liquid effluent from the Peterborough facility have been negligible. Additional information on liquid effluent discharges is provided in the EPR in Appendix D.

CNSC staff have reviewed the liquid effluent monitoring results and found the levels to be consistently low, acceptable, and conclude that releases have remained within the licence basis. Table 10 summarizes the uranium concentrations of liquid effluent discharged to municipal sanitary sewers during the current licence period.

Table 10: Liquid effluent discharges at BWXT, 2011 to 2018

Parameter	Toronto - Uranium discharged to sewer (kg/year)	Peterborough - Uranium discharged to sewer (kg/year)
Facility Licence Operating Limit	9,000	760
2011	1.05	0.00010
2012	0.90	0.00010
2013	0.83	0.00020
2014	0.72	0.00014
2015	0.39	0.00006
2016	0.65	0.00013
2017	0.94	0.00003
2018	0.94	0.00001

Environmental Management System

BWXT currently maintains an environmental management system that describes and manages the activities associated with the protection of the environment. The two licensed facilities have implemented REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures* to ensure effective environmental management systems are in place to achieve annual environmental objectives and targets. CNSC staff assessed BWXT's audits, management reviews, environmental objectives and targets to ensure compliance with REGDOC-2.9.1. CNSC staff conclude that BWXT has implemented its EMS in accordance with CNSC requirements.

Assessment and Monitoring

BWXT's environmental monitoring programs based on CSA standard N288.4-10, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, demonstrate that the site emissions of nuclear and hazardous substances are properly controlled. The program also provides data for estimates of annual radiological dose to the public to ensure that the public dose attributable to BWXT facilities are well below the annual regulatory dose limit of 1 mSv and are as low as reasonably achievable. The principal monitoring activities, as

described in the following paragraphs, focus on uranium in air and soil at the Toronto facility, as well as gamma radiation around both facilities.

Ambient Air Monitoring

The Toronto facility measures uranium in ambient air at several locations around the facility, to confirm the effectiveness of emission abatement systems and to monitor the impact of the facility on the environment. The results from these monitoring locations show that uranium in air as suspended particulate has consistently remained very low throughout the current licence period. The highest annual average concentration (among the sampling stations) of uranium in ambient air during the current licence period was 0.001 $\mu g/m^3$. This is well below the MECP's standard for uranium in ambient air of 0.03 $\mu g/m^3$. Additional information with data is provided in the EPR in Appendix D.

The atmospheric emissions discharged from the Peterborough facility already meet the MECP annual standard of 0.03 $\mu g/m^3$ at the point of release, eliminating the need for additional ambient monitoring. However, CNSC staff require that BWXT implement ambient air monitoring at the Peterborough facility, similar to the Toronto facility with the addition of pelleting operations. Facility-specific licence condition 15.1 has been included in the proposed licence for this purpose.

Soil Monitoring

BWXT conducts soil sampling at its Toronto facility on an annual basis as part of its environmental protection program. Samples of surface soil are taken at 49 locations on the BWXT site, on commercial property located along the south border of the site, and in the nearby residential neighborhood. These samples are analyzed for uranium content. The average uranium-in-soil concentrations over the current licence period are well below the applicable Canadian Council of Ministers of the Environment (CCME) soil quality guidelines for the Protection of Environmental and Human Health for industrial, commercial and residential/park land use. This data demonstrates that the Toronto facility's operations do not contribute to the accumulation of uranium in surrounding soil, and that no adverse impacts to relevant human and environmental receptors are expected. Additional information with data is detailed in the EPR provided in Appendix D.

The atmospheric emissions discharged from the Peterborough facility already meet the MECP annual standard of 0.03 μg/m3 at the point of release, eliminating the need for additional ambient soil monitoring. However, CNSC staff require that BWXT implement soil monitoring at the Peterborough facility, similar to the Toronto facility with the addition of pelleting operations. A facility specific licence condition 15.1 has been included in the proposed licence for this purpose.

Gamma Monitoring

A portion of radiological public dose at the BWXT Toronto and Peterborough facilities is due to gamma radiation sources. Consequently, monitoring gamma radiation effective dose rates at the fence line of the Toronto site and at the Peterborough plant boundary is conducted to ensure that levels of potential gamma radiation exposure are safe and are maintained ALARA.

Since 2014, the gamma radiation effective dose rate for the BWXT Toronto facility has been measured using environmental dosimeters. The highest estimated effective dose as a result of gamma radiation during the current licence period was 0 mSv. When combined with the contribution from the air emissions, the highest estimated public dose for a critical receptor was 0.0175 mSv, which occurred in 2017. This is well below the regulatory dose limit of 1 mSv per year to a member of the public.

Since 2016, the gamma radiation effective dose rate for the BWXT Peterborough facility has been measured using environmental dosimeters. The highest estimated effective dose as a result of gamma radiation during the current licence period was 0 mSv, for a total estimated critical receptor (public) dose of 0 mSv when combined with the contribution from the air emissions.

These estimates indicate that gamma dose rates from both BWXT facilities are controlled and that the public is protected. Additional information on gamma dose rates is detailed in the EPR provided in Appendix D of this CMD.

CNSC Independent Environmental Monitoring Program (IEMP)

The CNSC has implemented its IEMP to verify that the public and the environment around nuclear facilities remain protected. It is separate from, but complementary to, the CNSC's ongoing compliance verification program. The IEMP for the two BWXT facilities consists of measurements of potential contaminants of interest in the environment based on the releases from these facilities.

CNSC staff conducted IEMP monitoring at BWXT Toronto in 2016 and around both BWXT facilities in 2014, 2018 and 2019. Samples of air, water and soil were collected in publicly accessible areas near these facilities during the sampling campaigns. The samples were analyzed for uranium and beryllium.

IEMP results indicate that the public and the environment around the BWXT facilities is safe and that there are no health impacts as a result of facility operations. The results are available on the CNSC's IEMP webpage. These results are consistent with the results submitted by BWXT, demonstrating that the licensee's environmental protection program protects the health of persons and the environment.

Figure 6: CNSC IEMP staff performing air sampling near the BWXT Toronto facility

Protection of the Public

BWXT is required to demonstrate that the health and safety of the public are protected from exposures to radiological and hazardous substances released from the two licensed facilities. The effluent and environmental monitoring programs currently conducted by BWXT are used to confirm that releases to the environment do not result in concentrations that may affect public health.

CNSC receives reports of discharges to the environment through the reporting requirements outlined in the BWXT licence and LCH. CNSC staff's review of discharges to the environment for BWXT indicates that no significant risks to the public or environment have occurred during this period.

Based on CNSC staff's assessment of the programs at the BWXT facilities, CNSC staff conclude that the public continues to be protected from facility emissions.

Environmental Risk Assessment

CNSC staff use CSA standard N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills* to help determine whether licensees comply with regulatory requirements regarding protection of the environment and human health. CSA standard 288.6-12 specifically states "facility ERAs should be reviewed on a five-year cycle or more frequently if major facility changes are proposed that would trigger a predictive assessment".

BWXT submitted ERAs for its facilities in Toronto and Peterborough in 2017. CNSC staff reviewed the ERAs and concluded that they were consistent with the overall methodology and in compliance with all the applicable requirements of

CSA standard N288.6-12 and that, the ERA conclusions and recommendations are valid. Meaningful human health or ecological effects attributable to current BWXT operations in Toronto and Peterborough are unlikely. BWXT currently has acceptable environmental programs in place to ensure protection of the public and the environment.

In November 2018, BWXT submitted an ERA that considered the operations in Peterborough including pelleting operations proposed. CNSC staff have reviewed this document and found that the ERA is compliant with all the applicable requirements of CSA standard N288.6-12. CNSC staff conclude based on its review of the 2018 ERA that the risks attributable to emissions of radiological and non-radiological substances from BWXT's operations in Peterborough including pelleting operations, is very low and, that no adverse effects to human health and non-human biota are expected. In accordance with CSA N288.6-12, ERAs CNSC staff will require that BWXT reviews and revises its ERA every five years, or more often, if there is a change in operations or change in scientific knowledge.

3.9.3.2 Regulatory Focus

CNSC staff will continue to monitor BWXT's performance in the Environmental Protection SCA through regulatory oversight activities including onsite inspections and desktop reviews of BWXT compliance reporting and revisions to relevant program documentation.

3.9.3.3 Proposed Improvements

CNSC expects BWXT to update its environmental action levels in accordance with CSA standard N288.8 *Establishing and implementing action levels for releases to the environment from nuclear facilities* in 2020. BWXT will continue to update licence documentation related to environmental monitoring as it implements new upcoming CNSC regulatory documents and CSA standards. There are no other proposed improvements for this SCA.

3.9.4 Conclusion

CNSC staff assessed BWXT's documentation and monitoring data under the Environmental Protection SCA and conclude them to be acceptable. CNSC staff conclude that BWXT's overall performance for this SCA is satisfactory. CNSC staff conclude that BWXT has and will continue to make adequate provision for the protection of the environment and the health of persons.

3.9.5 Recommendation

Standardized licence condition 9.1 has been included in the proposed licence for this SCA. This licence condition requires BWXT to implement and maintain an Environmental Protection program, which includes a set of action levels with a requirement to notify the CNSC within seven days of any exceedances. Compliance verification criteria for this licence condition are included in the draft LCH. If the Commission accepts CNSC staff's recommendation and allows for the conduct of pelleting operations at the Peterborough facility, additional

monitoring practices including, ambient air, soil and ground water and additional stack and effluent treatment/monitoring practices, are required to be incorporated at the Peterborough facility, similar to those in place at the Toronto facility.

Prior to conducting pelleting operations at Peterborough, BWXT is required to revise the Peterborough facility's Environmental Protection program accordingly with CNSC staff's review to confirm all safety measures are in place and within the licensing. One facility-specific licence condition, 15.1 has been included in the proposed licence for this purpose.

3.10 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.

This SCA also includes any results of participation in exercises. This CMD covers the specific areas of:

- Emergency preparedness and response; and
- Fire protection.

3.10.1 Trends

The following table indicates the overall rating trends for the Emergency Management and Fire Protection over the current licence period:

TRENDS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT has implemented and maintained a fire protection program at Toronto and Peterborough in accordance with CNSC regulatory requirements. During the licence period, there have been no adverse fire protection findings at both facilities. BWXT's emergency preparedness measures met applicable CNSC regulatory and performance objectives. CNSC staff continue to monitor BWXT's implementation of this program through regular compliance verification activities.				

3.10.2 Discussion

BWXT implements an emergency preparedness program, as required by CNSC REGDOC 2.10.1, *Nuclear Emergency Preparedness and Response*, Version 2. CNSC staff can also confirm that BWXT has a FHA and Fire Protection Programs (FPP) that complies with NFPA 801 and NFCC. The plans under BWXT's Emergency and FPP are reviewed annually and updated as required. The plans are verified through regular testing, scheduled emergency drills and exercises as defined in the documented plans, and are supported by event specific

procedures, standard operating guidelines, and pre-incident plans. BWXT also maintains mandated arrangements with offsite response organizations (fire, security and emergency medical services) to provide support for emergencies at each of the licensed facilities. BWXT conducts regular exercises involving offsite response organizations to ensure their familiarity with the site, opportunities to train together, as well as to ensure integration of BWXT staff with off-site response organizations for direct facility-related support.

BWXT maintains a FPP at the Toronto and Peterborough facilities to minimize both the likelihood of occurrence and the severity of consequences due to fire at the facility. This is achieved through appropriate fire protection system design, fire safe operation and fire prevention. BWXT's fire protection program has been established to comply with the requirements of the NFPA-801 and, since notification in 2019, CSA standard N393: *Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances*.

During its current licence period, BWXT submitted annual third party review reports of inspection, testing and maintenance of fire protection in accordance with CNSC regulatory requirements. These reports indicate BWXT is meeting requirements of the NFCC and NFPA 801. CNSC staff conclude BWXT is qualified to conduct the activities proposed in the licence application and the licensee's performance in this SCA is satisfactory.

3.10.3 Summary

The following subsection presents a summary of the licensee's past performance, challenges and proposed improvements.

3.10.3.1 Past Performance

Emergency Preparedness and Response

CNSC staff conducted five focused inspections of the Emergency Management and Fire Protection SCA during the current licence period. Three of the five inspections focused on fire protection and two on emergency preparedness.

In March 2017, CNSC staff issued eight enforcement actions of non-compliance to BWXT related to the effectiveness and implementation of the Toronto facility emergency response program. The enforcement actions were based on CNSC staff observations from a major exercise conducted at the Toronto facility in conjunction with Toronto Fire Services (TFS). Corrective actions identified during this compliance inspection included a need for a formalized mutual aid agreement with TFS; improved incident command functioning and integration with TFS; and a review of BWXT emergency response organization staffing, facilities and equipment to ensure that they are adequate to support an emergency response at the Toronto location.

In 2018, BWXT conducted a full review of its emergency preparedness plan and implemented significant improvements for the Toronto facility based on lessons learned and the corrective actions resulting from the previous exercise. In 2018, CNSC staff conducted a follow-up inspection to evaluate the implementation of

the revised emergency preparedness plan and found BWXT to be fully compliant with the applicable regulatory requirements. CNSC staff will continue to monitor BWXT's implementation through regulatory oversight activities including onsite inspections and desktop reviews of BWXT compliance reporting.

Fire Protection

CNSC staff monitor BWXT's implementation of its fire protection program (FPP) through ongoing compliance verification activities and desktop reviews. CNSC staff's last on-site fire protection focused inspection was conducted in March, 2018 at the Toronto facility which concluded that the implementation of the FPP met regulatory requirements and the overall condition of the facility is satisfactory with respect to fire protection.

In January 2017, BWXT reported a minor fire in the Toronto facility. The minor hydrogen jet fire was immediately controlled and extinguished. In July 2017, BWXT reported an activation of a fire sprinkler at the Toronto facility that resulted in release of significant quantities of firewater inside the plant. The firewater from the sprinklers was collected, treated and released into the water treatment system with no impact to the public or the environment. The facility is designed so that its concrete structure can hold internal firewater with no external release from the facility. BWXT submitted a detailed investigation report as well as a third party review of the subsequent modifications to the sprinkler systems. CNSC staff reviewed the corrective actions and found them to be acceptable.

CNSC staff conclude that BWXT's performance over the licence period in the Emergency Preparedness and Fire Protection SCA is satisfactory and the program implementation meets regulatory requirements and CNSC expectations.

3.10.3.2 Regulatory Focus

CNSC staff continue to monitor BWXT's performance in this area through regulatory oversight activities including onsite inspections and desktop reviews of BWXT's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.10.3.3 Proposed Improvements

As part of implementing REGDOC 2.10.1 and lessons learned from the major exercises conducted at the Toronto facility, BWXT has committed to undertaking a full review of the implementation of its emergency plans for the Peterborough facility, with the expectation of implementing and testing the revised plan with a full-scale emergency exercise in 2020. This full-scale exercise will be a CNSC evaluated inspection as part of the 10-year compliance plan.

While BWXT's fire protection measures met applicable CNSC regulatory and performance objectives, BWXT has committed to the full implementation of CSA N393-13. CNSC staff will continue to monitor BWXT's implementation through regulatory oversight activities including on-site inspections and desktop reviews of BWXT compliance reporting on this matter.

3.10.4 Conclusion

CNSC staff assessed BWXT's documentation and performance under the Emergency Management and Fire Protection SCA and concluded that BWXT has an acceptable emergency preparedness program and fire protection program. CNSC staff conclude that BWXT is qualified to carry on the activities in this SCA as per its renewal application.

3.10.5 Recommendation

Two standardized licence conditions are included in the proposed licence for the Emergency Management and Fire Protection SCA. Licence condition 10.1 requires BWXT to implement and maintain an emergency preparedness program and licence condition 10.2 requires BWXT to implement and maintain a fire protection program. Compliance verification criteria for these licence conditions are also provided in the draft LCH.

3.11 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 area also covers the planning for decommissioning.

The specific areas that comprise this SCA at BWXT include:

- Waste characterization;
- Waste minimization;
- Waste management practices; and
- Decommissioning plans.

3.11.1 Trends

The following table indicates the overall rating trends for the Waste Management over the current licence period:

TRENDS FOR WASTE MANAGEMENT				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT's waste management program met applicable CNSC regulatory and performance objectives. CNSC staff monitor BWXT's implementation of this program through regular compliance verification activities.				

3.11.2 Discussion

BWXT has a waste management program that meets the requirements of CSA standard N292.3-08, *Management of Low and Intermediate Level Radioactive*

Waste for both facilities. The objectives of this program are to minimize the generation of waste at the facility and dispose of waste, and by-products generated in accordance with CNSC regulatory requirements. The waste management program describes how waste is managed throughout its lifecycle to the point of disposal. This includes storage, recycling and removal/transfer activities.

In accordance with paragraph 3(k) of the CINFR, BWXT is required to maintain a decommissioning plan throughout the life of the facility. BWXT maintains a Preliminary Decommissioning Plan (PDP) for its two licensed facilities as per CSA standard N294-09 *Decommissioning of Facilities Containing Nuclear Substances and CNSC Regulatory Guide G-219, Decommissioning Planning for Licensed Activities.*

BWXT regularly assesses its waste management program and PDP to ensure the adequacy and effectiveness of its programs. Based on CNSC staff's assessment of the licence renewal application, supporting documents and past performance in this SCA, CNSC staff conclude that BWXT continues to maintain and implement a documented waste management program in accordance with CNSC regulatory requirements and the licensee's performance and have demonstrated satisfactory performance for this SCA.

3.11.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.11.3.1 Past Performance

Waste Characterization, Minimization, and Management Practices

BWXT's application for a licence renewal included a documented waste management program for both facilities. The program involves minimizing waste, storing waste, and disposing hazardous waste.

Radioactive solid waste is segregated and accumulated in controlled and appropriately classified areas at both facilities. The waste is then consolidated at the Toronto facility, characterized, compacted for volume reduction and shipped periodically to another CNSC licensed waste management facility. Liquid waste generated from licensed activities is processed through the water effluent treatment system.

CNSC staff conducted two inspections focused on the Waste Management SCA, in 2013 and 2017. Enforcement actions from this inspection dealt with how BWXT segregated waste and labelling of containers. BWXT submitted a corrective action plan that was acceptable and CNSC staff are satisfied with how BWXT addressed all actions from these inspections. CNSC staff assessed the waste management program, associated procedures and supporting documentation submitted by BWXT with the licence renewal application for the SCA and consider BWXT's programs to be satisfactory.

Decommissioning Plans

CNSC staff assessed BWXT's PDP along with associated financial guarantees for the Toronto and Peterborough facilities, submitted in March 2019 as part of this licence renewal application. The PDP captured the strategy, activities and cost estimates associated with decommissioning the Toronto and Peterborough facilities. Decommissioning involves removing the radioactive and other hazardous materials from the site and restoring it to an agreed end state before submitting an application for a CNSC licence to abandon.

Decommissioning must be conducted in a manner that ensures that the health, safety, and security of workers, the public, and the environment are protected. BWXT's strategy for decommissioning is to remove all radioactive and non-radioactive hazardous materials used during its operations to provide an end state, which is unrestricted industrial use of the facility in the future. BWXT has detailed in its PDP how it will execute this strategy, which includes putting the facilities in a safe shutdown state and then executing a plan to decommission the facility for unrestricted industrial use. The financial guarantee is based on this decommissioning plan and an associated cost estimate. Additional details of the financial guarantee and its assessment are provided in Section 4.4. The PDP reflects any changes in the facility or operations. The CNSC requires BWXT to revise its PDP for both facilities at a minimum every five years or when required by the Commission.

In July 2019, CNSC staff accepted BWXT's PDP as compliant with regulatory and licence requirements.

3.11.3.2 Regulatory Focus

CNSC staff will continue to monitor and evaluate BWXT's compliance with regulatory requirements through regulatory oversight activities including onsite inspections and reviews of compliance reports and revisions to relevant program documentation.

3.11.3.3 Proposed Improvements

CNSC staff verified that BWXT is currently in compliance with CSA standard N292.3-08, *Management of low- and intermediate-level radioactive waste* for the Toronto and Peterborough facilities. CNSC staff will continue to monitor program effectiveness through the conduct of compliance verification activities.

3.11.4 Conclusion

Based on the assessment of BWXT's revised PDP, CNSC staff conclude that the PDP meets the applicable regulatory requirements of CSA standard N294-09, *Decommissioning of facilities containing nuclear substances,* and CNSC regulatory guide G-219, *Decommissioning Planning for Licensed Activities*.

3.11.5 Recommendation

Two Standardized licence conditions are included in the proposed licence for the Waste Management SCA. Standardized licence condition 11.1 requires BWXT to

implement and maintain a waste management program. Standardized licence condition 11.2 requires BWXT to maintain a decommissioning plan. Compliance verification criteria for these licence conditions are included in the draft LCH.

3.12 Security

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

This CMD covers the following specific areas of the Security SCA:

- Facilities and equipment;
- Response arrangements;
- Security practices;
- Drills and exercises; and
- Cyber security.

3.12.1 Trends

The following table indicates the overall rating trends for the Security SCA over the current licence period:

TRENDS FOR SECURITY				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT Toronto and Peterborough Facilities have implemented and maintained Security Programs that meet regulatory requirements under the GNSCR and part 2 of *Nuclear Security Regulations* (NSR) to prevent the loss, unauthorized removal and sabotage of nuclear substances, nuclear materials, prescribed equipment or information.				

3.12.2 Discussion

The GNSCR and NSR require that licence applications contain information including the proposed measures to control access to the site of the activity to be licensed, the nuclear substance, and the prescribed equipment or prescribed information.

In addition, REGDOC 2.12.3: *Security of Nuclear Substances: Sealed Sources and Category I, II, and III, Nuclear Material* provides further information on how to meet the requirements identified in the GNSCR for those licensees that possess sealed source nuclear substances and nuclear material.

Further, the licensee is subject to Part 2 of the NSR, which provide additional requirements, specifically with regard to access control, facilities and equipment,

response arrangements, training, staff trustworthiness and reliability programs, practices and procedures, as they relate to security.

CNSC staff assessed BWXT's Security SCA as satisfactory for calendar year 2019. This assessment is based upon a detailed technical review of the licensees site security plan, a Type II Security Inspection conducted in January 2017, and further evaluation and monitoring of licensee activity and reports. The assessment takes into consideration the overall site security based on the risk of its activities and its location surrounded by a residential neighborhood.

During the previous calendar year, there were no serious threats to security or incidents reported at the Toronto and Peterborough facilities. There have been no changes in the security requirements applicable to these facilities since May 2016 after the full implementation of REGDOC 2.12.3: *Security of Nuclear Substances: Sealed Sources and Category I, II, and III Nuclear Material*.

CNSC staff are confident that BWXT has implemented and maintained Security Programs that meet regulatory requirements under the GNSCR and part 2 of NSR and REGDOC 2.13.3 to prevent the loss, unauthorized removal and sabotage of nuclear substances, nuclear materials, prescribed equipment or information.

3.12.3 Summary

The following subsections provide a summary of the licensee's past performance, challenges and proposed improvements.

3.12.3.1 Past Performance

CNSC staff verified that BWXT has implemented and maintained security programs that meet regulatory requirements to prevent the loss, unauthorized removal and sabotage of nuclear substances, nuclear materials, prescribed equipment and information.

Specific performance evaluation for security is evaluated as security sensitive information and has been designated as Confidential – Prescribed Information. This information is not available for public release.

3.12.3.2 Regulatory Focus

CNSC staff confirm that BWXT has incorporated satisfactory measures and has addressed all non-compliances related to onsite nuclear material security identified in compliance verification activities for the Security SCA.

3.12.3.3 Proposed Improvements

Specific proposed improvements for security are evaluated as security sensitive information and has been designated as Confidential – Prescribed Information. This information is not available for public release.

3.12.4 Conclusion

CNSC staff confirm that the licensee has met regulatory requirements for the Security SCA and rate BWXT's performance in this SCA as Satisfactory. CNSC

staff's assessment of the facilities has not identified any systemic deficiencies concerning the performance of the licensed facilities as they affect the Security SCA.

3.12.5 Recommendation

One standardized licence condition is included in the proposed licence for this SCA. Licence condition 12.1 requires BWXT to implement and maintain a security program. A compliance verification criterion for this licence condition is included in the draft LCH.

3.13 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/International Atomic Energy Agency (IAEA) safeguards agreements, as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons* and bilateral Nuclear Cooperation Agreements.

This CMD covers the following specific areas of Safeguards and non-proliferation:

- Nuclear material accountancy and control;
- Access and assistance to the IAEA;
- Operational and design information;
- Safeguards equipment, containment and surveillance; and
- Import and export.

3.13.1 Trends

The following table indicates the overall rating trends for safeguards and non-proliferation over the current licence period:

TRENDS FOR SAFEGUARDS AND NON-PROLIFERATION				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT continues to perform satisfactorily in this SCA. Overall, CNSC staff concludes BWXT's safeguards and non-proliferation programs meet regulatory requirements.				

3.13.2 Discussion

CNSC staff assessed BWXT's safeguards program and confirm that it conforms to measures required by the CNSC to meet Canada's international safeguards obligations as well as other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*. Pursuant to this treaty, Canada has entered into

a Comprehensive Safeguards Agreement and an Additional Protocol with the International Atomic Energy Agency (IAEA) (hereafter, the safeguards agreements). The objective of the safeguard agreement is for the IAEA to provide annual assurance to Canada and to the international community that all declared nuclear material is used for peaceful, non-explosive purposes and that there is no indication of undeclared material.

The CNSC provides the mechanism, through the NSCA, its regulations and the facility licence, for the implementation of safeguards. Conditions for the application of safeguards are contained in the operating licence and criteria in order to meet those conditions, are contained in the LCH and in regulatory document REGDOC 2.13.1, *Safeguards and Nuclear Material Accountancy*. Compliance includes the timely provision of reports on the movement and location of nuclear material, provision of access and assistance to IAEA inspectors for safeguards activities, support for IAEA equipment, and the submission of annual operational information, additional protocol updates as well as accurate design information.

CNSC staff assessed BWXT's safeguards program as compliant with REGDOC 2.13.1. However, two gaps were identified related to BWXT's use of outdated forms for nuclear material accountancy reporting and lack of reporting through the Nuclear Material Accountancy Reporting (NMAR) e-business portal. BWXT has since implemented updated nuclear material accountancy forms, is reporting to the CNSC through the NMAR portal and has submitted an updated program document for CNSC staff's review. CNSC staff are satisfied with the performance of the licensee in the Safeguards SCA and conclude that BWXT is qualified to carry on the activities proposed in its licence application for this SCA

3.13.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.13.3.1 Past Performance

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Nuclear Material Accountancy and Control

CNSC staff determined that BWXT has complied with all elements of CNSC's regulatory requirements in accordance with REGDOC 2.13.1.

Access and Assistance to the IAEA

CNSC staff determined that BWXT granted adequate access and assistance to the IAEA for safeguards activities, including inspections and the maintenance of the IAEA's equipment.

During the licence period, the IAEA performed inspections and verifications, including 13 Physical Inventory Verification and 20 short-notice random inspections. In all cases, the licensee provided the IAEA with the necessary access

and assistance to perform the inspection activities, and complied with all regulatory requirements.

The licensee has no major issues and the inspection results were satisfactory.

Operational and Design Information

BWXT has submitted annual operational programs, quarterly updates and annual updates to the Additional Protocol, as well as other required information to the IAEA and the CNSC in a timely manner.

Import and Export

The scope of the non-proliferation program under this licence is limited to the tracking and reporting of foreign obligations and origins of nuclear material through Inventory Change Documents (ICD) and Obligated Material Inventory Summaries (OMIS). CNSC staff determined that BWXT has complied with the CNSC's regulatory requirements in this respect through the submission of the ICD and OMIS Reports.

3.13.3.2 Regulatory Focus

CNSC staff will continue to monitor and evaluate BWXT's performance through participation in IAEA inspections, CNSC evaluations, and ongoing assessments of compliance with reporting requirements.

3.13.3.3 Proposed Improvements

No changes to the regulatory requirements or programs within this SCA are anticipated at this time.

3.13.4 Conclusion

CNSC staff note that BWXT is compliant with the requirements of REGDOC 2.13.1. CNSC staff determined that the licensee is qualified to carry on the authorized activities within this SCA and BWXT's performance is satisfactory.

3.13.5 Recommendation

One standardized licence condition is included in the proposed licence. Licence condition 13.1, requires that the licensee implement and maintain a safeguards program. Compliance verification criteria for this licence condition is included in the draft LCH.

3.14 Packaging and Transport

The SCA Packaging and Transport covers the safe packaging and transport of nuclear substances to and from the licensed facility. This CMD covers the following specific areas:

- Packaging design and maintenance; and
- Packaging and transport.

3.14.1 Trends

The following table indicates the overall rating trends for the Packaging and Transport SCA over the current licence period:

TRENDS FOR PACKAGING AND TRANSPORT				
Overall Compliance Ratings				
2015	**2016**	**2017**	**2018**	**2019**
SA	SA	SA	SA	SA
Comments				
BWXT has a packaging and transport program that ensures compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015* and the *Transportation of Dangerous Goods Regulations*. CNSC staff monitor BWXT implementation of this program through compliance verification activities and review of annual reports.				

3.14.2 Discussion

BWXT has developed and implemented a nuclear substances transport program to ensure compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015* (PTNSR) as well as the *Transport of Dangerous Goods Act, 1992* (TDG) and its associated regulations.

BWXT's transport program procedures detail requirements and practices. BWXT currently transports UO_2 in Type IP-1 packages as well as waste generated by its operations in appropriate containers and other equipment between its licensed facilities safely.

BWXT maintains and stores all records as required by CNSC requirements. These records have been reviewed, for accuracy and completeness by CNSC inspectors. BWXT also trains and maintains certified personnel under TDG for its transportation needs. Labelling and placarding of transport packages and trailers are as per the requirements of the CNSC and Transport Canada requirements.

BWXT also maintains an emergency response assistance plan with timely and effective off-site response capabilities as required under the TDG.

During this licence period, CNSC staff conducted two inspections focused on transport and also assessed the performance of the licensee through other compliance verification activities, including event reviews and review of annual compliance reports submitted by BWXT.

BWXT's application for licence renewal provides adequate information and CNSC staff assessed BWXT's performance as satisfactory. Nuclear substances as well as non-nuclear dangerous goods are transported to and from the two licensed facilities safely.

3.14.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.14.3.1 Past Performance

During the current licence period, CNSC staff conducted two focused inspections in the Packing and Transport SCA, reviewed event reports and conducted desktop reviews of the licensee's annual compliance reports. Enforcement actions from the two inspections dealt with better documentation of package design and better record keeping practices. No significant deficiencies were identified.

There were two packaging related events reported during this licence period due to the mislabeling of uranium skids that are used to transport between the two facilities. BWXT submitted a detailed root cause analysis and several corrective actions associated with these events. CNSC staff, as part of its compliance verification activities reviewed BWXT's corrective actions and are satisfied with their implementation.

There were two transport events reported during the licence period. One event in January 2014 related to a damaged drum containing grinder sludge from Toronto, which was observed to have a puncture when received at the Cameco Corporation's Port Hope Conversion Facility. Trace contamination was observed on the outside of the drum with no contamination detected on the floor of the trailer. The licensee conducted an investigation and implemented preventive actions because of this incident, which was reported to the Commission as part of the *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities – 2014*. A second event in March 2019 related to a minor traffic accident. The reported events did not have an impact on the safety of the public and the environment. CNSC staff reviewed and determined that the licensee addressed these events in a satisfactory manner.

CNSC staff are satisfied with the performance of BWXT in this SCA, and find that the licensee is qualified to conduct the activities as proposed in its application for the renewal of its operating licence.

3.14.3.2 Regulatory Focus

CNSC staff will continue to monitor BWXT's performance for the Packaging and Transport SCA through onsite inspections and assessments of annual compliance reporting and revisions to BWXT's written notification documentation.

3.14.3.3 Proposed Improvements

CNSC staff are satisfied with BWXT's implementation of its programs under the Packaging and Transport SCA, and no changes are proposed.

3.14.4 Conclusion

CNSC staff's conclude that BWXT has met regulatory requirements for the Packaging and Transport SCA for this licence renewal application and rate its performance as satisfactory.

3.14.5 Recommendation

One standardized licence condition is included in the proposed licence. Licence condition 14.1 requires that the licensee implements and maintains a packaging and transport program. Compliance verification criteria for this licence condition is included in the draft LCH.

4. OTHER MATTERS OF REGULATORY INTEREST

4.1 Indigenous Consultation and Engagement

The common-law duty to consult with Indigenous groups applies when the Crown contemplates actions that may adversely affect potential or established Indigenous and/or treaty rights. The CNSC ensures that all of its licence decisions under the NSCA [5] uphold the honour of the Crown and consider Indigenous peoples' potential or established Indigenous and/or treaty rights pursuant to section 35 of the constitution.

4.1.1 Discussion

CNSC staff have identified the First Nation and Métis groups who may have an interest in the proposed relicensing of BWXT's activities in Toronto and Peterborough. These groups include: the Williams Treaties First Nations (WTFN) consisting of Alderville First Nation, Curve Lake First Nation, Hiawatha First Nation, The Mississaugas of Scugog Island First Nation, Chippewas of Mnjikaming (Rama First Nation), Georgina Island First Nation and the Chippewas of Christian Island (Beausoleil First Nation)); the Mississaugas of the Credit First Nation; the Mohawks of the Bay of Quinte (MBQ); and the Métis Nation of Ontario (MNO) Regions 6 and 8. These groups were identified because all have previously expressed interest in being kept informed of CNSC licensed activities occurring in proximity to their traditional and/or treaty territories.

CNSC staff sent letters of notification in March 2019 to the Indigenous groups identified above, providing information regarding the proposed licence renewal application, the availability of participant funding to facilitate participation in the hearing process, and details on how to participate in the Commission's public hearing process proposed for March 2020.

CNSC staff conducted follow-up phone calls with the identified groups in April 2019 to ensure they had received the letters and to answer any questions about the regulatory process and how to get involved in the Commission proceedings. Additional communication with identified groups conveyed updated information pertaining to the specific hearing dates and information on the participant funding opportunity through the CNSC's Participant Funding Program (PFP). In addition, CNSC staff met with members of the Williams Treaties First Nations and MNO in 2018 and 2019 and with MBQ in 2019, to provide updates on a number of CNSC regulated facilities and activities in their traditional territories, including discussions on the BWXT licence renewal.

As part of the engagement activities, the main concerns raised by Indigenous groups pertained to the transportation of nuclear materials and changes to BWXT activities, as proposed in the licence renewal application. CNSC staff answered the questions and concerns raised during the meetings and CNSC staff followed up with correspondence in order to provide additional information such as emergency safety protocols and planning documentation. CNSC staff are

committed to continuing to address concerns and provide information pertaining to the BWXT renewal and the regulation of transportation of nuclear materials.

CNSC staff have initiated discussions with WTFN to determine if they would be interested in formalizing the engagement relationship between CNSC staff and WTFN. WTFN have expressed an interest and discussions have been initiated on developing a Terms of Reference with CNSC staff to formalize the relationship. CNSC staff are working with the MNO to develop a Terms of Reference (TOR) for on-going collaboration and are open to discussing BWXT as part of this formalized engagement, should the MNO express an interest.

To date, the Mississaugas of the Credit have not expressed any direct interest in the licence renewal to the CNSC. However, CNSC staff will continue to provide them, along with the other identified Indigenous groups with key project updates and discuss any areas of interest and concern in relation to the BWXT facilities and projects.

CNSC REGDOC-3.2.2, *Indigenous Engagement*, published in February 2016, sets out requirements and guidance for licensees whose proposed projects may raise the Crown's duty to consult. While the CNSC cannot delegate its obligation, it can delegate procedural aspects of the consultation process to licensees, where appropriate. The information collected and measures proposed by licensees to avoid, mitigate or offset adverse impacts from the proposed licence renewal, may be used by CNSC staff in meeting its consultation obligations.

BWXT's licence renewal application does not raise the formal requirements of REGDOC-3.2.2. However, CNSC staff encourages BWXT to use the guidance set out in CNSC REGDOC-3.2.2 to help inform its engagement activities with Indigenous communities who have an interest in their facilities and activities including the licence renewal application.

4.1.2 Conclusion

CNSC staff conclude that BWXT's licence renewal will not cause any adverse impacts to any potential or established Indigenous and/or treaty rights. BWXT's operations occur within its facilities and there is no planned expansion of the footprint of the facilities. The emissions and/or waste being produced at the facilities present a low risk of adversely impacting the surrounding environment. BWXT's facilities are located in an existing industrial zone within a suburban neighborhood in close proximity to large urban centers.

The CNSC is committed to meaningful, ongoing engagement with Indigenous groups that have an interest in CNSC regulated facilities and activities.

4.1.3 Recommendation

CNSC staff recommend the continuing meaningful ongoing engagement with interested Indigenous groups and continue to provide relevant information concerning BWXT's licensed activities.

4.2 Other Consultation

The CNSC awarded up to $36, 251.10 through its Participant Funding Program to support the funding recipients in providing value-added information to the Commission through informed and topic-specific interventions. This funding was offered to review BWXT's application and associated documents and to prepare for and participate in the Commission's public hearing. The funding recipients include:

- Citizens Against Radioactive Neighborhoods (C.A.R.N);
- Lake Ontario Water-keeper;
- Curve Lake First Nation; and
- Canadian Nuclear Workers Council.

4.3 Cost Recovery

Paragraph 24(2)(c) of the NSCA requires that a licence application is accompanied by the prescribed fee. The CNSC *Cost Recovery Fees Regulations* (CRFR) set out the specific requirements based on the activities to be licensed. An applicant for a Class I facility licence is subject to Part 2 of CRFR, which is based on Regulatory Activity Plan fees.

CNSC staff confirm that BWXT is in good standing with respect to CRFR requirements and has paid their cost recovery fees in full. CNSC staff do not have concerns regarding payment of future cost recovery fees for this licensee.

4.4 Financial Guarantees

The financial guarantee for decommissioning is established to fund the activities described in the PDP. BWXT currently maintains a financial guarantee for the decommissioning of its two facilities as per licence condition 1.3 of its current licence. The CNSC regulatory guide *G-206: Financial Guarantees for the Decommissioning of Licensed Activities* provides the regulatory requirements for this financial guarantee.

4.4.1 Discussion

In December 2016, the Commission accepted BWXT's financial guarantee in the form of a letter of credit for $52,371,600 for both the Toronto and Peterborough facilities. The breakdown of this financial guarantee is $45,568.100 for decommissioning the Toronto fuel pellet operations and $6,803,500 for decommissioning the Peterborough fuel assembly facility.

In March 2019, BWXT submitted an updated PDP for both the Peterborough and Toronto facilities as part of the licence renewal application. CNSC staff have assessed the updated PDP and find that it meets the applicable regulatory requirements and provides an acceptable decommissioning cost estimate.

As part of this licence application, BWXT has proposed a financial guarantee of $48,137,867, which includes $37,362,745 for decommissioning the Toronto fuel

pellet operations and $10,775,122 for decommissioning the Peterborough fuel assembly operations. This decrease of $4,233,733 from the current financial guarantee is a result of more accurately defined decommissioning activities and a 5% lower contingency estimate (from 25% to 20%). CNSC staff have assessed the cost estimate against the requirements of CNSC regulatory guide *G-206: Financial Guarantees for the Decommissioning of Licensed Activities* and consider the proposed amount to be adequate.

BWXT is proposing to use a combination of a letter of credit and a surety bond to fund its financial guarantee. Both financial instruments are acceptable forms of financial guarantees, as identified in CNSC regulatory guide *G-206: Financial Guarantees for the Decommissioning of Licensed Activities*. CNSC regulations require that payments are made upon demand. Since the terms of the surety bond only provide that payment can be made within 30 days, BWXT has proposed to provide a letter of credit to fund the decommissioning activities for the first 30 days, with the remainder of the financial guarantee obligations satisfied by the surety bond.

BWXT has estimated that the activities to put the facilities in a safe state during the first 30 days after shutting down would cost $521,000 for the Peterborough facility and $992,000 for the Toronto facility. BWXT has proposed a $2,000,000 letter of credit that covers $700,000 for the Peterborough facility and $1,300,000 for the Toronto facility. CNSC staff have reviewed BWXT's estimates and consider that the proposed amount of $2,000,000 for the letter of credit will adequately cover the first 30 days of decommissioning and the remainder of $46,137,867 may be funded by the surety bond.

BWXT has provided a draft of the surety bond and letter of credit with terms and conditions acceptable to CNSC staff. BWXT has requested 90 days from the date decision by the Commission to have the financial guarantee in place. The current financial guarantee will continue to remain valid until the revised financial guarantee is in place.

4.4.2 Conclusion

CNSC staff conclude that BWXT's proposed financial guarantee is acceptable.

4.4.3 Recommendation

CNSC staff recommend that the Commission accept the proposed financial guarantee in the form of a letter of credit for $2,000,000 and a surety bond for $46,137,867 and direct BWXT to provide the original instruments within 90 days from the issuance of a decision on this matter.

Standardized licence condition G.3 has been included in the draft licence for the Commission's consideration which requires that the licensee maintain a financial guarantee for decommissioning that is acceptable to the Commission.

4.5 Improvement Plan and Significant Future Activities

BWXT has requested the authorization to conduct pelleting operations at the Peterborough facility. CNSC staff assessed this request and conclude that the conduct of pelleting operations at the Peterborough facility would remain within the overall safety case for the Peterborough facility. As previously discussed in Section 3.9, CNSC staff also assessed the potential effects to the environment of this operation and conclude that BWXT has and will continue to make adequate provision for the protection of the environment and the health of persons.

4.5.1 Discussion

BWXT has not requested any changes to its existing uranium possession and production limits. Any addition of equipment to conduct pelleting processes in Peterborough will be managed under its existing change control procedures and the requested change is within the currently authorized safety case for the Peterborough facility. CNSC staff considered BWXT's capability and qualifications to safely implement these changes and ensure the protection of the public and the environment.

BWXT's licence currently allows it to design, modify, commission and operate new and existing equipment, including building modifications and supporting systems at both the Toronto facility and the Peterborough facility. BWXT regularly carries out major equipment maintenance and commissioning activities at the Toronto and Peterborough facilities, including:

- New sintering furnace controllers at Toronto in 2014;
- Construction of the radiation refurbishment facility at Peterborough in 2011;
- Fire safety and powder storage upgrades at Peterborough in 2013;
- Enhancements /modifications to ventilation systems at Toronto in 2016;
- Installation of a new emergency operations center in 2017; and
- Commissioning automation equipment to conduct operations that are currently licensed at the Toronto and Peterborough facilities.

Based on CNSC staff's technical assessment, BWXT is required to implement additional ambient environmental monitoring before conducting any pelleting operations. CNSC staff included facility-specific licence condition 15.1in the draft licence.

While the requested authorization is within the authorized licensed activities, BWXT will not be permitted to conduct pelleting operations at the Peterborough facility until CNSC staff are satisfied that the programs and procedures related to the pelleting operations are implemented safely. In order to ensure compliance with CNSC requirements, CNSC staff included facility-specific licence condition 15.2 in the draft licence.

4.5.2 Conclusion

CNSC staff recommend that the Commission accept BWXT's request for the conduct of pelleting operation in Peterborough, and accept CNSC staff's facility-specific licence conditions 15.1 and 15.2 to ensure adequate environmental monitoring and regulatory oversight of these changes.

4.5.3 Recommendation

Two facility specific licence conditions 15.1 and 15.2 have been included in the draft licence.

- Licence condition 15.1 requires that the licensee shall submit and implement an updated environmental monitoring program at the Peterborough facility prior to the commencement of production of fuel pellets as described in paragraph (iv) of Part IV of this licence; and
- Licence condition 15.2 requires that the licensee shall submit a commissioning report related to production of fuel pellets as described in paragraph (iv) of Part IV of this licence, that is acceptable to the Commission, or a person authorized by the Commission.

4.6 Licensee Public Information Program

A Public Information and Disclosure Program (PIDP) is a regulatory requirement for licence applicants and licensees of Class I nuclear facilities, uranium mines and mills and certain Class II nuclear facilities. These requirements are found in REGDOC-3.2.1, *Public Information and Disclosure*.

The primary goal of the PIDP is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities are effectively communicated to the public. The program must include a commitment to, and protocol for ongoing, timely communication of information related to the licensed facility during the course of the licence period.

CNSC's expectations of a licensee's public information program and disclosure protocol are commensurate with the level of risk of the facility, as well as the level of public interest in the licensed activities. The program and protocol may be further influenced by the complexity of the nuclear facility's lifecycle and activities, and the risks to public health and safety and the environment perceived to be associated with the facility and activities.

4.6.1 Discussion

BWXT is required under its licence to maintain a PIDP as per REGDOC-3.2.1, *Public Information and Disclosure*.

CNSC staff have reviewed BWXT's PIDP [16] and determined that it:

- Identifies clear goals and objectives in terms of dissemination of information to targeted audiences;
- Is available to the public and is posted on the licensee's website;

- Provides information on the locations that require a CNSC licence for nuclear-related activities. BWXT provides this information in a variety of ways including community information sessions, facility tours, quarterly newsletters, social media, and its website;
- Targets multiple audiences such as local residents, elected and government representatives, business leaders and local aboriginal groups; and
- Provides contact information for members of the public who want to obtain additional information.

CNSC staff will continue to monitor BWXT's compliance with public information requirements and ongoing implementation of the PIDP.

Improvements to PIDP During the Current Licence Period

In November 2013, the Commission held a meeting in Toronto where the licensee's operational performance was discussed. A number of interveners expressed concerns about the safety of the facility and a lack of public information and awareness. Having heard those concerns, the Commission directed the licensee to take action to improve its public information program. CNSC staff conducted an inspection of the licensee's public information program in June 2014 with enforcement actions directing the licensee to improve the assessment of target audience needs, improve communication products and their frequency and program improvements related to public feedback.

Subsequently, the licensee responded to these issues raised in the Commission meeting and the inspection, and adapted its program to better inform and engage those living and working near the Toronto and Peterborough facilities. The licensee established an active Community Liaison Committee that meets a minimum of three times per year, established two community newsletters for each community, and conducts a minimum of one public outreach activity every year for each site.

In addition, the licensee has appointed a dedicated communication manager, as per CNSC staff's expectations. BWXT regularly updates its website with information on its operations, safety measures and performance. Annual compliance reports and information on events or incidents are posted on the licensee's website.

Figure 6: CNSC staff participation in the Toronto outreach – June 2019

BWXT has recently consolidated the position responsible for the public information program into its corporate communications role, increased social media presence, held annual open houses for both sites, made improvements to the community newsletter and increased outreach to elected members and target audiences with scheduled plant tours and sponsoring of local community activities. CNSC staff continue to closely monitor the effectiveness of the public information program and the implementation of the action plan as per licensee commitments to the Commission in the November 2013 Commission meeting. Given the concerned citizens in the immediate communities to operations in Toronto and Peterborough, CNSC staff have an active public engagement plan including participation in most licensee outreach activities and engagement with local public officials (Toronto Public Health, Peterborough Public Health and the MECP), to ensure awareness and adequate response to public concerns.

CNSC staff also conducted outreach to the local neighborhoods as part of the CNSC's IEMP activities by answering questions on how the CNSC monitors the local environment to ensure safety and provide technical briefings on staff capabilities in air monitoring and sample collection techniques in targeted neighborhoods.

Proposed Improvements

BWXT has indicated that it has recently completed public opinion surveys of their facilities and operations in Toronto and Peterborough. The views of the public and the media regarding the facilities and related activities are likely to influence the communications tools and information used by the licensee to deliver an

effective public information program in the future. CNSC staff also expect BWXT to update its PIDP to include social media as a vehicle to communicate events that might be of public interest.

CNSC staff confirm that BWXT currently maintains an acceptable PIDP and the program design is commensurate with the nature of the licensee's operations and the degree of local public interest.

4.6.2 Conclusion

CNSC staff conclude that BWXT's PIDP meets the regulatory requirements for public information and disclosure. CNSC staff continue to oversee BWXT's implementation of the PIDP to ensure that it meets obligations regarding disseminating and notifying the public and Indigenous communities on its licensed activities. CNSC staff also encourage BWXT to refine and update its PIDP on a regular basis to meet the changing information needs of its target audiences.

4.6.3 Recommendation

Standardized licence condition G.4 has been included in the draft licence that requires the licensee to implement and maintain a PIDP.

4.7 Nuclear Liability Insurance

BWXT's Toronto and Peterborough facilities are not designated facilities under the *Nuclear Liability and Compensation Act* (NLCA). This is because BWXT only processes natural and depleted uranium, which is excluded from the definition of nuclear material under the NLCA. As a result, BWXT's operations do not meet the criteria to be designated as nuclear installations and are not under the purview of the NLCA. BWXT maintains industrial insurance as a commercial necessity.

4.8 Delegation of Authority

The Commission may include any licence condition it considers necessary for the purposes of the NSCA. The Commission may delegate authority to CNSC staff with respect to the administration of licence conditions, or portions thereof.

There are two proposed licence conditions in the proposed licence for BWXT that contain the phrase "the Commission or a person authorized by the Commission".

- LC 3.2 Reporting; and
- LC 15.2 Commissioning report

CNSC staff recommend the Commission delegate its authority for the purpose described in the above licence conditions to the following staff:

- Director, Nuclear Processing Facilities Division;
- Director General, Directorate of Nuclear Cycles and Facilities Regulation; and

- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch.

5. OVERALL CONCLUSIONS AND RECOMMENDATIONS

CNSC staff conclude the following with respect to paragraphs 24(4)(a) and (b) of the NSCA:

1. BWXT is qualified to carry on the activities requested in the renewal application;
2. BWXT's request for authorization to conduct pelleting operations at the Peterborough facility is acceptable as the requested activities are within this facility's current operating limits. BWXT has the required management system programs and resources in place to implement pelleting operations at the Peterborough facility. The hazards associated with the proposed activities are well characterized and controlled, and BWXT's operations would remain protective of the public and the environment;
3. In carrying on the authorized activities, BWXT has made and will continue to make adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and measures required to implement international obligations to which Canada has agreed; and
4. BWXT's proposed financial guarantee of approximately $48.1 million, through two proposed instruments, a letter of credit for $2 million and a surety bond for approximately $46.1 million, is a credible cost estimate and the financial guarantee instruments are acceptable.

Based on above conclusions, CNSC staff recommend that the Commission take the following actions:

1. Issue a 10-year nuclear fuel facility licence to BWXT with the proposed licence conditions and authorize the conduct of pelleting operations and the delegation of authority as set out in the CMD; and
2. Accept the proposed financial guarantee of $48,137,867 in the form of a letter of credit for $2,000,000 and a surety bond for $46,137,867 and direct BWXT to provide the original instruments within 90 days from the issuance of a decision on this matter.

REFERENCES

1. Letter from J. MacQuarrie (BWXT) to M. Leblanc (CNSC), titled "BWXT Nuclear Energy Canada Inc. FFOL 3620.01/2020 renewal application", dated November 09, 2018 (e-Doc 5714814 and 5714817).
2. Letter from J. MacQuarrie (BWXT) to J. Amalraj (CNSC), titled: "BWXT NEC response to CNSC Staff sufficiency check of licence renewal application and request for additional information', dated March 7, 2019 (e-Doc 5837803).
3. BWXT NEC Peterborough – Consolidated ERA, dated November 09, 2018 (e-Doc 5714818).
4. CMD 16H-113, CNSC staff submission on GE Hitachi Nuclear Energy Canada Inc transfer of licence (e-Doc 5137882)
5. Record of Decision GE-Hitachi Nuclear Energy Canada Inc, Application to transfer and amend licence, request to accept financial guarantee, 2016.
6. Letter from D. Snopek (BWXT) to J. Amalraj (CNSC), titled: "Proposed Financial Guarantee Instrument", dated February 25, 2019 (e-Doc 5826067).
7. Regulatory Oversight Report – 2017
8. BWXT document: "Radiation Protection Manual and Beryllium Safety Manual" (e-Doc 5051442).
9. BWXT documents: "Environmental health and safety plan, Peterborough, Toronto" (e-Doc 5837833 and 5837834).
10. Letter from D. Snopek (BWXT) to J. Amalraj (CNSC), titled " Submission of documents – Proposed CNSC licence limits", dated May 03, 2019 (e-Doc 5898832).
11. BWXT document" "Public Information and Disclosure Program" (e-Doc 5277275).
12. CNSC licence to BWXT Nuclear Energy Canada Inc: FFOL-3620.01/2020 (e-Doc 5151105).
13. CNSC Licence Conditions Handbook for FFOL-3620.01/2020 (e-Doc 5159117).
14. Record of Decision, GE-Hitachi Nuclear Energy Canada Inc, Applications to renewal licences for Toronto and Peterborough facilities.
15. EA decision from 2010.

GLOSSARY

For definitions of terms used in this document, see REGDOC-3.6 Glossary of CNSC Terminology, which includes terms and definitions used in the *Nuclear Safety and Control Act* [7] and the regulations made under it, and in CNSC regulatory documents and other publications. REGDOC-3.6 is provided for reference and information.

Additional terms and acronyms used in this CMD are listed below.

Acronym	Term
AIA	Authorized Inspection Agency
ALARA	As Low As Reasonably Achievable
BWXT	BWXT Nuclear Energy Canada Inc
CLC	Community Liaison Committee
CMD	Commission Member Document
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CVC	Compliance Verification Criteria
DRL	Derived release limit
EA	Environmental Assessment
ECA	Environmental Compliance Approval
EIR	Event Initial Report
EMS	Environmental Management System
ERA	Environmental Risk Assessment
FG	Financial Guarantee
FHA	Fire Hazard Analysis
GEH-C	GE-Hitachi Nuclear Energy Canada Inc.
GNSCR	General Nuclear Safety and Control Regulations
HAZOP	Hazards and Operability
IAEA	International Atomic Energy Agency
IEMP	Independent Environmental Monitoring Program
JHA	Job Hazard Analysis
Kg	Kilogram

LCH	Licence Conditions Handbook
L	Litre
LTI	Lost-Time Injury
LTWMF	Long Term Waste Management Facilities
MOECP	Ontario Ministry of the Environment, Conservation and Parks
Mg	Megagram
mSv	millisievert
NEW	Nuclear Energy Worker
OSLD	Optically stimulated luminescent dosimeters
OLC	Operating Limits and Conditions
PDP	Preliminary decommissioning plan
PFP	Participant Funding Program
PPE	Personal Protective Equipment
ppm	Parts per million
REGDOC	Regulatory Document
ROR	Regulatory Oversight Report
RP	Radiation Protection
SAT	Systematic approach to training
SCA	Safety and control area
SSC	Structures, systems and components relied upon for safety
µg	Microgram
UO_2	Uranium Dioxide
µSv	microSievert
WHMIS	Workplace Hazardous Materials Information System

A. RATING LEVELS

Fully Satisfactory (FS)

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

Satisfactory (SA)

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

Below Expectations (BE)

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

Unacceptable (UA)

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

B. BASIS FOR THE RECOMMENDATION(S)

B.1 Regulatory Basis

The recommendations presented in this CMD are based on compliance objectives and expectations associated with the relevant SCAs and other matters. The regulatory basis for the matters that are relevant to this CMD are as follows.

Management System

The regulatory foundation for the recommendation(s) associated with Management System includes the following:

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 3(*d*) that an application for a licence for a Class I nuclear facility shall contain the proposed quality assurance program for the activity to be licensed.
- The *General Nuclear Safety and Control Regulations* requires that an application for a licence shall contain, under paragraphs:
  - 3(1)(*k*), the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the NSCA and the regulations made under the NSCA, including the internal allocation of functions, responsibilities and authority.
  - 15(*a*), the persons who have the authority to act for them (the applicant/licensee) in their dealings with the Commission.
  - 15(*b*), the names and position titles of the persons who are responsible for the management and control of the licensed activity and the nuclear substance, nuclear facility, prescribed equipment or prescribed information encompassed by the licence.

Human Performance Management

The regulatory foundation for the recommendation(s) associated with Human Performance Management includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under section 12, that the licensee shall:
  - 12(1)(*a*), ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence.
  - 12(1)(*b*), train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence.
  - 12(1)(*e*), require that every person at the site of the licensed activity to use equipment, devices, clothing and procedures in accordance with the Act, the regulations made under the Act and the licence.

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(*m*) that a licence application contains information on the proposed responsibilities of and the qualification requirements and training program for workers, including the procedures for the requalification of workers.
- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(*n*) that a licence application contains information on the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility.

Operating Performance

The regulatory foundation for the recommendation(s) associated with operating performance includes the following:

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(d) that an application for a licence to operate a Class I nuclear facility shall contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Safety Analysis

The regulatory foundation for the recommendation(s) associated with safety analysis includes the following:

- 3(1)(*i*) of the *General Nuclear Safety and Control Regulations* requires that an application for a licence shall contain a description and the results of any test, analysis or calculation performed to substantiate the information included in the application.
- It is a requirement of the *Class I Nuclear Facilities Regulations* that an application for a licence to operate a Class I nuclear facility shall contain the following information under paragraphs:
  - 6(*c*), a final safety analysis report demonstrating the adequacy of the design of the nuclear facility.
  - 6(*h*), the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects.

Physical Design

The regulatory foundation for the recommendation(s) associated with physical design includes the following:

- Paragraph 3(1)(*d*) of the *General Nuclear Safety and Control Regulations* requires that an application for a licence shall contain a description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence.
- Other requirements set out in paragraphs 3(a), 3(b), 6(a) and 6(b) of the *Class I Nuclear Facilities Regulations* require more specific information to be submitted in

the licence application related to the site and design of the facility and the final safety analysis report.

- Paragraphs 6(*c*) and 6(*d*) of the *Class I Nuclear Facilities Regulations* require that an application for a licence contain a final safety analysis report demonstrating the adequacy of the design of the facility and proposed measures, policies, methods and procedures for operating and maintaining the facility.

Fitness for Service

The regulatory foundation for the recommendation(s) associated with fitness for service includes the following:

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(d) that an application for a licence to operate a Class I nuclear facility contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Radiation Protection

The regulatory foundation for the recommendation(s) associated with radiation protection includes the following:

- The *General Nuclear Safety and Control Regulations* require, under subsection 3(1), that a licence application contain the following information under paragraphs:
  - 3(1)(*e*), the proposed measures to ensure compliance with the *Radiation Protection Regulations*.
  - 3(1)(*f*), any proposed action level for the purpose of section 6 of the *Radiation Protection Regulations*.
  - The *Radiation Protection Regulations* require, under sections 4 to 6, that the licensee implements a radiation protection program, ascertain and record doses, and take the required actions in the case that an action level has been reached.
- The *Class I Nuclear Facilities Regulations* require that an application for a licence to operate a Class I nuclear facility contain:
  - Under paragraph 6(*e*), the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.
  - Under paragraph 6(*h*), the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measure that will be taken to prevent or mitigate those effects.

Conventional Health and Safety

The regulatory foundation for the recommendation(s) associated with Conventional Health and Safety includes the following:

- It is a requirement of the C*lass I Nuclear Facilities Regulations* under paragraph 3(f) that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the proposed worker health and safety policies and procedures.

- BWXT's activities and operations must comply with the *Canada Labour Code*, Part II: *Occupational Health and Safety*.

Environmental Protection

The regulatory foundation for the recommendation(s) associated with Environmental Protection includes the following:

- The *General Nuclear Safety and Control Regulations*, under paragraphs 12(1)(c) and (f), require that each licensee take all reasonable precautions to protect the environment and the health and safety of persons, and to control the release of radioactive nuclear substances and hazardous substances within the site of the licensed activity and into the environment.
- The *Radiation Protection Regulations* prescribe dose limits for the general public, which under Subsection 1(3) is 1 mSv per calendar year.
- In addition, Sections 3 and 6 of the *Class I Nuclear Facilities Regulations* must be met by the applicant. The application for a licence shall contain under paragraphs:
    - 3(*e*), the name, form, characteristics and quantity of any hazardous substances that may be on the site while the activity to be licensed is carried on.
    - 3(*g*), the proposed environmental protection policies and procedures.
    - 3(*h*), the proposed effluent and environmental monitoring programs.
    - 6(*e*), the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.
    - 6(*h*), the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects.
        - 6(*i*), the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics.
        - 6(*j*), the proposed measures to control releases of nuclear substances and hazardous substances into the environment.

Emergency Management and Fire Protection

The regulatory foundation for the recommendation(s) associated with Emergency Management and Response includes the following:

- 12(1)(c) of the *General Nuclear Safety and Control Regulations* states that every licensee shall "take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security".
- 12(1)(f) of the *General Nuclear Safety and Control Regulations* states that every licensee shall "take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances within the site of the licensed activity and into the environment of the licensed activity".

- It is a requirement of the Class I Nuclear Facilities Regulations under paragraph 6(k) that a licence application contains information on the licensee's proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of national security, including measures to:
  - Assist offsite authorities in planning and preparing to limit the effects of an accidental release;
  - Notify offsite authorities of an accidental release or the imminence of an accidental release;
  - Report information to offsite authorities during and after an accidental release;
  - Assist offsite authorities in dealing with the effects of an accidental release; and
  - Test the implementation of the measures to prevent or mitigate the effects of an accidental release.

Waste Management

The regulatory foundation for the recommendation(s) associated with Waste Management includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under paragraph 3(1)(j) that an application for a licence include the name, quantity, form and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed, or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste.

Security

The regulatory foundation for the recommendation(s) associated with Security includes the following:

- It is a requirement of all Class I licensees to comply with the *Nuclear Security Regulations*.

Safeguards and Non-Proliferation

The regulatory foundation for the recommendation(s) associated with Safeguards and Non-Proliferation includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under paragraph 12(1)(i) that each licensee take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement, where the applicable agreements are:
- The Agreement between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons.

- The Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons.

Packaging and Transport

Cameco is required to comply with the *Packaging and Transport of Nuclear Substances Regulations* and Transport Canada's *Transportation of Dangerous Goods Regulations*.

Decommissioning Strategy and Financial Guarantees

The regulatory foundation for the recommendation(s) associated with BWXT's Decommissioning Strategy and Financial Guarantees includes:

- The *General Nuclear Safety and Control Regulations* requires under paragraph 3(1)(l) that a licence application contains a description of any proposed financial guarantee relating to the activity to be licensed.
- Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the proposed plan for the decommissioning of the nuclear facility or of the site.

Licensee's Public Information Program

It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 3(j) that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain information on the licensee's public information program.

B.2 Technical Basis

The technical basis for the recommendations presented in this CMD is addressed was provided to the applicant before the submission of the application and is reproduced below.

BWXT NEC - Applicable Standards and Codes per Safety and Control Area

SCA	Document Title
Management System	CSA N286-12 (2012): *Management System Requirements for Nuclear Facilities*
Human Performance Management	CNSC REGDOC-2.2.2 (2014): *Personnel Training*
	CNSC REGDOC-2.1.2 (2018): *Safety Culture*
	CNSC G-323(2007): *Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities - Minimum Staff Complement*
Operating Performance	CNSC REGDOC-3.1.2: *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills*
Safety Analysis	IAEA NS-R-5: *Safety of Nuclear Fuel Cycle Facilities*

SCA	Document Title
Physical Design	CSA B51-14(2014): *Boiler Pressure Vessel and Pressure Piping Code*
	NBC-2015(2015): *National Building Code*
	NFC-2015(2015): *National Fire Code*
Fitness for Service	CSA B51-14(2014): *Boiler Pressure Vessel and Pressure Piping Code*
	NBC-2015(2015): *National Building Code*
	NFC-2015(2015): *National Fire Code*
Radiation Protection	CNSC G-129 Rev 1(2004): *Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"*
	CNSC G-91(2003): *Ascertaining and recording radiation doses to individuals*
	CNSC G-228(2001): *Developing and Using Action Levels*
	CNSC S-260(2004): *Making changes to dose related information filed with the national dose registry*
Conventional Health and Safety	CLC Part II *: Canada Labour Code Part II and associated regulations*
Environmental Protection	CNSC REGDOC-2.9.1(2017): *Environmental Protection: Environmental Principles, Assessments and Protection Measures*, version 1.1
	CSA N288.6-12(2012): *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills*
	CSA N288.4-10(2010): *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
	CSA N288.5-11(2011): *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
	CSA N288.1(2014): *Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities*
	CSA N288.7-15(2015): *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
	CSA N288.8-17(2017): *Establishing and implementing action levels for releases to the environment from nuclear facilities*
Emergency Management and Fire Protection	CNSC REGDOC-2.10.1(2017): *Nuclear Emergency Preparedness and Response*
	CSA N393-14 (2014): *Fire Protection for facilities that process, handle or store nuclear substances*

SCA	Document Title
Waste Management	CSA N294-09(2009): *Decommissioning of Facilities Containing Nuclear Substances*
	CNSC G-219(2000): *Decommissioning Planning for Licensed Activities*
	CSA N292.0-14(2014): *General Principles for the Management of Radioactive Waste and Irradiated Fuel*
	CSA N292.3-14(2014): *Management of Low- and Intermediate – level Radioactive Waste*
Security	CNSC REGDOC-2.12.3(2013): *Security of Nuclear Substances: Sealed Sources*
Safeguards	IAEA-Canada: *Protocol Additional to the Agreement Between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*
	IAEA SG-SGOB-3105: *Integrated Safeguards Procedure*
	CNSC REGDOC-2.13.1: *Safeguards and Nuclear Material Accountancy*
	CNSC REGDOC-2.13.2: *Import and Export Version 2*
Packaging and Transport	CNSC Regulation*: Packaging and Transport of Nuclear Substances Regulations*
	Transport Canada Regulation*: Transportation of Dangerous Goods Regulations*
	IAEA Regulation*: Regulations for the Safe Transport of Radioactive Material (2012)*
Public Information Program	CNSC REGDOC-3.2.1: *Public Information and Disclosure*
Aboriginal Consultation	REGDOC-3.2.2: *Aboriginal Engagement*
Cost Recovery	CNSC Regulation*: Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*
Financial Guarantee	CNSC G-206(2000): *Financial Guarantees Guide for the Decommissioning of Licensed Activities*

C. SAFETY AND CONTROL AREA FRAMEWORK

C.1 Safety and Control Areas Defined

The safety and control areas identified in section 2.2, and discussed in summary in sections 3.1 through 3.14 are comprised of specific areas of regulatory interest which vary between facility types.

The following table provides a high-level definition of each SCA. The specific areas within each SCA are to be identified by the CMD preparation team in the respective areas within section 3 of this CMD.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
Management	Management System	Covers the framework which establishes the processes and programs required to ensure an organization achieves its safety objectives and continuously monitors its performance against these objectives and fostering a healthy safety culture.
	Human Performance Management	Covers activities that enable effective human performance through the development and implementation of processes that ensure that licensee staff is sufficient in number in all relevant job areas and that licensee staff have the necessary knowledge, skills, procedures and tools in place to safely carry on their duties.
	Operating Performance	This includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.
Facility and Equipment	Safety Analysis	Maintenance of the safety analysis that supports that 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 preventative measures and strategies in reducing the effects of such hazards.
	Physical Design	Relates to activities that impact on the ability of systems, components and structures to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
	Fitness for Service	Covers activities that affect the physical condition of systems, components and structures to ensure that they remain effective over time. This includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.
Core Control Processes	Radiation Protection	Covers the implementation of a radiation protection program in accordance with the RP Regulations. This program must ensure that contamination and radiation doses received are monitored and controlled.
	Conventional Health and Safety	Covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.
	Environmental Protection	Covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.
	Emergency Management and Fire Protection	Covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. This also includes any results of exercise participation.
	Waste Management	Covers internal waste-related programs which 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. Also covers the planning for decommissioning.
	Security	Covers the programs required to implement and support the security requirements stipulated in the regulations, in their licence, in orders, or in expectations for their facility or activity.
	Safeguards and Non-Proliferation	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*.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
	Packaging and Transport	Programs that cover the safe packaging and transport of nuclear substances and radiation devices to and from the licensed facility.

C.2 Specific Areas for Uranium Processing Facilities

The following table identifies the specific areas that comprise each SCA for a uranium processing facility as applicable for this licence application:

SPECIFIC AREAS FOR URANIUM PROCESSING FACILITY		
Functional Area	**Safety and Control Area**	**Specific Areas**
Management	Management System	▪ Management System ▪ Organization ▪ Performance Assessment, Improvement and Management Review ▪ Operating Experience (OPEX) ▪ Change Management ▪ Safety Culture ▪ Configuration Management ▪ Records Management ▪ Management of Contractors ▪ Business Continuity
	Human Performance Management	▪ Human Performance Programs ▪ Personnel Training ▪ Fitness for Duty
	Operating Performance	▪ Conduct of Licensed Activity ▪ Procedures ▪ Reporting and Trending
Facility and Equipment	Safety Analysis	▪ Deterministic Safety Analysis ▪ Hazard Analysis
	Physical Design	▪ Design Governance ▪ Site Characterization ▪ Facility Design ▪ Structure Design ▪ Components Design

SPECIFIC AREAS FOR URANIUM PROCESSING FACILITY		
Functional Area	**Safety and Control Area**	**Specific Areas**
	Fitness for Service	▪ Equipment Fitness for Service/Equipment Performance ▪ Maintenance ▪ Periodic Inspection and Testing
Core Control Processes	Radiation Protection	▪ Application of ALARA ▪ Worker Dose Control ▪ Radiation Protection Program Performance ▪ Radiological Hazard Control ▪ Estimated Dose to Public
	Conventional Health and Safety	▪ Performance ▪ Practices ▪ Awareness
	Environmental Protection	▪ Effluent and Emissions Control (releases) ▪ Environmental Management System (EMS) ▪ Assessment and Monitoring ▪ Protection to the Public ▪ Environmental Risk Assessment
	Emergency Management and Fire Protection	▪ Conventional Emergency Preparedness and Response ▪ Nuclear Emergency Preparedness and Response ▪ Fire Emergency Preparedness and Response
	Waste Management	▪ Waste Characterization ▪ Waste Minimization ▪ Waste Management Practices ▪ Decommissioning Plans ▪

SPECIFIC AREAS FOR URANIUM PROCESSING FACILITY		
Functional Area	**Safety and Control Area**	**Specific Areas**
	Security	▪ Facilities and Equipment ▪ Response Arrangements ▪ Security Practices ▪ Drills and Exercises
	Safeguards and Non-Proliferation	▪ Nuclear Material Accountancy and Control ▪ Access and Assistance to the IAEA ▪ Operational and Design Information ▪ Import and Export
	Packaging and Transport	▪ Package Design and Maintenance ▪ Packaging and Transport

D. ENVIRONMENTAL PROTECTION REVIEW REPORT

e-Doc 5930866

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Canada's Nuclear Regulator

Environmental Protection Review Report:
BWXT Nuclear Energy Canada Inc.
Toronto and Peterborough Facilities – FFOL-3620.01/2020 Licence Renewal

December 2019

e-Doc: 5930866 (Word)
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Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

REVISION HISTORY

The following table identifies the revision history of this document.

Revision number	Change	Summary of changes	Date
000	Initial release	N/A	December 2019
001			

EXECUTIVE SUMMARY

The Canadian Nuclear Safety Commission (CNSC) conducts Environmental Protection Reviews (EPR) for all licence applications with potential project-environmental interactions, in accordance with its mandate under the *Nuclear Safety and Control Act* (NSCA), to ensure the protection of the environment and the health of persons. An EPR is a science-based environmental technical assessment conducted by CNSC staff as set out in the NSCA. The fulfillment of other aspects of the CNSC's mandate, such as safety and security, are met through other regulatory oversight activities.

This EPR Report was written by CNSC staff for the Commission, Indigenous peoples and the public. It describes the scientific, evidence-based findings from CNSC staff's review of the application by BWXT Nuclear Energy Canada Inc. (BWXT) to renew its single Class 1B Fuel Facility Operating Licence 3620.01/2020.Under BWXT's current operating licence, FFOL 3620.01/2020, BWXT is permitted to produce natural and depleted uranium fuel bundles at its facilities in Toronto and Peterborough. These fuel bundles are used at both of Ontario Power Generation's Pickering and Darlington nuclear power generating stations. The licence application proposes the continued operations of both the Peterborough and Toronto facilities for a period of 10 years, from December 31, 2020 to December, 2030. BWXT has also requested authorization to allow pelleting operations at the Peterborough facility. Currently, pelleting operations are only performed at the Toronto facility. This request would not result in a change of how current pelleting operations are carried out or the licenced production and possession limits; the only change would be to where the pelleting operation would be conducted.

CNSC staff's EPR Report can be read as a stand-alone document that focuses on items that are of current public and regulatory interest such as potential releases from normal operations and decommissioning activities, of radiological and hazardous substances to the receiving environment, valued ecosystem components and species at risk.

This EPR Report includes CNSC staff's assessment of the documents submitted in support of the licence application, as well as but not limited to, the following:

- the results of BWXT's environmental monitoring, as reported in Annual Compliance Monitoring Reports
- BWXT's submitted Environmental Risk Assessments for the Toronto and Peterborough facilities, and for pelleting operations at the Peterborough facility
- BWXT's preliminary decommissioning plan
- the results of CNSC's Independent Environmental Monitoring Program
- the results from other regional monitoring programs and/or health studies completed by other levels of government in proximity to the BWXT Toronto and Peterborough facilities

The information provided in this EPR Report supports the environmental protection conclusions made by CNSC staff in Commission Member Document 20-H2 that BWXT has made, and will continue to make adequate provision for the protection of the environment and the health of persons.

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Environmental Protection Review (EPR) is to report the outcome of Canadian Nuclear Safety Commission (CNSC) staff's review of licensing and environmental compliance activities conducted under the *Nuclear Safety and Control Act* (NSCA). This review serves to assess whether BWXT Nuclear Energy Canada Inc. (BWXT) has made, and will continue to make, adequate provision to protect the environment and health of persons at the Peterborough and Toronto facilities.

This EPR Report presents information that supports CNSC staff's recommendations in Commission Members Document (CMD) 20-H2 regarding the proposed licence renewal of the BWXT Fuel Facility Operating Licence (FFOL) 3620.01/2020, as it pertains to environmental protection (EP). BWXT has requested to renew its licence for a period of 10 years, from December 31, 2020 to December, 2030 [1]. The current licence expires on December 31, 2020 [2].

CNSC staff assess the environmental and health effects of nuclear facilities and activities at every phase of its lifecycle. EPR Reports are prepared to provide transparency regarding staff's assessment of the performance of BWXT relating to EP. The fulfillment of other aspects of the CNSC's mandate, such as safety and security, are met through other regulatory oversight activities that are outside the scope of this report.

This EPR Report is based on information submitted by BWXT, compliance and technical assessment activities completed by the CNSC staff, and independent verification activities, including the following:

- regulatory oversight (section 2.0)
- CNSC staff review of the BWXT decommissioning strategy and program overview (section 2.2.) [3]
- CNSC staff review of BWXT's Annual Compliance Monitoring Reports (formerly referred to as Annual Safety Reports) [4-12]
- CNSC staff review of the submitted Environmental Risk Assessments (ERA) for the Toronto and Peterborough facilities, as well as the ERA for pelleting operations at the Peterborough facility (section 3.2) [13] [14]
- Independent Environmental Monitoring Program (IEMP) results (section 4.0)
- health studies and other regional monitoring programs in proximity to the BWXT sites (sections 5.0 and 6.0)

A review has been conducted for all environmental components related to the project, but only a selection of topics related to environmental protection are presented in detail in this report. These were selected based on licensing requirements, as well as those that have historically been of interest to the Commission, Indigenous peoples and the public.

This EPR Report can be read as a stand-alone document that focuses on topics related to the environmental performance of the facility including emissions (atmospheric releases) and effluents (liquid releases) to the environment, its potential transfer through key environmental pathways and

associated potential exposures and/or effects on valued ecosystem components (VEC) including human and non-human biota. The focus is on nuclear and hazardous substances associated with the BWXT sites' activities, with additional information provided on other topics of public and/or regulatory interest such as greenhouse gas (GHG) emissions. CNSC staff also present information on relevant regional environmental or health monitoring, or studies conducted by the CNSC (e.g., IEMP) or other governmental organizations.

1.2 Project Background

This section of the report provides general information on the BWXT sites. This includes a description of the site locations and a basic history of site activities and licensing, followed by information on activities planned for the proposed licence period.

This information is intended to provide context for later sections of this report, which discuss completed and ongoing regulatory oversight activities.

1.2.1 Site Description

BWXT owns and operates two nuclear processing facilities, one in Toronto and the other in Peterborough, approximately 135 km northeast of Toronto.

1.2.1.1 BWXT Toronto

BWXT's facility in Toronto is located on the east side of Lansdowne Avenue and north of Dupont Street, and has been producing fuel pellets since 1965. The facility consists of two buildings (as seen in figure 1.1):

- building 7 houses the natural and depleted uranium pelleting operations and administrative offices
- building 9 is primarily used to store contaminated substances such as filters, waste water, other waste products, and contaminated zirconium tubes

The Toronto facility is located in a highly urbanized area and within immediate proximity to residential homes and a number of high rise residential buildings.

1.2.1.2 BWXT Peterborough

The Peterborough facility has also been in operation, assembling fuel bundles for nuclear power plants, since 1965 and is located within an industrial site owned by General Electric Canada (GE). There are four buildings associated with BWXT's operations (as seen in figure 1.2):

- building 21 houses the fuel bundle assembly operations
- building 24 is used for storage of finished products prior to shipping and occasionally for storage of incoming pellets and powder
- building 26 is used for manufacturing, refurbishment and assembly of fuel handling equipment
- building 28 acts as the shipping and receiving dock

The industrial site is located in the centre of Peterborough and is surrounded by residential buildings and a public school.

Figure 1.1: Aerial image of BWXT Toronto facility location [15]

Figure 1.2: Aerial image of BWXT Peterborough facility location [15]

1.2.2 Project Overview

Under BWXT's current operating licence, FFOL 3620.01/2020, BWXT is permitted to produce natural and depleted uranium fuel bundles at its facilities in Toronto and Peterborough. These fuel bundles are used at both of Ontario Power Generation's Pickering and Darlington nuclear power generating stations.

For more detailed information on the operations carried out at the Toronto and Peterborough facilities, please refer to CMD 20-H2 [16], CNSC staff's written submission that outlines these activities.

In November 2018, BWXT submitted an application [1] requesting renewal of its current licence [2], set to expire in 2020, for a 10-year period. In this application, BWXT is also requesting the approval of a revised financial guarantee, and authorization to conduct pelleting operations at the Peterborough facility. BWXT has not requested an increase or decrease in production limits and possession limits, nor have they requested to change the footprint of the Peterborough facility.

2.0 REGULATORY OVERSIGHT

The CNSC regulates nuclear facilities and activities in Canada to protect the environment and the health and safety of persons in a manner that is consistent with Canadian environmental policies, acts and regulations and with Canada's international obligations. The CNSC assesses the environmental and health effects of nuclear facilities and activities at every phase of its lifecycle. This section of the EPR Report discusses the CNSC's regulatory oversight of EP measures at both BWXT Peterborough and Toronto sites.

To meet CNSC's regulatory requirements, BWXT is responsible for implementing and maintaining EP measures that identify, control and (where necessary) monitor releases of radiological and hazardous substances and effects on human health and the environment, from both the Peterborough and Toronto sites. These EP measures must comply with, or have implementation plans in place to comply with, the regulatory requirements included in BWXT's licence. The regulatory requirements for both the BWXT Peterborough and Toronto sites are outlined in this section of the report.

2.1 Environmental Protection Reviews and Assessments

Under the NSCA, an assessment of the environment is part of the ongoing lifecycle EP framework wherein EPR Reports, such as this one, are produced. No decision is made on the EPR itself, as the information is intended to inform and support the regulatory decision being sought from the Commission.

Depending on the scope and impact of project activities, other legislation such as the *Impact Assessment Act of Canada* [17] or the former *Canadian Environmental Assessment Act, 2012* (CEAA 2012) [18] and the *Canadian Environmental Assessment Act* (CEAA) [19] may require, or have required, an impact or environmental assessment (EAs). The following section provides information on any past EAs completed with respect to activities at the BWXT sites. When the BWXT facilities were first constructed and began operations, no EA was carried out, as there were no EA requirements stipulated in either federal guidelines or legislation at the time.

2.1.1 Previous EA Completed Under CEAA

Addition of a Low Enriched Uranium Fuel Bundle Manufacturing Line in Peterborough

In 2007, GE-Hitachi Nuclear Energy Canada (predecessor proponent to BWXT) proposed to manufacture Low Enriched Uranium (LEU) fuel bundles at its Peterborough facility [20]. Under CEAA, it was determined that a screening type EA would be required for this project. The proposal included the addition of new equipment to support an LEU manufacturing line, including a LEU pellet receiving area, a LEU fuel bundle production area, and a LEU fuel bundle storage area. No new structures, licensed facilities, or expansions to the existing licensed area were proposed, and no change in production limits were requested.

After the Commission's consideration of the screening report, a decision on the EA was rendered stating that, upon taking into account implementation of appropriate mitigation measures and public input, that the project, as proposed, would not likely cause significant adverse environmental effects [21].

Following the positive EA decision, GE-Hitachi Nuclear Energy Canada withdrew the application and canceled the project, choosing not to apply for the CNSC licence required to continue with the project.

No EA follow-up program was implemented because the project was not carried out.

2.2 Preliminary Decommissioning Plan

Decommissioning activities for nuclear facilities are regulated by the CNSC. The following sub-section provides high level information with respect to the Preliminary Decommissioning Plan (PDP) for the BWXT sites.

Decommissioning plans document the decommissioning strategy and end-state objectives; the major decontamination, disassembly and remediation steps; the approximate quantities and types of waste generated; an overview of the principal hazards and protection strategies; and an estimate of cost. As a full lifecycle regulator, the CNSC will continue to carry out regulatory oversight of the end state of the BWXT sites.

The decommissioning strategy for the BWXT sites is documented in the 2019 *Updated Preliminary Decommissioning Plans for the BWXT Nuclear Energy Canada Toronto and Peterborough Facilities* [3].

BWXT is required to plan, implement and complete decommissioning activities in accordance with the PDP, which CNSC staff have reviewed and accepted. Through analysis of these plans, staff can provide a high level assessment of how the project/environmental interactions will change over time, which are expected to decrease as operations cease and decommissioning activities start to occur.

Additional detail is provided in the Waste Management SCA, section 3.11 of the CMD 20-H2 [16].

2.3 Environmental Regulatory Framework and Protection Measures

The CNSC has a comprehensive EP regulatory framework which includes both nuclear and hazardous substances, the protection of the public and the environment, including ecosystem functions and non-human biota. Public dose is considered under the EP framework, as well as from a radiation protection standpoint, as public exposure is a result of the public's interaction with the environment (i.e., the public are a part of the environment). The focus of this subsection of the EPR Report is on the EP regulatory framework and the status of BWXT's environmental protection program (EPP). The results derived from these programs are detailed in section 3.0 of this report.

The EPP at the BWXT facilities was designed and implemented in accordance with REGDOC 2.9.1-2013 *Environmental Protection: Policies, Programs and Procedures* [22], as well as Canadian Standards Association (CSA) standards that are listed below. The EPP includes Derived Release Limits, referred to as Derived Emission Limits (DEL) by BWXT, and public dose modelling. BWXT is also required to update its EPP to meet the latest version of REGDOC 2.9.1-2017 *Environmental Protection: Environmental Principles, Assessments and Protection Measures* [23] and the associated CSA standards. The implementation status for these items is shown in table 2.1 below.

Table 2.1: Status of BWXT Environmental Protection Measures to Implement Regulatory Documents and Standards

Regulatory document or standard	Status
CNSC Regulatory Document REGDOC 2.9.1 *Environmental Protection: Policies, Programs and Procedures* (2013) [22]	Implemented
CSA Standard N288.1-08, G*uidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities* [24]	Implemented
CSA Standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities* [25]	Implemented by January 2020
CSA Standard N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and Uranium mines and mills* [26]	Implemented
CSA Standard N288.5-11, *Effluent Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills* [27]	Implemented
CSA Standard N288.6-12, *Environmental risk assessment at Class I nuclear facilities and Uranium mines and mills* [28]	Implemented
CSA Standard N288.8-17, *Establishing and implementing action levels to control releases to the environment from nuclear facilities* [29]	Implemented by January 2020
CNSC Regulatory Document REGDOC 2.9.1, *Environmental Principles, Assessments and Protection Measures, version 1.1* (2017) [23]	Implemented by January 2020

CNSC staff confirm that BWXT has either implemented programs according to the relevant EP regulatory documents or standards, or has implementation plans in place. BWXT has committed to a schedule, such that its programs will be designed and implemented, according to REGDOC-2.9.1-2017 [23] and the full range of associated CSA standards before the licencing hearing.

In addition, licensees are required to regularly report on the results of these programs. Reporting requirements are specified within the *Radiation Protection Regulations* [30] (action level (AL) or dose limit exceedances)), the licensees' approved programs and manuals, or as specified within the Licence Condition Handbook [31].

BWXT is required to submit annual compliance monitoring reports. These annual reports are reviewed by CNSC staff for compliance and verification as well as trending. BWXT's annual compliance monitoring reports are available on BWXT's website [32].

CNSC staff regularly report on the licensee performance to the Commission for activities conducted at the BWXT sites. Regulatory Oversight Reports (RORs) are the CNSC's standard mechanism for updating the Commission on the operation and regulatory performance of licensed facilities.

2.3.1 Environmental Protection Measures

To meet CNSC's regulatory requirements under REGDOC-2.9.1-2013 [21], BWXT is responsible for implementing and maintaining EP measures that identify, control and monitor releases of radioactive and hazardous substances and effects on human health and the environment, from the Peterborough and Toronto BWXT facilities. EP measures are an

important component of the overall requirement of licensees to make adequate provision to protect the environment and health of persons.

This, and the following sub-sections, provide a brief summary of the BWXT EP program and the status of each specific EP measure, relative to the latest regulatory document or CSA standard. Section 3.0 of this EPR Report summarizes the results of these programs/measures against relevant regulatory limits and environmental quality objectives/guidelines, and discusses any trends of interest.

BWXT was required to implement an Environmental Management System (EMS) to conform with REGDOC-2.9.1-2013 [21], and submitted the Radiation Protection Manual (RPM) [34] as its EPP. BWXT's EPP includes the following requirement and guidance components as outlined in REGDOC-2.9.1-2013:

- EMS
- ERA
- Effluent Emissions Control and Monitoring:
    - Derivation of DELs and Facility Licence Operating Limits (FLOLs)
    - Air emissions and liquid effluent monitoring
- Environmental Monitoring Program (EMP):
    - Ambient air monitoring (Toronto), soil monitoring (Toronto) and gamma monitoring (Peterborough and Toronto)

2.3.2 Environmental Management System

An EMS refers to the management of an organization's environmental policies, programs and procedures in a comprehensive, systematic, planned and documented manner. It includes the organizational structure, planning and resources to develop, implement and maintain a policy for EP. The EMS serves as a management tool to integrate all of a licensee's EP measures in a documented, managed and auditable process as follows:

- identify and manage non-compliances and corrective actions within the activities, through internal and external inspections and audits
- summarize and report the performance of these activities both internally (licensee management) and externally (Commission and public)
- train personnel involved in these activities
- ensure the availability of resources (i.e., qualified personnel, organizational infrastructure, technology and financial resources)
- define and delegate roles, responsibilities and authorities essential to effective management

BWXT established and implemented an EMS for the Peterborough and Toronto facilities in accordance with REGDOC-2.9.1-2013 [21], which is also registered and certified under CAN/CSA ISO-14001-2015 *Environmental Management Systems – Requirements with Guidance for Use* [33]. CNSC staff review BWXT's annual internal audits, management reviews, and environmental objectives to ensure compliance with REGDOC-2.9.1-2013. While formal ISO certification is not solely considered by the CNSC as meeting the requirements of

REGDOC-2.9.1, the results of these third party audits are reviewed by CNSC staff, as part of the compliance program.

2.3.3 Environmental Risk Assessment

An environmental risk assessment (ERA) of nuclear facilities is a systematic process used 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. The ERA serves as the basis for the development of site specific effluent and EMPs. These programs in turn inform and refine future revisions of the ERA.

In 2017, BWXT submitted a package including two updated ERAs to the CNSC, for both the Toronto and Peterborough facilities, which were also revised and resubmitted in 2018, both ERAs are publicly available on BWXT's website here [13]. In 2018, BWXT also submitted an additional ERA that assessed the proposed pelleting operations and eventual consolidation of the nuclear fuel pellet operation [14] to the facility in Peterborough; also posted online and available here. The proposed pelleting operations at Peterborough would not require any changes to the physical footprint of the current Peterborough facility but would increase the levels of uranium in both airborne and waterborne releases to the surrounding environment at Peterborough. Based on CNSC staff's assessment, which is discussed in section 3.2 of this report, these levels are expected to remain low and continue to be below regulatory limits.

CNSC staff reviewed all three ERAs and found them to be in accordance with CSA standard N288.6-12 *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills* [28]. Conclusions of the three ERAs are summarized in table 2.2 below, and ecological and human health effects due to releases of Contaminants of Potential Concern (COPC) to the air and water from the BWXT facilities were found to be unlikely.

Table 2.2: Conclusions of the three separate ERAs conducted by BWXT for the Toronto and Peterborough facilities, as well as the proposed pelleting operations at the Peterborough site [13, 14]

Type	BWXT Toronto		BWXT Peterborough		Proposed pelleting operations at BWXT Peterborough	
	Members of the public	Aquatic and terrestrial environment	Members of the public	Aquatic and terrestrial environment	Members of the public	Aquatic and terrestrial environment
Radiological	No adverse impacts expected from radiological COPCs released from the Toronto site.	No adverse impacts expected from radiological COPCs released from the Toronto site.	No adverse impacts expected from radiological COPCs released from the Peterborough site.	No adverse impacts expected from radiological COPCs released from the Peterborough site.	No adverse impacts expected from radiological COPCs released from the Peterborough site including the pelleting operations.	No adverse impacts expected from radiological COPCs released from the Peterborough site including the pelleting operations.
Non-radiological	No adverse impacts expected from non-radiological COPCs released from the Toronto site.	No adverse impacts expected from non-radiological COPCs released from the Toronto site.	No adverse impacts expected from non-radiological COPCs released from the Peterborough site.	No adverse impacts expected from non-radiological COPCs released from the Peterborough site.	No adverse impacts expected from non-radiological COPCs released from the Peterborough site including the pelleting operations.	No adverse impacts expected from non-radiological COPCs released from the Peterborough site including the pelleting operations.
Physical	No adverse impacts expected to human health expected from noise at the Toronto site.	No physical stressors associated with the operation of the Toronto site were found to be relevant for assessment.	No adverse impacts expected to human health expected from noise at the Peterborough site.	No physical stressors associated with the operation of the Peterborough site were found to be relevant for assessment.	No adverse impacts expected to human health expected from noise associated including the pelleting operations.	No physical stressors associated with pelleting operations at the Peterborough site were found to be relevant for assessment.

2.3.4 Effluent and Emissions Control and Monitoring

Controls on environmental releases are established to provide protection to the environment and to respect the principles of sustainable development and pollution prevention. The effluent and emissions prevention and control measures are established based on industry best practice, the application of optimization (e.g., in design) and *As Low As Reasonably Achievable* (ALARA) principles, the Canadian Council of Ministers of the Environment (CCME) and Ontario's Ministry of the Environment, Conservation, and Parks (MECP) guidelines, and results of the licensee's ERAs.

BWXT's RPM [34] and *Beryllium Safety Manual* [35], both reviewed and approved by CNSC staff, contain site-specific DELs, action levels (ALs), and FLOLs to control radiological and hazardous effluents and emissions. The DELs represent the maximum acceptable level of emitted contaminants from the processes at the BWXT facilities and are derived from the dose limit for members of the public. The ALs serve as an early warning of potential loss of control. The FLOLs are loading based limits that ensure both facilities continue to operate within their licensing basis.

In 2020, BWXT plans to implement CSA standard N288.8-17 *Establishing and implementing action levels to control releases to the environment from nuclear facilities* [29]. The action levels will be derived from actual operating expectations and performance, in accordance with CSA standard N288.8-17. Currently CSA N288.8-17 is not a licensing requirement in BWXT's current LCH, however it has been included in the updated LCH before the Commission as compliance verification criteria.

BWXT's RPM [34] has been reviewed and approved by CNSC staff and is in compliance with REGDOC-2.9.1-2013 [21]. BWXT will revise its RPM accordingly in the upcoming licence period to address any changes in their programs associated with REGDOC 2.9.1-2017 [23] and CSA standards N288.8-17 [29] and N288.1-14 [25].

Based on compliance and technical assessment activities, CNSC staff have concluded that the RPM [34] currently in place for the BWXT facilities continues to protect the public and the environment.

2.3.5 Environmental Monitoring Program

CNSC requires licensees to design and implement an EMP specific to the monitoring and assessment requirements associated with its facility, and the environment within which the facility is situated. The program is required to:

- measure contaminants in surrounding environmental media of the facility or site
- determine the effects, if any, of the site or facility operations on people and the environment
- serve as a secondary support to emission monitoring programs to demonstrate the effectiveness of emission controls

More specifically, the program must obtain the necessary environmental data to calculate public dose, to demonstrate compliance with the public dose limit (1 mSv per year). The program

design must also address the potential environmental interactions identified at the site. Radiation and radionuclides are the major focus at the BWXT facilities, though hazardous substances are included within monitoring activities associated with sewage discharge and air emissions. BWXT's EMP consists of uranium in ambient air monitoring (Toronto facility), soil monitoring (Toronto facility), and gamma monitoring (Toronto and Peterborough facilities). Uranium is also directly measured by continuous in-stack monitoring at both facilities.

Based on compliance and technical assessment activities, CNSC staff conclude that for the previous licence period, the BWXT facilities conducted its EMP as per its current licensing basis and in compliance with REGDOC-2.9.1-2013 [21].

2.4 Greenhouse Gas Emissions

A core element of the CNSC requirement for an EMS is the identification of all regulatory requirements applicable to the facility, whether under the NSCA or other federal or provincial legislation. The EMS must ensure that programs are in place to respect these requirements.

There are a range of broadly applicable federal environmental regulations (e.g., petroleum products storage tanks, environmental emergency regulations), including the management of GHG emissions.

Under the federal *Canadian Environmental Protection Act, 1999* [37], BWXT is required to monitor and report on GHG emissions [38]. Since 2013, nuclear facilities that emit more than the 50,000 tons of CO_2 equivalent (CO_2e) emission reporting threshold on an annual basis must report its GHG emissions. The BWXT facilities have continually been below the GHG emission threshold and are therefore not required to report these numbers to the CNSC.

The CNSC maintains a collaborative working relationship with Environment and Climate Change Canada (ECCC) through a formal Memorandum of Understanding (MOU). This ensures a coordinated regulatory approach is achieved to meet all federal requirements associated with EP, such as GHGs.

3.0 STATUS OF THE ENVIRONMENT

The following section of this EPR Report includes summaries of project-environment interactions that were assessed by CNSC staff and deemed to be of specific public, Indigenous and/or regulatory interest including atmospheric, aquatic, terrestrial and hydrogeological environments and human health, for the licence application by BWXT to renew the licence for both Peterborough and Toronto facilities.

Environmental components are regularly reviewed through annual reporting requirements and CNSC compliance verification activities, as detailed in other areas of this report. These are reported to the Commission in the environmental protection safety and control areas of licensing Commission Member Documents and annual RORs.

This section provides a summary of the status of the environment around both BWXT sites. It first includes a description of the radiological and hazardous releases to the environment (section 3.1), followed by a description of the surrounding environment of both BWXT facilities and an assessment of any potential effects to human health and the environment, as a result of exposure to these contaminants (section 3.2).

3.1 Releases to the Environment

3.1.1 Airborne Emissions

BWXT controls and monitors airborne emissions to the environment under its EPP. This program is based on CSA N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [27] where radiological and hazardous emissions are monitored.

BWXT has Environmental Compliance Approvals [39] issued by MECP for air emissions. Each facility maintains emission summaries and dispersion modelling reports to demonstrate compliance. BWXT monitors uranium air emissions from the stacks at the Peterborough and Toronto facilities, and beryllium air emissions at the Peterborough facility. Beryllium stack discharges to the environment from the Peterborough facility are considered to be negligible by CNSC staff. During the current licensing period (2011-2018), beryllium emissions have continually been below detectable limits and thus monitoring data has not been included in this report. Hazardous substances are monitored for trends and continuous improvement and are reportable to the National Pollutant Release Inventory (NPRI) [40] if reporting thresholds are exceeded.

Emissions of both uranium and beryllium are controlled at the source by the use of engineering and management controls such as but not limited to the design of machines, material handling equipment, and dust collection systems. At the Peterborough facility, a single uranium process emission point exists which is used to open and empty welded fuel elements. Three beryllium ventilation systems provide exhaust from areas which use beryllium as part of the fuel bundle manufacturing process. At the Toronto facility, there are six stacks that filter uranium dust and exhaust to the atmosphere due to the fuel pelleting operations which processes natural uranium dioxide powder (UO_2) into fuel pellets.

Uranium air emissions from the Toronto and Peterborough facilities are provided in table 3.1 and compared against the licence limits (FLOLs), as discussed in section 2.3.4 of this report. Air

emissions in Peterborough are lower than Toronto since the Toronto facility processes uranium powder to produce UO_2 pellets whereas the Peterborough facility packages the prepared pellets into CANDU reactor fuel bundles. Air emissions of uranium have been consistently several orders of magnitude below licence limits during the current licensing period. If pelleting operations were authorized for the Peterborough facility, the stacks would be re-evaluated since uranium emissions are expected to increase from the combined pelleting operations and fuel bundling process being housed at one facility. This increase is expected to be equivalent to emission levels currently seen at the Toronto facility. The stack re-evaluation would be reviewed by CNSC staff prior of the conduct of pelleting operations to assure adequate protective measures are in place.

In addition to these contaminants, a number of hazardous substances are also emitted to air which are associated with licensed operations and manufacturing activities such as spray booths, dust collectors, furnaces, rotoclines, and fuel bundle manufacturing. These contaminants have been adequately identified, respectively, in the Peterborough Emission Summary and Dispersion Modeling Report (uranium dioxide, beryllium, particulate matter, and volatile organic compounds) and, in the Toronto Emission Summary and Dispersion Modeling Report (uranium dioxide, particulate matter, zinc compounds, nitrogen oxides and volatile organic compounds) [41]. Annual summary reports are submitted to Ontario's MECP to demonstrate compliance with their Environmental Compliance Approvals (ECAs) to ensure hazardous emissions remain below thresholds.

Table 3.1: Uranium air emissions (kg/year) monitoring results and licence limits for BWXT Toronto and Peterborough (2011-2018) [4-12]

Parameter	Uranium - Toronto	Uranium - Peterborough
Licence Limit (FLOLs)	**0.76**	**0.55**
2011	0.00928	0.000011
2012	0.01267	0.000005
2013	0.00579	0.000013
2014	0.01090	0.000003
2015	0.01080	0.000003
2016	0.01080	0.000004
2017	0.00744	0.000002

2018	0.00628	0.000002

3.1.2 Conclusions – Airborne Emissions

Based on CNSC staff's review of the results of BWXT's EPP, CNSC staff conclude that BWXT's reported uranium emissions to the atmospheric environment from the BWXT facilities have remained below CNSC approved licence limits during the current licensing period. BWXT continues to monitor hazardous substances emitted to the atmosphere. BWXT continues to provide adequate protection of people and the environment from atmospheric emissions.

3.1.3 Waterborne Effluent

BWXT controls and monitors liquid effluent to the environment under its implementation of EPP. This program is based on CSA N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [27] where radiological and hazardous releases are monitored.

BWXT monitors uranium effluent from the Peterborough and Toronto facilities and beryllium effluent from the Peterborough facility. At the Peterborough facility, uranium contaminated wastewater is generated from routine activities such as washing floors, walls, and equipment in the uranium pellet loading and end closure weld area. The beryllium liquid effluent is generated from equipment use and washing in the fuel bundling area. At the Toronto facility, uranium contaminated wastewater is generated from activities such as cleaning protective clothing, walls, floors and equipment. Wastewater from the BWXT facilities is collected, treated or filtered and sampled prior to its release into the sanitary sewers. Beryllium concentrations in liquid effluent from the Peterborough facility during the current licensing period resulted in negligible discharges to the environment.

Table 3.2 summarizes the average beryllium concentrations of liquid effluent discharged to the sanitary sewer in Peterborough during the current licensing period. BWXT has established a beryllium liquid effluent action level and internal control level. The internal control level is conservative and consistent with international drinking water guidelines for beryllium. In 2015, the internal control level was exceeded leading to an investigation and the implementation of corrective actions. BWXT replaced their weir settling treatment system in December 2015, resulting in a downward trend of beryllium liquid effluent concentrations in the following years. Hazardous substances are monitored for trends and continuous improvements and are reportable to the NPRI if reporting thresholds are exceeded.

Table 3.3 summarizes the uranium concentrations of liquid effluent discharged to the sanitary sewers in Toronto and Peterborough during the current licensing period. Effluent releases are several orders of magnitude below the FLOLs.

Table 3.2: Average Beryllium concentrations in liquid effluent (µg/L) for BWXT Peterborough (2011-2018) [4-12]

Parameter	Beryllium - Peterborough
BWXT's Internal Control Level[1]	**4.0**
2011	N/A[2]
2012	N/A[2]
2013	0.38
2014	1.34
2015	4.5
2016	0.4
2017	1.0
2018	0.6

[1] United States Environment Protection Agency maximum contaminant level for drinking water [42]
[2] Beryllium liquid effluent monitoring results were not reported until 2013

Table 3.3: Uranium liquid effluent (kg/year) monitoring results and licence limits for BWXT Toronto and Peterborough (2011-2018) [4-12]

Parameter	Uranium - Toronto	Uranium - Peterborough
Licence Limit (FLOL)	**9,000**	**760**
2011	1.05	0.00010
2012	0.90	0.00010
2013	0.83	0.00020

Parameter	Uranium - Toronto	Uranium - Peterborough
2014	0.72	0.00014
2015	0.39	0.00006
2016	0.65	0.00013
2017	0.94	0.00003
2018	0.94	0.00001

3.1.4 Conclusions – Waterborne Effluent

CNSC staff conclude that BWXT's reported uranium and beryllium effluent to the sanitary sewers from the BWXT facilities remained below CNSC approved licence limits during the current licensing period. BWXT continues to provide adequate protection of people and the environment from effluent released to the sanitary sewers.

3.1.5 Release Limits

BWXT had established loading based FLOLs to control uranium releases to the environment. BWXT's FLOLs are based on a dose constraint to a member of the public of 50 µSv/yr. As part of the licence renewal process, BWXT established Exposure Based Release Limits (EBRLs) at identified release points at the Toronto and Peterborough facilities. The EBRLs are based on uranium and beryllium discharges to water and air. In addition, technology-based performance targets for uranium and beryllium discharges to water were established and incorporated as objectives into BWXT's Environmental Management System (EMS), to demonstrate continuous improvement and pollution prevention. The targets were established by assessing the treatment systems and control measures in place to control releases of nuclear and hazardous substances to the environment.

For effluent released to water, BWXT calculated EBRLs by deriving the release limits based on the CCME Protection of Aquatic Life Guidelines, the annual flows released by the Toronto and Peterborough municipal WWTPs, and the average annual treated water that is discharged from the Toronto and Peterborough facilities, respectively. Additionally, BWXT established EBRLs for effluent from the Peterborough facility, in the case where activities currently conducted at the Toronto facility are moved to Peterborough.

For emissions to air, BWXT harmonized with the provincial air quality standards under O. Reg. 419/05 *Air Pollution – Local Air Quality* [43] and calculated EBRLs by deriving release limits that apply at the stack, which are based on meeting the applicable air quality standards at the Point-of-Impingement (POI). Should pelleting operations be authorized in Peterborough, EBRLs similar to those for Toronto would be expected and would be determined based on actual stack details and locations.

The established EBRLs for the current operations at Toronto and Peterborough facilities can be found in CNSC staff's CMD 20-H2. The EBRLs were established at the point of release and consider radiotoxicity, chemical toxicity, and protection of aquatic life. The EBRLs are currently being implemented by BWXT and are reflected in the updated BWXT LCH [36] before the Commission. In addition, the technology-based performance targets established by BWXT will be included in the next revision of the RPM [33] and BSM [34].

3.2 Environmental Effects Assessment

As noted earlier in this report, three recent ERAs were conducted by BWXT, one for the Peterborough facility, one for the Toronto facility, and one for the pelleting operations at the Peterborough facility. These ERAs, along with the support of annual compliance monitoring reports submitted by the licensee, were reviewed and assessed, and inform this section of the EPR Report.

The following sub-sections discuss the activities proposed in BWXT's licence application, which include the potential effect of continued operations and the proposed pelleting operations at the Peterborough facility. CNSC staff's conclusions on whether BWXT will continue to make adequate provision for the protection of the environment and human health are also provided.

Each sub-section also presents an overview and assessment of the predicted effects, using the results of both environmental monitoring and modelling, to determine whether the environment and human health are, and will continue to be, protected in the proposed licensing period.

The assessment of predicted effects of the proposed activities in the licence application was carried out in a step-wise manner as follows:

- identifying potential environmental and health effects
- determining whether the environment and health of persons are protected

A review was conducted for all environmental components, but only a selection of topics are presented in detail in this section.

3.2.1 Atmospheric Environment

An assessment of the atmospheric environment consists of characterizing both the meteorological conditions and the ambient air quality at both BWXT sites. Meteorological conditions such as temperature, wind speed, wind direction and precipitation are monitored in order to assess the extent of the atmospheric dispersion of contaminants emitted to the atmosphere, the rates of contaminant deposition, and to determine predominant wind directions which are used to identify critical receptor locations from the air pathway.

Ambient air monitoring is used to confirm that ambient air quality, as a result of atmospheric emissions from the facilities due to operations, remain at levels protective of human health and the environment.

3.2.1.1 BWXT Toronto

Located on the shores of Lake Ontario, Toronto generally enjoys warmer winters with less snow and cooler summers when compared to most regions in Ontario, as its proximity to the lake has a large impact on its weather. Local temperature data is collected from the ECCC meteorological

station at Toronto Pearson International Airport. In 2012-2016 mean daily temperatures were below 0°C from December through March and ranged from 22.4°C in July to -5.6°C in February.

Wind direction is reported as the direction from which the wind blows and is based on surface (i.e., 10 m) observations. The most frequent wind recorded at Toronto Pearson International Airport in the period 1981 to 2010 was from the west, with average annual wind speed of 15 km/h.

Local precipitation data is available from daily data collected at the Toronto Pearson International Airport meteorological station in the form of rainfall, snowfall and total precipitation. The annual total precipitation over a 5-year period from 2012 to 2016 was 743.2 mm, with 87% of the total precipitation falling as rain. Precipitation over the 5-year period 2012 to 2016 was 94.5% of the 30-year climatic norm. The highest mean monthly rainfall was in June (92.1 mm), while the highest mean monthly snowfall was in February (34.8 cm) [13].

Assessment of Potential Effects

As part of BWXT's EPP, the BWXT Toronto facility measures uranium in ambient air at several locations around the facility, to confirm the effectiveness of emission abatement systems and to monitor the impact of the facility on the environment. Over the past 5 years, the results from these monitoring locations show that uranium in air, measured as suspended particulate, has consistently remained very low as seen in table 3.4. The highest annual average concentration (among the sampling stations) of uranium in ambient air measured around the facility was 0.001 µg/m3, well below the MECP's standard for uranium in ambient air of 0.03 µg/m3 [50].

Table 3.4: Annual average concentrations of uranium in ambient air as measured around BWXT Toronto [4-12]

Parameter	2013	2014	2015	2016	2017	2018	Ontario standard
Annual average concentration ($\mu g/m^3$)	0.0007	0.0006	0.0010	0.0010	< 0.0001	<0.0001	0.03

3.2.1.2 BWXT Peterborough

Peterborough's climate is typical of the region, influenced greatly by the Great Lakes. Summers in Ontario are warm with several stretches of hot, humid and hazy weather. Fall brings mainly warm sun-filled days and cool temperatures at night. Winters can last anywhere from three to five months whereas spring is the shortest season of the year.

Local temperature data is collected from the ECCC meteorological station at Peterborough. In 2012-2016 mean daily temperatures were below 0°C from December through March and ranged from 19.9°C in July to -8.5°C in February. The average daily temperature was 6.7°C. The mean daily maximum temperature was in the range from a high of 27°C in July to a low of -3°C in February for the 5-year period 2012 to 2016.

Wind direction is reported as the direction from which the wind blows and is based on surface (i.e., 10 m) observations. The most frequent wind recorded at Peterborough in the period 1981 to 2010 was from the west, with average annual wind speed of 10.6 km/h.

Local precipitation data is available from daily data collected from the Peterborough meteorological station in the form of total precipitation (i.e., individual rain and snowfall data were not available). The annual total precipitation over the 5-year period 2012 to 2016 was 684 mm, with monthly precipitation averages ranging from 29 mm in March to 98 mm in June [13].

Assessment of Potential Effects

As outlined by BWXT's EPP, the Peterborough facility does not monitor uranium in ambient air since the atmospheric emissions discharged from the facility already meets the MECP annual standard of 0.03 $\mu g/m^3$ at the point of release, eliminating the need for additional ambient monitoring.

With the proposed pelleting operations in Peterborough, an EMP will be implemented, similar to that currently in place at the existing fuel pelleting operation in Toronto. As the main source of uranium dioxide emissions are associated pelleting operations, BWXT will implement an environmental ambient air monitoring program similar to that in place at the existing nuclear fuel pelleting operation in Toronto, to verify that the public and environment around the facility will continue to be protected.

3.2.1.3 Conclusion – Effects on Atmospheric Environment

Based on CNSC staff's review of the annual EMP data for the last 5 years and ERA results for both BWXT facilities, CNSC staff conclude that uranium atmospheric emissions attributable to operations of the facilities remain significantly below the provincial standard and, therefore, ambient air quality consistently remains at levels protective of human health and the environment.

3.2.2 Terrestrial and Aquatic Environment

An assessment of potential effects on biota at both BWXT sites consists of characterizing local habitat and species (including consideration of federal and provincial species at risk) and assessing the possibility of their exposure to radioactive, non-radiological and physical stressors that may be disruptive to ecological receptors.

3.2.2.1 BWXT Toronto

Habitat and Biota

Toronto is located within the Lake Erie – Lake Ontario Ecoregion of the Mixedwood Plains Ecozone which is bounded by the western portion of Lake Ontario, the southern portion of Lake Huron, and the northern shore of Lake Erie (Windsor to the Niagara River) with land cover being dominated mostly by agricultural and urban areas. High Park, only approximately 1.9 kilometers (km) southwest of the facility, contains an area of natural heritage and scientific interest, is an environmentally significant area, and is considered a provincially significant wetland. Bodies of water that surround the BWXT Toronto include Grenadier Pond (3.2 km southwest), Lake Ontario (3.4 km southwest), and the Humber River (3.9 km east). Land immediately adjacent to

the BWXT Toronto facility is mostly developed urban area with a mix of residential, commercial and industrial uses. Interspersed within the urban area are small recreational green spaces. The property is a fenced-off area with very limited vegetative growth. There are no natural features within the BWXT Toronto site and no water-bodies located near the site.

The urban wildlife that may be found in the area around the site includes brown bat, striped skunk, racoon, Eastern chipmunk, Eastern grey squirrel, woodchuck (groundhog), Virginia opossum, house mouse, meadow vole and Eastern cottontail, but given the lack of habitat found on and in the vicinity of the facility, many species are unlikely to permanently reside on site. Toronto is also home to hundreds of bird species, which can frequent the BWXT Toronto site. Some of the more common birds that are likely present in the area of the facility include the American crow, Northern cardinal, house sparrow, rock pigeon, mourning dove, and the ring-billed gull.

In accordance with the *Species at Risk Act* (SARA), when reviewing local biota, it is important to consider the potential for species at risk. In the vicinity of the facility, the probability that these species could be present on or in the vicinity of the facility is extremely low due to the absence of suitable habitat, aquatic bodies and open areas for foraging. Table 3.5 lists the identified SARA species with the potential of being present at BWXT Toronto, but none have been recorded on site or in the immediate surrounding area within the licensed period.

Table 3.5: Federally and Provincially listed species of concern with the potential to be within the vicinity of the BWXT Toronto facility

Species	SARA status	Ontario ESA status
Birds		
Barn swallow	Threatened	Threatened
Black tern	No status	Special concern
Bobolink	Threatened	Threatened
Chimney swift	Threatened	Threatened
Eastern meadowlark	Threatened	Threatened
Least bittern	Threatened	Threatened
Peregrine falcon	Special concern	Special concern
Yellow-breasted chat	Endangered	Endangered
Fish and Mussels		
Lake sturgeon	No status	Threatened

Species	SARA status	Ontario ESA status
Redside dace	Endangered	Endangered
Insects		
Rusty-patched bumble bee	Endangered	Endangered
Plants and Lichens		
Broad beech fern	Special concern	Special concern
Butternut	Endangered	Endangered
Reptiles		
Blanding's turtle	Threatened	Threatened
Eastern musk turtle	Special concern	Threatened
Eastern ribbonsnake	Special concern	Special concern
Northern map turtle	Special concern	Special concern
Snapping turtle	Special concern	Special concern
Spiny softshell	Endangered	Threatened

Soil Monitoring

BWXT conducts soil sampling at its Toronto facility on an annual basis as part of its EPP. Samples of surface soil are retrieved from 49 locations on the BWXT site, on commercial property located along the south border of the site and in the nearby residential neighborhood. These samples are analyzed for uranium content. For the current licensing period, the average uranium-in-soil concentrations were well below the applicable *CCME Soil Quality Guidelines for the Protection of Environmental and Human Health* for industrial, commercial and residential/parkland land use [45]. The data reported over the current licensing period demonstrates that the current BWXT Toronto facility does not contribute to the accumulation of uranium in surrounding soil, and that no adverse impacts to human and environmental receptors are expected.

Should BWXT be authorized for pelleting operations at its Peterborough facility, CNSC staff expect that an EMP for soil will be implemented, similar to that currently in place at the existing fuel pelleting operation in Toronto. A soil monitoring program will be required to verify that the public and environment around the facility remain protected as the main source of uranium dioxide emissions at the Peterborough facility will be from the proposed pelleting operations.

Assessment of Potential Effects on Biota

The most recent assessment of potential effects on biota near the BWXT facility in Toronto is provided in the 2018 ERA report [13]. This ERA was completed to fully conform with requirements of CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills* [28] and to incorporate recent monitoring data.

A total of five VEC were chosen for the assessment: earthworms (soil invertebrate), grass (vegetation), American robin (bird), deer mouse (small mammalian omnivore), and shrew (small mammalian herbivore). Aquatic species were not considered as there is no aquatic ecosystem present near the site or within the local study area.

An assessment of potential radiological effects is based on comparison of estimated radiation dose received by each VEC from key radiological stressors through all applicable pathways (i.e., external and internal exposure due to uranium in air and soil and gamma radiation) to the recommended benchmark values (dose limits to non-human biota). Based on 2012-2016 environmental data measurements from thermoluminescent dosimeters (TLD), maximum potential external exposure of VECs to gamma radiation at the boundary of the facility is approximately 1.6 µGy/h while radiation dose from uranium is negligible given its very low concentrations measured in both air and soil. This level of exposure is below the most conservative screening criteria for biota of 10 µGy/h and therefore below the values known to cause adverse effects.

The ERA demonstrated that airborne emissions of hazardous substances (specifically uranium dioxide, particulate matter, zinc compounds, nitrogen oxides and volatile organic compounds) from the facility were generally well below the MECP Point of Impingement (POI) standards. Exposures to non-radiological contaminants in water discharges to sewer were estimated to be insignificant based on concentrations and quantities released from the facility and subsequent dilution approximately 40,000 times before discharge from the Humber Water Treatment Plant to Lake Ontario.

CSA N288.6-12 identifies road kill, bird strikes, heat and intake of cooling water as examples of physical stressors applicable to ecological receptors. Artificial night lighting and noise also have the potential to interact with biota. The BWXT Toronto facility is located in a highly urbanized area which limits the site-specific potential for physical stressors to impact on VECs. As such, it is highly unlikely that these stressors can pose adverse effects on biota near the facility. In addition, the noise generated by the facility is common to other noises in the urban settings and to ecological receptors in the vicinity of the facility.

3.2.2.2 BWXT Peterborough

Habitat and Biota

Peterborough is located within the Manitoulin-Lake Simcoe Ecoregion of the Mixedwood Plains Ecozone. The Mixedwood Plains Ecozone is bounded by the three Great Lakes in southern Ontario and extends along the St. Lawrence valley. The Manitoulin Lake Simcoe Ecoregion extends from Manitoulin Island to Kingston in southern Ontario. The dominant land cover is agricultural land (56%) with significant areas of mixed forest.

There is one sensitive area within approximately two kilometres of the BWXT Peterborough facility, this being the Harper Creek Wetland. Harper Creek Wetland is located 2.3 km southwest from the facility and is 17.8 ha in surface area.

Wildlife is characterized by white-tailed deer, snowshoe hare, coyote, red and grey squirrel, and eastern chipmunk. Bird species includes the northern cardinal, wood thrush, screech owl, mourning dove, green heron, pileated and red-bellied woodpeckers, and wood and American black ducks.

The five-lined skink (a lizard) with a provincial status of vulnerable, was found within approximately two kilometers of the site, though it has not been observed since 1934 [44]. There are no recent records of species of concern on site or within the immediate surrounding area; consequently, it was not considered further in the assessment.

Land immediately adjacent to the Peterborough facility is mostly developed urban area with a mix of residential, commercial and industrial uses. Interspersed within the urban area are small recreational green spaces. The property is a fenced-off area with very limited vegetative growth and there are no natural features on-site.

The urban wildlife that may be found in the area around the site include birds such as red-breasted nuthatch, downy woodpecker, American robin, black-capped chickadee, blue jay, and house sparrow. Among mammals, urban species may include house mouse, eastern gray squirrel, Eastern cottontail, striped skunk, raccoon and red fox [13].

Assessment of Potential Effects

The most recent assessment of potential effects on biota near BWXT Peterborough facility is provided in the 2018 ERA report [13]. This ERA was completed to fully conform with requirements of CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills* [28] and to incorporate recent monitoring data.

A total of six VEC were chosen for the assessment: earthworms (soil invertebrate), grass (vegetation), American Robin (bird), Deer Mouse (small mammas), Eastern Cottontail (herbivore), and Red Fox (omnivore). Aquatic species were not considered as there is no aquatic ecosystem present near the site or within the local study area.

An assessment of potential radiological effects is based on comparison of estimated radiation dose received by each VEC from key radiological stressors through all applicable pathways (i.e., external and internal exposure due to uranium in air and soil and gamma radiation) to the recommended benchmark values (dose limits to non-human biota). Based on 2011-2016 environmental TLD data, maximum potential external exposure of VECs to gamma radiation at the boundary of the facility is similar to background doses while radiation dose from uranium is negligible given its very low concentrations measured in both air and soil. With the proposed pelleting operations in Peterborough, VECs can potentially receive radiation doses which would be similar to those estimated for the BWXT Toronto facility. Therefore, no potential effects are expected to biota due to radioactive emission attributable to the facility operations.

The ERA demonstrated that airborne emissions of hazardous substances (specifically uranium dioxide, beryllium, particulate matter, and volatile organic compounds) from the facility were generally well below the MECP Point of Impingement (POI) standards. Exposure to non-radiological contaminants in water discharges to sewer is expected to be negligible based on concentrations and quantities released from the facility and its further dilution (40:1 in average) with waste water from other non-BWXT operations in the Peterborough Plant Complex prior to discharge to the municipal sewer.

CSA N288.6-12 [28] identifies road kill, bird strikes, heat and intake of cooling water as examples of physical stressors applicable to ecological receptors. Artificial night lighting and noise also have the potential to interact with biota. The BWXT Peterborough facility is located in a highly urbanized area which limits the site-specific potential for physical stressors to impact on VECs. As such, it is highly unlikely that these stressors can pose adverse effects on biota near the facility. Also, no measurable change that will affect road kill, bird strikes, heat, noise or artificial lighting is expected due to the authorization of pelleting operations at Peterborough.

3.2.2.3 Conclusion – Effects on Terrestrial and Aquatic Environment

Based on CNSC staff's review of the results of the EMP at BWXT facilities in Toronto and Peterborough and assessment of potential radiological dose to ecological receptors conducted within the respective ERAs, CNSC staff confirm that biota and soil quality remain protected from radiological exposures due to releases from the BWXT sites.

Releases of hazardous substances form BWXT facilities are not expected to result in impacts to non-human biota since contaminant concentrations and quantities released are below all applicable limits and benchmarks or negligible.

CNSC staff have also determined that the ERA for pelleting operations at Peterborough includes sufficient information to conclude with confidence that risks attributable to potential emissions of radiological and non-radiological substances from the proposed pelleting operations at BWXT's Peterborough facility is very low and, therefore, CNSC staff have concluded that human health and the environment would remain protected.

3.2.3 Hydrogeological Environment

An assessment of the hydrogeological environment at the BWXT sites consists of identifying potential sources of groundwater contamination on the site, determining the extent of contamination, if any, which could lead to a pathway for exposure to human and/or non-human receptors, and determining the significance of any exposure from this pathway. Additionally, the hydrogeological assessment confirms whether control measures in place continue to remain effective in protecting the environment.

3.2.3.1 BWXT Toronto

Hydrogeological Environment

Considering the facility's proximity to Lake Ontario, the regional, deeper groundwater flows southwards towards the great lake or towards deeper river valleys. In built-up areas such as Toronto, shallower groundwater flows can be influenced by infrastructure such as buildings, roadways or buried utilities.

Public water wells are not expected to be in use currently within the vicinity of the site and the potable water supply for the City of Toronto is extracted from Lake Ontario and not groundwater sources. There is no water supply development expected in the foreseeable future [13].

Assessment of Potential Effects

BWXT Toronto relies on the Provincial Groundwater Monitoring Network (PGMN) [47] to assess the current groundwater conditions and as a warning system for changes in water levels

and water quality. Monitoring data from 2003 to 2015 (the latest available data) from the nearest PGMN wells show uranium levels to be below regulatory limits. Data collected from the PGMN is accessible online.

BWXT's updated ERA states that there are no pathways for contaminants to enter the groundwater system and no known or suspected groundwater contamination plumes or subsurface contamination related to BWXT Toronto operations. For these reasons, there is no risk to the hydrogeological environment.

3.2.3.2 BWXT Peterborough

Hydrogeological Environment

The Peterborough County is located within the Trent River system, which is connected by a chain of lakes and rivers. Groundwater in the region flows towards the southeast, to the Otonabee River. The BWXT Peterborough facility does not extract any groundwater, utilizing only the Peterborough municipal water system to meet water needs, and so there are no active groundwater extraction wells on site or within 0.5km of the site [13].

Assessment of Potential Effects

BWXT Peterborough also relies on the PGMN [47] with monitoring data from 2003 to 2015 (the latest available data) from the closest PGMN wells showing levels of beryllium and uranium to be below regulatory limits. Data collected from the PGMN is accessible online.

BWXT's updated ERA states that there are no pathways for contaminants to enter the groundwater system and no known or suspected groundwater contamination plumes or subsurface contamination related to BWXT Peterborough operations. For these reasons, there is no risk to the hydrogeological environment.

3.2.3.3 Conclusion – Effects on Hydrogeological Environment

CNSC staff have reviewed and assessed the hydrogeological conclusions drawn by BWXT for both facilities. CNSC staff have accepted that a groundwater monitoring program specific to either site is not warranted at this time given the current operations, the absence of a pathway for potential contamination, and the results of BWXT's EMP.

CNSC staff have also concluded that the proposed pelleting operations in Peterborough would not pose any additional risk of groundwater contamination. This is based on the well understood operations of the Toronto facility and BWXT's commitment to implementing an EMP similar to the one currently in place at the Toronto facility for the pelleting operations in Peterborough, as well as the results of the current EMP at the Toronto facility. This monitoring data would then be used to confirm or revise the current position that groundwater monitoring is not warranted for the proposed authorization of pelleting operations at the Peterborough facility.

Based on the assessments from BWXT's ERAs, annual reports, and annual environmental monitoring data, CNSC staff conclude that there are no impacts to the groundwater from both BWXT facilities and BWXT continues to provide adequate protection of human health and the environment.

3.2.4 Human Environment

An assessment of the human environment at both BWXT sites consists of identifying critical groups located in proximity to the sites, and whether the aforementioned environmental pathways will have an impact on these human receptors. The critical receptor for the general public is defined as the "most affected neighbour", to include all types of receptors, and owing to the urban setting where the facilities are located. Toddlers (0.5 – 4 years) were considered to be the most exposed receptors because they eat, drink and breathe more in proportion to body size, and exhibit behaviours (e.g., hand-to-mouth activity) that increases exposure to soil [48]. Therefore, toddlers were identified as the critical receptor for both BWXT facilities. In addition, at both sites, on-site workers such as BWXT employees, contractors, and visitors were considered in the assessment.

3.2.4.1 Public Exposure - Radiological

The CNSC's *Radiation Protection Regulations* [30] prescribe radiation dose limits to protect the public from exposure to radiation as a result of licensed activities. The annual effective dose limit for a member of the public is 1 mSv per year.

The annual doses to persons residing in the vicinity of both Peterborough and Toronto sites, as a result of the licensed activities carried out at those sites, are due to airborne emissions of radiological substances from the facilities on the site. The members of the public with the highest calculated exposure are residents located nearby the facility. These residents are assumed to reside year-round while being exposed to emissions from the facilities, and to gamma radiation from materials on site. Liquid effluents contribute a negligible amount [12]; the majority of the annual dose to these residents is primarily due to released gamma radiation.

The annual doses to residents in vicinity of the Peterborough and Toronto sites have been calculated based on environmental monitoring data as well as from measurements of airborne emissions. The gamma doses to these residents spanning from 2014 to 2018, are either based on environmental monitoring data from TLDs surrounding the boundary of the BWXT facility or from surveys performed via a survey meter. From 2014 to 2016 gamma doses from the Toronto site were estimated from dose rates measured annually using a survey meter as opposed to the TLDs and then in 2017, the Toronto site started using TLDs [50]. The doses from both air emissions and environmental TLD are shown in table 3.6 below and are in units of microsieverts.

There is no information regarding the gamma dose from environmental TLD at the Peterborough facility in 2014 and 2015 as they were put into place in the beginning of 2016. No gamma monitoring was done prior to 2016 [9]. During 2018, the annual dose to the public was calculated to be 0.41 μSv for the Toronto facility and 0 μSv for the Peterborough location [12]. The annual dose limit for members of the public, as stipulated in the *Radiation Protection Regulations* [30] is 1000 μSv (1 mSv).

The 2014 to 2018 dose to the public from both BWXT's Toronto and Peterborough sites remained well below the regulatory limit of 1000 μSv (1 mSv) per year. It can be seen in table 3.6, that annual doses are generally very low. Due to the type of operations at Peterborough, namely fuel bundle assembly, atmospheric emissions are negligible compared to those from the Toronto facility when fuel fabrication is carried out. Gamma doses for the Toronto facility are reported to be variable from year to year, while doses from airborne emissions are fairly constant. This variability can be attributed to a number of reasons such as the nature of the

various operations on the site or the physical location of radioactive material, there will be a variation of doses that will be recorded on the TLD. In 2017, gamma dose from TLD at the Toronto facility was reported as 17 µSv. The change in the Toronto gamma contribution compared to other years was the result of a change in the placement of the background TLD.

Table 3.6: Estimated annual public doses from air emissions and environmental TLD for both Toronto and Peterborough facilities respectively [8-12]

Period	Toronto			Peterborough			Public dose limit [µSv]
	Gamma dose from TLD/Survey Meters [µSv]	Dose from air emissions [µSv]	Total [µSv]	Gamma dose from TLD [µSv]	Dose from air emissions [µSv]	Total [µSv]	
2014	4.8	0.41	5.2	N/A	0.00	0.00	1000
2015	9.4	0.41	9.8	N/A	0.00	0.00	
2016	0.00	0.7	0.7	0.00	0.00	0.00	
2017	17	0.49	17.49	0.00	0.00	0.00	
2018	0.00	0.41	0.41	0.00	0.00	0.00	

It is notable that gamma doses as reported are close to the instrument detection limit, and doses reported to be zero are below the detection limit. A zero dose may in fact be just below the detection limit. In the case of TLDs the lower detection limit is 0.06 mSv.

Over the licensing period, CNL continued to ensure protection of members of the public in accordance with the *Radiation Protection Regulations* [30].

3.2.4.2 Public Exposure – Hazardous Substances

At both BWXT facilities, on-site workers such as BWXT employees, contractors, and visitors could be potentially exposed to non-radiological substances. These exposures were considered and are controlled through the application of BWXT's Occupational Safety and Health procedures.

At BWXT Peterborough, principal chemical hazards to humans were identified to be uranium and beryllium, while at BWXT Toronto it was uranium. Uranium is a radionuclide with low specific activity and emits very low amounts of radiation as compared to other isotopes. It is, however, chemically toxic to humans, with kidneys as the primary target organ. Beryllium is a toxic industrial material and can be absorbed in the bloodstream primarily through inhalation route of exposure and cause chronic berylliosis and lung cancer. It can also cause a skin reaction (dermatitis) if exposure occurs via the dermal route.

Effects on public health were assessed using an approach encompassing a semi-quantitative pathways analysis to determine if members of the public would likely be exposed through air,

water or the food chain. A tiered approach to the Human Health Risk Assessment [13] was undertaken, with a Tier 1 preliminary screening where conservative estimates of emissions and environmental concentrations were compared to the screening criteria. For BWXT Peterborough, the primary pathways for exposure to COPCs were identified to be air inhalation/skin absorption, and air immersion (external exposure), whereas for BWXT Toronto, in addition to air, pathways such as soil, drinking water, and ingestion were also assessed.

Consistent with the CSA N288.6-12 [28], noise was also selected as a physical stressor for both BWXT locations.

At both BWXT facilities, hazardous substances emitted to air and water as a result of operations were below the applicable federal or provincial screening criteria and pose a negligible risk to human health. For noise, analyses of the modeling results showed that noise levels from operations at both sites were compliant with the NPC-300 (Ontario environmental noise criteria) for all locations and time periods [51].

3.2.4.3 Conclusion – Effects on Human Health

The radiation dose from airborne emissions in 2018 are 0.41 μSv and 0.0 μSv for the Toronto and Peterborough locations respectively. Similarly the gamma dose at the boundary of the sites are 0.0 μSv for both locations. The results from table 3.6 above have shown that radiological doses to the public are well below the annual dose limit of 1 mSv [30]. It can be concluded that the radiological emissions from both Toronto and Peterborough BWXT sites pose no human health risk.

With respect to hazardous substances, airborne emissions and effluent releases to water at both BWXT facilities were below applicable screening criteria and posed a negligible risk to human health.

Based on the assessments from BWXT's ERAs, annual reports, and annual environmental monitoring data, CNSC staff conclude that there are no impacts to the human environment.

4.0 CNSC INDEPENDENT ENVIRONMENTAL MONITORING PROGRAM

The CNSC has implemented its IEMP to verify that the public and the environment around licensed nuclear facilities are protected. It is separate from, but complementary to the CNSC's ongoing compliance verification program. The IEMP involves taking samples from public areas around the facilities, and measuring and analyzing the amount of radiological and hazardous contaminant substances in those samples. CNSC staff collect the samples and send them to the CNSC's laboratory for testing and analysis.

4.1 IEMP at the BWXT Sites

CNSC staff conducted IEMP sampling at both BWXT facilities in 2014, 2018 and 2019, and at BWXT Toronto in 2016. The sampling plans for the BWXT facilities focused on radioactive and hazardous contaminants. A site-specific sampling plan was developed based on BWXT's approved EMP and the CNSC's regulatory experience with the sites.

In publicly accessible areas, CNSC staff collected samples of the following:

- air (1 location in 2014, 4 locations in 2018, and 4 locations in 2019 for Peterborough; 2 locations in 2014, 2 locations in 2016, 4 locations in 2018, and 3 locations in 2019 for Toronto)
- water (2 locations in 2018 and 2 locations in 2019 for Peterborough)
- soil (8 locations in 2014, 8 locations in 2018, and 9 locations in 2019 for Peterborough; 8 locations in 2014, 8 locations in 2016, 9 locations in 2018, and 10 locations in 2019 for Toronto)

Collected samples were analyzed by qualified laboratory specialists in the CNSC's laboratory in Ottawa, using appropriate protocols. CNSC staff measured uranium in the samples from both sites as well as beryllium in samples from Peterborough.

Figure 4.1 and figure 4.2 provide an overview of the sampling locations for the 2019 IEMP sampling campaigns at BWXT Peterborough and BWXT Toronto, respectively. The IEMP results are published on the CNSC's website [52].

4.2 Summary of Results

The levels of uranium and beryllium in all of the samples were below available guidelines and tables 4.1 and 4.2 provide the range of results from the 2014, 2016, 2018 and 2019 IEMP sampling campaigns at BWXT Peterborough and Toronto, respectfully. The IEMP results are also published on the CNSC's website [52].

The IEMP results verify that the public and the environment near the BWXT facilities are protected. These results are consistent with the results submitted by BWXT and reviewed by CNSC's environmental protection staff, demonstrating that the licensee's EPP protects the health and safety of people and the environment.

Figure 4.1: BWXT Peterborough - Location overview of the 2019 sample locations [53]

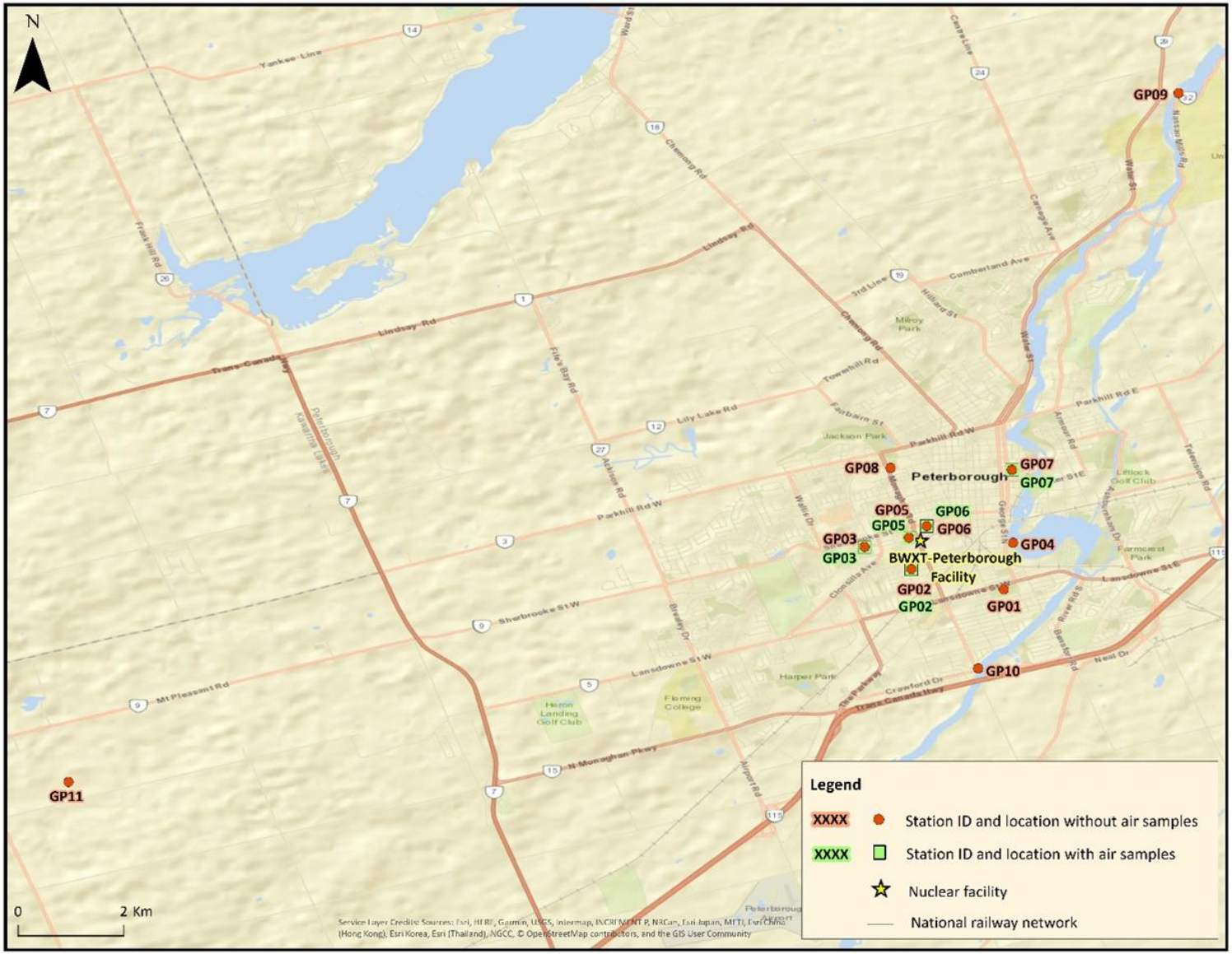

Figure 4.2: BWXT Toronto - Location overview of the 2019 sample locations [53]

Table 4.1: Summary of the BWXT Peterborough IEMP results for 2014, 2018, and 2019 [51]

Analyte	Range of measured radioactivity			Guideline
Water (µg/L)				
	2014	**2018**	**2019**	
Uranium	N/A	0.2	0.29 – 0.34	15 (2)
Beryllium	N/A	<0.1(1)	<0.01(1)	11(3)
Air (µg/m^3)				
	2014	**2018**	**2019**	
Uranium	0.0013	<0.003(1)	<0.00009(1)	0.03(4)
Beryllium	0.000077	<0.003(1)	<0.0003(1)	0.01(4)
Soil (mg/kg dry weight)				
	2014	**2018**	**2019**	
Uranium	1.0 – 1.8	1.38 – 1.92	1.21 – 2.05	23(5)
Beryllium	0.7 – 1.1	1.08 – 1.34	1.10 – 2.34	4.0(5)

(1) The < symbol indicates that a result is below the detection limit for laboratory analysis

(2) CCME Water Quality Guidelines for the Protection of Aquatic Life – Long Term Exposure [54]

(3) Ontario Provincial Water Quality Objective (PWQO) [55]

(4) Ontario MECP air quality standards [43]

(5) CCME Soil Quality Guidelines for the Protection of Environmental and Human Health – Residential/parkland[45]

Table 4.2: Summary of the BWXT Toronto IEMP results for 2014, 2016, 2018, and 2019 [51]

Analyte	Range of measured radioactivity				Guideline
Air (µg/m^3)					
Uranium	**2014**	**2016**	**2018**	**2019**	0.03(2)
	0.0000488 – 0.000128	<0.0009(1)	<0.003(1)	<0.00005(1)	
Soil (mg/kg dry weight)					
Uranium	**2014**	**2016**	**2018**	**2019**	23(3)
	0.72 – 1.72	1.30 – 1.80	1.17 – 1.91	0.98 – 1.89	
	<0.1(1)	N/A	N/A	N/A	

(1) The < symbol indicates that a result is below the detection limit for laboratory analysis

(2) Ontario MECP air quality standards [42]

(3) CCME Soil Quality Guidelines for the Protection of Environmental and Human Health – Residential/parkland [44]

5.0 HEALTH STUDIES

The following section draws from the results of regional health studies to provide further independent verification that the health of people living near the BWXT Toronto and Peterborough sites are protected. The health of populations around both BWXT sites are monitored by various organizations and institutions in Ontario such as Cancer Care Ontario (CCO), and Public Health Ontario, and by the local public health units. In addition, disease rates around BWXT sites are compared to similar populations to detect any potential health outcomes that may be of concern. CNSC staff keep abreast of any new publications and data related to the health of populations living near nuclear facilities.

There are several health studies and reports that have assessed the health of populations living the near the BWXT sites in Toronto and Peterborough, which are discussed below. Additional information on health studies related to nuclear facilities is available on the CNSC webpage on Health Studies [56].

5.1 Population and Community Health Studies and Reports

5.1.1 Peterborough Public Health Reports

The Peterborough Public Health 2018 Annual Report [57] examines health outcomes and factors that affect the health of people living in areas serviced by Peterborough Public Health. Cancer, circulatory diseases, respiratory diseases, and unintentional injuries, are the leading causes of death in the region, representing 72% of all deaths. This is consistent with the rest of Ontario where the leading causes of death are cancer and heart disease [58].

5.1.1.1 Summary of Selected Cancers, Peterborough County and City, 2012 [59]

The Summary of Selected Cancers in Peterborough County and City 2012 report [59] presents information on the incidence, mortality and trends of common cancers within the region from 1986-2007. The report uses cancer data from the Ontario Cancer Registry through CCO and risk factor data from the Canadian Community Health Survey (CCHS) conducted by Statistics Canada.

The report shows that the incidence of all cancers in both male and females has been increasing in Peterborough during the study period of 1986-2007, however cancer incidence rates in Ontario and Peterborough did not significantly differ over this time period. The most commonly diagnosed cancers from 1986-2007 were prostate (males), breast (female), lung (both sexes), and colorectal cancer (both sexes). Lung, breast, and colorectal cancer accounted for more than half (55%) of all cancer diagnoses among females and accounted for more than half of all female cancer deaths (52%). Prostate, lung, and colorectal cancer accounted for 56% of male cancers in the region, and accounted for 55% of all male cancer deaths.

Males in Peterborough had significantly higher incidence of lung cancer than Ontario by 6.5% and melanoma by 24.4%. However, Peterborough males had significantly lower incidence of prostate cancer (5.6%) compared to Ontario males. Females in Peterborough have significantly higher incidence of lung cancer (21.9%), melanoma (21.5%), and uterine cancers (14.7%) compared to Ontario. The incidence of cancer increases with age, 66.0% of new cases in males and 58.5% of new cases in females were diagnosed in persons above 65 years old.

Mortality rates for all cancers combined in both Peterborough and Ontario males have been declining since 1986. However, female mortality rates for all cancers combined have remained fairly constant differing from the slowly declining rates in Ontario. Compared to Ontario, mortality from lung cancer was significantly higher in both Peterborough males (6.6%), and females (14.9%). Similar to cancer incidence, cancer mortality also increases with age, 75.3 % of deaths in males and 72.6% of deaths in females due to cancer, occurred in persons above 65 years old. When comparing Peterborough to Ontario, there were no significant differences in cancer mortality rates by age group for either sex.

The report also summarizes data on risk factors associated with cancer. The most important risk factor for lung cancer is smoking. It also contributes to the incidence of other cancers such as breast, bladder and cervical. Compared to Ontario, the prevalence of male current smokers in Peterborough was lower and prevalence of female current smokers was higher but not significantly. Within Ontario, the prevalence of current smoking in males increased from 1925 and 1960 and has decreased since then. For females, the peak in current smoking occurred 25 to 35 years after males, which helps to explain why within the studied timeframe of this report we see the incidence and mortality of lung cancer in males decreasing and increasing in females. Alcohol consumption is associated with increased risk of breast, colorectal, and oral cancers. These cancers show a dose-response relationship (increased consumption of alcohol is associated with increased risk of developing these alcohol-related cancers). A significantly greater proportion of males in Peterborough engage in hazardous drinking episodes compared to Ontario males and Peterborough females. Additionally a larger proportion of females in Peterborough reported hazardous drinking compared to females in Ontario, however this difference was not significant.

5.1.1.2 Report on Maternal and Infant Health Peterborough County-City Health Unit, 2014 [60]

In Peterborough, 529 babies were identified as having a congenital anomaly from 2000-2010. The most common anomaly was congenital heart defects (33%). Congenital anomalies (32.7%) are the second leading cause of death to infants in Peterborough, with conditions originating in the perinatal period being the most common cause of infant death (50.0%). Compared to Ontario, the rate of babies born with congenital anomalies in Peterborough is significantly higher than Ontario. Factors such as smoking, nutrition, physical activity, and alcohol and substance abuse use prior to and during pregnancy can affect infant health.

5.1.2 Toronto Public Health Surveillance Indicator Reports

The following section is a summary of relevant Toronto Public Health Surveillance Indicator Reports. These provide a snapshot of health in Toronto, with information related specifically to the area near the BWXT facility, when available. These reports provide an understanding of trends, patterns, and populations at higher risk of adverse health outcomes.

5.1.2.1 All-cause mortality and life expectancy [61]

The leading cause of death for both sexes in Toronto (excluding the greater Toronto area) is ischemic heart disease. Other leading causes of death include dementia and Alzheimer's disease, and lung cancer for females; and lung cancer and cerebrovascular disease (such as stroke) for males.

5.1.2.2 All Cancers [62]

Cancer is one of the leading causes of morbidity and mortality in Toronto. In Toronto, there has been a decrease in all cancer mortality from 2003-2010 and all cancer hospitalization from 2003-2013. Compared to Ontario (excluding Toronto), cancer incidence and mortality was significantly lower in Toronto. However, cancer hospitalizations were significantly higher in Toronto compared to Ontario.

In Davenport, the neighbourhood where BWXT Toronto is located, age-standardized all cancer hospitalization and mortality rates for 2011-2013 were similar to other neighbourhoods in Toronto.

In Toronto, all cancer incidence, hospitalization, and mortality rates were all significantly higher in males. All cancer incidence, hospitalization and mortality increases with age, with the highest rates in individuals above 65 years old.

5.1.2.3 Lung Cancer [63]

Lung cancer is one of the most commonly diagnosed cancers. There are various risk factors for lung cancer including smoking, second hand smoke exposure, asbestos, occupational exposure to chemicals and air pollution. Lung cancer incidence, hospitalization and mortality rates increase with age, with the highest rates in individuals above 65 years old.

Lung cancer incidence and hospitalization in Toronto has decreased from 2003-2013. Toronto's lung cancer incidence, hospitalization, and mortality rates were significantly lower than the rest of Ontario.

For age-standardized lung cancer hospitalization and mortality rates for 2011-2013 combined, Davenport had similar rates compared to other neighbourhoods in Toronto. Lung cancer incidence, hospitalization, and mortality rates were significantly higher in males compared to females in Toronto.

5.1.2.4 Breast Cancer [64]

Breast cancer is the most commonly diagnosed cancer among females in Ontario. Risk factors for breast cancer include obesity, alcohol consumption, taking oral birth control, and hormone replacement therapy. Breast cancer incidence, hospitalization and mortality increases with age, with the highest rates in individuals above 65 years old.

Breast cancer mortality (from 2003-2010) and hospitalizations (from 2003-2013) in Toronto have decreased. Toronto's breast cancer hospitalization was higher than the rest of Ontario, where as the mortality was significantly lower than the rest of Ontario. Breast cancer incidence in Toronto was not significantly different from the rest of Ontario. Davenport had similar age-standardized breast cancer hospitalization and mortality rates for 2011-2013 combined, compared to other neighbourhoods in Toronto.

5.1.2.5 Colorectal Cancer [65]

Colorectal cancer is the third most commonly diagnosed cancer in Ontario and second and third leading cause of cancer mortality in males and females, respectively. Various risk factors for colorectal cancer include age, physical activity, obesity, alcohol consumption, smoking, a diet low in fiber, and a diet high in red or processed meat.

Colorectal cancer mortality and hospitalizations in Toronto decreased from 2003-2010, and 2003-2013 respectively. Colorectal incidence, mortality and hospitalization rates were significantly lower in Toronto than the rest of Ontario. Davenport had similar age-standardized colorectal cancer hospitalization and mortality rates 2011- 2013, compared to other neighbourhoods in Toronto.

In Toronto, colorectal cancer incidence, hospitalization, and mortality rates were significantly higher in males and increased with age, with the highest rates in individuals above 65 years old.

5.2 Health Studies of populations living near nuclear processing facilities

There are no specific health studies that look at adverse health effects from the presence of BWXT Toronto and Peterborough uranium processing facilities. However, studies carried out over several decades have repeatedly demonstrated that people who live near nuclear facilities are as healthy as the rest of the general population. For instance, many health studies have been carried out in Port Hope, Ontario where the radium and uranium processing and fabrication industry has existed since 1932. These studies demonstrate that there are no adverse health effects attributable to the nuclear industry in Port Hope, even though low-level radioactive waste was improperly disposed of throughout the town from 1932-1966, unlike the BWXT sites. The evidence from these studies help to inform the health of other populations living near nuclear processing and fabrication facilities, such as BWXT.

5.2.1 Use of a Weight of Evidence Approach to Determine the Likelihood of Adverse Effects on Human Health from the Presence of Uranium Facilities in Port Hope, Ontario [66]

Several environmental and health studies have been conducted to assess the potential contamination effects in the Port Hope community over the last 70 years. This study used a weight of evidence approach to assess the types and levels of contaminants of concern in the environment and the potential human exposure to these contaminants. Their toxicological and radio-toxicological properties were also assessed to determine their potential health effects. The results of these assessments were further compared to findings of earlier epidemiological studies of Port Hope residents and nuclear industry workers. The conclusions of this study indicated that levels of exposure to radioactive and non-radioactive contaminants in Port Hope are below levels known to cause adverse health effects. Further, epidemiological studies provide no evidence of health effects as a result of past and present activities of the Port Hope nuclear industries. The ERAs and the epidemiological studies are consistent and support each other. Port Hope's findings are consistent with the results of over 40 epidemiological studies conducted elsewhere on populations living around similar facilities or exposed to similar environmental contaminants.

5.2.2 An ecological study of cancer incidence in Port Hope, Ontario from 1992 to 2007 [67]

In this ecological study, cancer incidence rates in Port Hope were studied for a 16-year period (1992–2007) for continued periodic cancer incidence surveillance of the community. The cancer incidence in the local community for all cancers combined was similar to the Ontario population, health regions with similar socio-economic characteristics in Ontario and in Canada, and the

Canadian population. No statistically significant differences in childhood cancer, leukaemia or other radiosensitive cancer incidence were observed, with the exception of statistically significant elevated lung cancer incidence among women. However, the statistical significance was reduced or disappeared when the comparison was made to populations with similar socio-economic characteristics. These findings are consistent with previous ecological, case-control and cohort studies conducted in Port Hope, EAs, and epidemiological studies conducted elsewhere on populations living around similar facilities or exposed to similar environmental contaminants.

5.3 Health Studies of uranium processing workers

The CNSC has conducted studies looking at the health of uranium processing workers in Port Hope, which is detailed below. Although, there are no current studies that include workers from BWXT, dose received by workers is monitored. In 2016, the mean dose of a fuel processor was 0.70 mSv, which is well below the worker dose limit for a nuclear energy worker of 50 mSv [68]. Adverse health effects in these workers would not be expected at these dose levels. However, the CNSC is currently proposing a Canadian wide study of uranium workers including miners, millers and processing workers, and is discussed further below. This study will include workers from BWXT.

5.3.1 Mortality (1950–1999) and cancer incidence (1969–1999) of workers in the Port Hope cohort study exposed to a unique combination of radium, uranium and gamma-ray doses [69]

This study looked at cancer incidence and mortality among uranium and radium processing workers in the Port Hope community. Uranium processing workers are exposed primarily to uranium, radium, gamma-ray radiation, and radon decay products to a lesser extent. The risks of these exposures in a cohort of workers from Port Hope radium and uranium refinery and processing plant in Port Hope, Ontario were examined for mortality (1950–1999) and cancer incidence (1969–1999). Overall, workers had lower mortality and cancer incidence compared with the general Canadian population.

5.3.2 The Canadian Uranium Workers Study

The Canadian uranium Workers Study (CANUWS) is a four year project proposed by the CNSC to assess the health effects of occupational radiation exposure among uranium workers. The retrospective cohort study will include over 80,000 Canadian uranium mine, mill and processing workers who will have their occupational radiation exposures (1932–2017), mortality (1950–2017) and cancer incidence (1969–2017) followed-up using data from the National Dose Registry, the Canadian Mortality Database and the Canadian Cancer Registry. The main objective of the study is to update information on the radon-lung cancer relationship. Importantly, the study will assess the potential health effects of low cumulative exposures and exposure rates. This is possible due to high quality exposure measurements and long-term follow-up of health outcomes of workers employed after radiation protection measures were put in place. The findings of the study will contribute to the verification, and if required, updating of occupational radiation safety standards. This information is relevant for radiation protection of current and future uranium workers with low cumulative exposures and exposure rates. The study is planned to begin in 2019-2020.

5.4 Conclusions - Health Studies

Reviewing and conducting health studies and reports is an important component of ensuring that the people living near nuclear facilities are protected. The population and community health studies and reports indicate that common causes of death among Peterborough and Toronto populations include heart disease and cancer. This is similar to the rest of Canada where heart disease and cancers are the two leading causes of death [58].

The above health studies are descriptive studies which compare the occurrence of health outcomes within a population at a certain time in a given geographical area to the "expected" occurrence of the disease in a stable reference population (such as the general population of the province or Canada). Descriptive studies have some limitations, such as: 1) the results are averaged over a group and do not look at the individual level, and 2) individual exposures are not known, and they cannot be used to determine the cause of a health outcome, however they are used to generate hypotheses regarding potential risk factors for health outcomes. For further information regarding advantages and disadvantages of health study designs please see INFO-0812 [70].

These health studies and reports provide a snapshot of the health of people living near BWXT Toronto and Peterborough. BWXT Toronto and Peterborough currently meet CNSC's regulatory requirements. Based on exposure and health data, CNSC staff have not observed and do not expect to observe any adverse health outcomes attributable to the presence of BWXT Toronto and Peterborough.

6.0 OTHER REGIONAL MONITORING PROGRAMS

There are several regional monitoring programs carried out by other levels of government, which the CNSC has reviewed to confirm that the environment and the health of persons around the BWXT Toronto and Peterborough facilities are protected. A summary of the findings of these programs is provided below.

The Radiation Protection Bureau of Health Canada manages the Canadian Radiological Monitoring Network (CRMN) [71]. The CRMN routinely collects drinking water, precipitation, atmospheric water vapour, air particulate, and external gamma dose for radioactivity analysis at 26 monitoring locations. The closest CRMN monitoring location to the BWXT facilities is in Toronto. The results at the Toronto station for 2018 are consistent with data from previous years and are well below the public dose limit.

In addition, Health Canada has complemented its CRMN network with a Fixed Point Surveillance (FPS) system [72]. The FPS functions as a real-time radiation detection system designed to monitor public dose from radioactive materials in the air, including atmospheric emissions associated with nuclear facilities and activities both nationally and internationally. Monitoring stations continuously measure gamma radioactivity levels from ground-deposited (ground-shine) and airborne contaminants.

Health Canada measures the radiation dose rate as Air KERMA (Kinetic Energy Released in unit MAss of Material) reported as nanogray per hour (nGy/h) of absorbed dose. These measurements are conducted every 15 minutes at 79 sites of its FPS network across the country. Air KERMA is also measured for three radioactive noble gases associated with nuclear fission which may escape into the atmosphere during normal operation of nuclear facilities. These three noble gases are Argon-41, Xenon-133 and Xenon-135. CNSC staff converted the absorbed dose rate to an effective dose, reported in millisievert (mSv) per year, which allows for comparison to annual background dose estimates and the regulatory public dose limit.

The 2018 total external gamma doses reported for the FPS network at the twelve locations in the Greater Toronto area and Lake Ontario are similar to the Canadian average for natural background from gamma (the range is 0.007 – 0.027 mSv per year). These results indicate that total external gamma dose at these stations is not significantly influenced by activities at the BWXT facilities. Further evidence of this is provided by the extremely low activity levels reported for the noble gases, as outlined in table 6.1. All of the results are significantly below the public dose limit of 1 mSv.

The closest monitoring location to the BWXT Toronto facility is located at Resources Road. The closest monitoring location to the Peterborough facility is located at Port Hope.

Table 6.1: Annual external gamma doses (mSv/year[1]) for 2018 at the Fixed Point Surveillance network monitoring stations associated with the BWXT facilities

Monitoring stations near BWXT facilities	External gamma dose				
	Year	All gamma sources	Monitored noble gases (Fission products)		
			Argon-41	Xenon-133	Xenon-135
Scarborough	2018	0.010	0.000003	*	*
Bowmanville	2018	0.014	*	*	*
Resources Road	2018	0.008	*	*	*
St. Clair Avenue East	2018	0.010	*	*	*
Pickering	2018	0.013	0.00002	*	*
Oshawa	2018	0.011	0.0000005	*	*
Markham	2018	0.013	0.000002	*	*
Ajax	2018	0.018	0.00004	*	*
Port Hope	2018	0.017	*	0.0000003	*
Hamilton	2018	0.019	0.0003	0.000008	0.0000004
Kingston	2018	0.010	*	*	*
St. Catherines	2018	0.009	*	*	*

*No data is reported when results are below the minimum detectable dose

[1] Assumptions: adult located at monitoring station for 24 hours a day, 365 days per year. Air KERMA in nanoGray corrected. Total Dose: 0.69 mSv for every Gray of absorbed dose measured: Argon-41: 0.74; Xenon-133: 0.75; Xenon-135: 0.67.

7.0 RECOMMENDATIONS AND CONCLUSIONS

The EPR conducted for the licence application to renew the BWXT's FFOL for the Peterborough and Toronto facilities concludes that BWXT has taken adequate provision for the health of persons and the protection of the environment and will continue to do so in the future.

CNSC staff reviewed BWXT's licence application and the documents submitted in support of the application, such as the three ERAs. CNSC staff also conducted compliance verification activities including the review of annual and quarterly reports, and onsite inspections conducted at both BWXT sites. CNSC staff conclude the licence application and supporting documents submitted in support of the application are satisfactory and meet CNSC's regulatory requirements. CNSC staff also reviewed the results from various relevant or comparable health studies and other regional monitoring programs conducted by other levels of government, which substantiate CNSC staff's conclusion that the environment and health of persons are protected from operations at the BWXT sites. CNSC staff also conducted IEMP sampling around BWXT Toronto in 2014, 2016, 2018, and 2019, and around BWXT Peterborough in 2014, 2018, and 2019. These studies and results support CNSC staff's conclusions that the public and the environment around the BWXT sites are protected and that there are no health impacts as a result of ongoing activities. These results are also consistent with the results submitted by BWXT, demonstrating that the licensee's environmental programs protect the health of persons and the environment.

CNSC staff's expectation regarding soil monitoring, as mentioned in section 3.2.2.1 of this EPR Report, is included in BWXT's updated LCH as Licence Condition 9.1 [36] and is further detailed in section 3.9.5 of CMD 20-H2 [16].

This EPR focused on items of current public and regulatory interest, including physical stressors, airborne and waterborne releases from ongoing operations, and from the proposed pelleting operations in Peterborough. CNSC staff conclude that the potential risk from physical stressors, and radiological and hazardous releases to the atmospheric, terrestrial, hydrogeological, aquatic and human environment are low to negligible.

This EPR conducted for the renewal of the BWXT FFOL concludes that BWXT has and will continue to make adequate provision for the protection of the environment and the health of persons. CNSC staff will continue to verify and ensure that, through ongoing licensing and compliance activities and reviews, the environment and the health of persons are protected and will continue to be protected over the proposed licence period.

The information provided in this EPR Report supports the recommendation by CNSC staff in CMD 20-H2 [16] to renew BWXT's FFOL for the Toronto and Peterborough sites (FFOL 3620.01/2020) for a period of ten years.

ACRONYMS

Acronym	Term
AL	Action Level
ALARA	As Low As Reasonably Achievable
BSM	Beryllium Safety Manual
BWXT	BWXT Nuclear Energy Canada Inc.
CBRL	Concentration Based Release Limits
CCME	Canadian Council of Ministers of the Environment
CCO	Cancer Care Ontario
CCHS	Canadian Community Health Survey
CEAA	*Canadian Environmental Assessment Act*
CNSC	Canadian Nuclear Safety Commission
COPC	Contaminant of Potential Concern
CRMN	Canadian Radiological Monitoring Network
CSA	Canadian Standards Association
DEL	Derived Emission Limit
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EMP	Environmental Monitoring Program
EMS	Environmental Management System
EP	Environmental Protection
EPP	Environmental Protection Program
EPR	Environmental Protection Review
ERA	Environmental Risk Assessment
FPS	Fixed Point Surveillance
FFOL	Fuel Facility Operating Licence
FLOL	Facility Licence Operating Limits
GHG	Greenhouse Gas
IEMP	Independent Environmental Monitoring Program
LEU	Low Enriched Uranium
KERMA	Kinetic Energy Released in unit Mass of Material

NPRI	National Pollutant Release Inventory
NSCA	*Nuclear Safety and Control Act*
MECP	Ontario Ministry of Environment, Conservation and Parks
PDP	Preliminary Decommissioning Plan
PGMN	Provincial Groundwater Monitoring Network
RPM	Radiation Protection Manual
ROR	Regulatory Oversight Report
SARA	Species At Risk Act
U.S.	United States
VEC	Valued Ecosystem Components

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PART TWO

Part Two provides all relevant information pertaining directly to the licence, including:

1. Any proposed changes to the conditions, licence period, or formatting of an existing licence;
2. The proposed licence;
3. The proposed licence conditions handbook; and
4. The current licence.

PROPOSED LICENCE CHANGES

Overview

BWXT currently operates the Peterborough and Toronto facilities under a Nuclear Fuel Facility Operating Licence, FFOL-3620.00/2020. The proposed licence incorporates standardized licence conditions in a standard format as well as two facility specific licence conditions.

Licence Conditions

The proposed licence incorporates the standardized licence conditions applicable to BWXT as a uranium processing facility as developed by CNSC staff.

Additionally, CNSC staff recommend adding the following facility specific licence conditions to the proposed licence to reflect BWXT's request to produce fuel pellets at the Peterborough facility:

LC 15. 1 The licensee shall submit and implement an updated environmental monitoring program at the Peterborough facility one year prior to the commencement of commissioning activities described in paragraph (iv) of Part IV of this licence.

LC 15.2 The licensee shall submit a commissioning report related to production of fuel pellets as described in paragraph (iv) of Part IV of this licence, that is acceptable to the Commission, or a person authorized by the Commission.

Licence Format

The existing licence, produced in 2010, is written in a different format than the current CNSC standard licences. The proposed licence for BWXT will contain conditions that authorize changes within the licensing basis as defined in CNSC's information document REGDOC-3.5.5, *Regulatory Fundamentals* and reflects the current licensing framework.

Licence Period

BWXT has requested a renewal of its licence for a period of 10 years. Based on CNSC staff's review of BWXT's application, performance history, and supporting information, CNSC staff recommend BWXT's request for a licence period of 10 years to the Commission. Over the proposed 10-year period, CNSC staff would provide regular reporting on regulatory oversight conducted at both facilities in public Commission proceedings.

PROPOSED LICENCE

e-Doc 5834926

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PDF Ref: e-Doc 6043994
Word Ref: e-Doc 5834926
File / dossier: 2.02

NUCLEAR FUEL FACILITY LICENCE

BWXT NUCLEAR ENERGY CANADA INC.
TORONTO AND PETERBOROUGH FACILITIES

I) LICENCE NUMBER: **FFL-3620.00/2030**

II) LICENSEE: Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:

BWXT Nuclear Energy Canada Inc.
(corporation # 3303655)
1160 Monaghan Road
Peterborough, Ontario
K9J 7B5

III) LICENCE PERIOD: This licence is valid from **January 1, 2021** to **December 31, 2030**, unless otherwise suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee to:

(i) operate and modify the Toronto nuclear fuel facility for the production of natural and depleted uranium dioxide pellets located at 1025 Lansdowne Avenue, Toronto, Ontario;

(ii) operate and modify the Peterborough nuclear fuel facility for the production of fuel pellets and the manufacturing, testing of fuel bundles from natural and depleted uranium dioxide and process contaminated equipment from offsite nuclear facilities located at 1160 Monaghan road, Peterborough, Ontario

(iii) possess, transfer, use, process, package, manage and store nuclear substances and equipment associated with or arise from the activities described in (i) (ii) and (iii); and

(iv) modify the Peterborough facility for the purpose of the production of fuel pellets described in (ii).

V) EXPLANATORY NOTES:

i) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.

ii) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations.

iii) The BWXT Nuclear Energy Canada Inc. Facilities Licence Conditions Handbook (LCH) provides compliance verification criteria used to verify compliance with the conditions set out in this licence, information regarding delegation of authority and applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria.

VI) CONDITIONS:

The licensee shall comply with the following conditions, established pursuant to subsection 24(5) of the *Nuclear Safety and Control Act*.

G. General

G.1 The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;

(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence; and

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (hereinafter "the Commission").

G.2 The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

G.3 The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

G.4 The licensee shall implement and maintain a public information and disclosure program.

1. Management System

1.1 The licensee shall implement and maintain a management system.

2. Human Performance Management

2.1 The licensee shall implement and maintain a training program.

3. Operating Performance

3.1 The licensee shall implement and maintain an operating program, which includes a set of operating limits.

3.2 The licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission.

4. Safety Analysis

4.1 The licensee shall implement and maintain a safety analysis program.

5. Physical Design

5.1 The licensee shall implement and maintain a design program.

5.2 The licensee shall implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency.

6. Fitness For Service

6.1 The licensee shall implement and maintain a fitness for service program.

7. Radiation Protection

7.1 The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

8. Conventional Health And Safety

8.1 The licensee shall implement and maintain a conventional health and safety program.

9. Environmental Protection

9.1 The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

10. Emergency Management And Fire Protection

10.1 The licensee shall implement and maintain an emergency preparedness program.

10.2 The licensee shall implement and maintain a fire protection program.

11. Waste Management

11.1 The licensee shall implement and maintain a waste management program.

11.2 The licensee shall maintain a decommissioning plan.

12. Security

12.1 The licensee shall implement and maintain a security program.

13. Safeguards

13.1 The licensee shall implement and maintain a safeguards program.

14. Packaging And Transport

14.1 The licensee shall implement and maintain a packaging and transport program.

15. Nuclear Facility Specific

15.1 The licensee shall submit and implement an updated environmental monitoring program at the Peterborough facility prior to the commencement of production of fuel pellets as described in paragraph (iv) of Part IV of this licence.

15.2 The licensee shall submit a commissioning report related to production of fuel pellets as described in paragraph (iv) of Part IV of this licence that is acceptable to the Commission, or a person authorized by the Commission.

SIGNED at OTTAWA, this day of Month 2020

Rumina Velshi, President,
on behalf of the Canadian Nuclear Safety Commission

PROPOSED LICENCE CONDITIONS HANDBOOK

e-Doc 5839357

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DRAFT

Canada's Nuclear Regulator

e-Doc 5839357 (Word)
e-Doc 6044239 (PDF)

LICENCE CONDITIONS HANDBOOK

LCH-FFL-3620.00/2030

BWXT Nuclear Energy Canada Inc.

Nuclear Fuel Facility Licence

FFL-3620.00/2030

Revision 0

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

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Licence Conditions Handbook **Effective: Month day, 2020**

LCH-FFL-3620.00/2030

BWXT Nuclear Energy Canada Inc.

Nuclear Fuel Facility Licence

FFL-3620.00/2030

SIGNED at OTTAWA this day of month 2020

_____

Caroline Ducros, Director

Nuclear Processing Facilities Division

Directorate of Nuclear Cycle and Facilities Regulation

CANADIAN NUCLEAR SAFETY COMMISSION

Revision History:

Effective Date	Revision	Word e-Doc and Version	Description of the Changes	CAF e-DOC
Month Day, 20XX	0	5839357	Original Document	N/A

TABLE OF CONTENTS

INTRODUCTION

The general purpose of the Licence Conditions Handbook (LCH) is to identify and clarify the relevant parts of the licensing basis for each licence condition (LC). This will help ensure that the licensee maintains facility operation in accordance with the licensing basis for the facility and the intent of the licence. The LCH should be read in conjunction with the licence.

The LCH typically has three parts under each LC: the Preamble, Compliance Verification Criteria (CVC), and Guidance. The Preamble explains, as needed, the regulatory context, background, and/or history related to the LC. CVC are criteria used by CNSC staff to verify and oversee compliance with the LC. Guidance is non-mandatory information, including direction, on how to comply with the LC.

Throughout the licence, the statement "or consent of a person authorized by the Commission" reflects to whom the Commission may delegate certain authority (hence "consent") to CNSC staff. Unless otherwise indicated in the CVC of specific LCs in this LCH, the delegation of authority by the Commission to act as a "person authorized by the Commission" is only applied to the incumbents of the following positions (source: Record of Decision for licence renewal issued month 20XX):

- Director, Nuclear Processing Facilities Division
- Director General, Directorate of Nuclear Cycle and Facilities Regulation
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch

The documents referenced in the LCH by e-Access numbers are not publicly available. The links provided in the LCH are references to the internal CNSC electronic filing system, and those documents cannot be opened from outside of the CNSC network.

Current versions of the licensee documents listed in this LCH are recorded in *BWXT – Written Notification* (e-Doc xxxxxxx), which is controlled by the Nuclear Processing Facilities Division and is available to the licensee upon request.

Most CNSC documents referenced in the LCH are available through the CNSC website. Documents listed on CNSC website may contain prescribed information as defined by the *General Nuclear Safety and Control Regulations* (GNSCR). Information in these documents will be made available only to stakeholders with appropriate security clearance on a valid need to know.

The licensee documents referenced in the LCH are not publicly available; they contain proprietary information or prescribed information as defined by the GNSCR. The CNSC is required to protect the information under its control as per the *Access to Information Act.* As such if a request for a BWXT document were received, CNSC staff would consult with BWXT for their direction on the release of any information, per the law.

Domestic and international standards (in particular consensus standards produced by the CSA Group) are an important component of the CNSC's regulatory framework. Standards support the regulatory requirements established through the *Nuclear Safety and Control Act* (NSCA), its

regulations and licences by setting out the necessary elements for acceptable design and performance at a regulated facility or a regulated activity. Standards are one of the tools used by the CNSC to evaluate whether licensees are qualified to carry out licensed activities.

The CNSC offers complimentary access to the CSA Group suite of nuclear standards through the CNSC website. This access platform allows interested stakeholders to view these standards online through any device that can access the Internet. Standards applicable to the licensees are documented in the CVC or guidance as appropriate.

This LCH has the following appendices.

- APENDIX A, which provides definitions of terms and a list of acronyms used throughout this LCH.
- APENDIX B, which provides a list of version controlled documents referenced in this LCH.

This licence authorizes the licensee to:

a) operate and modify the Toronto nuclear fuel facility for the production of natural and depleted uranium dioxide pellets located at 1025 Lansdowne Avenue, Toronto, Ontario;

b) operate and modify the Peterborough nuclear fuel facility for the production of fuel pellets and the production and testing of fuel bundles from natural and depleted uranium dioxide located at 1160 Monaghan road, Peterborough, Ontario;

c) receive, repair, modify and transport contaminated equipment at the Peterborough facility located at 1160 Monaghan Road, Peterborough, Ontario; and

d) to possess, process, use, transfer, package, import, manage and store the nuclear substances and equipment that are required for and associated with, or arise from the activities described in (a), (b) and (c).

The facilities descriptions and general site layout drawings that describe the facility are under LC 5.1.

GENERAL

Licence Condition G.1: Licensing Basis

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) The regulatory requirements set out in the applicable laws and regulations;

(ii) The conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence; and

(iii) The safety and control measures described in the licence application and the documents needed to support that licence application.

Unless otherwise approved in writing by the Canadian Nuclear Safety Commission (hereinafter "the Commission").

Preamble:

The licensing basis sets the conditions for acceptable performance at a regulated facility or activity, and thus establishes the basis for the CNSC's compliance program with respect of that regulated facility or activity. The degree to which the regulatory requirements are applied to BWXT facilities and activities should reflect their importance to the health and safety of persons, environment, national security, international obligations to which Canada has agreed, licensee's quality and economic expectations, the complexity of facility or activity, and the possible consequences if accidents occur or the activity is carried out incorrectly.

Where the licence condition requires the licensee to implement and maintain a particular program, the licensee documents that describe and implement the program are part of the licensing basis. Programs required by licence conditions or referred to in the LCH may or may not be health, safety, security, environment, and quality programs as defined in the BWXT's management system.

Compliance Verification Criteria:

Part (i) of the Licensing Basis

Part (i) of the licensing basis refers to applicable laws and regulations. There are many federal and provincial acts and regulations, and international laws, agreements, guidelines, etc., applicable to activities performed at BWXT.

The laws, regulations and international agreements for which CNSC has a regulatory role are:

- Nuclear Safety and Control Act (NSCA) and its Regulations;
- Impact Assessment Act and its Regulations;
- Canadian Environment Protection Act;

- Nuclear Liability and Compensation Act;
- Transportation of Dangerous Goods Act and its Regulations;
- Radiation Emitting Devices Act;
- Access to Information Act;
- Canada/IAEA Safeguards Agreements;
- *Canada Labour Code, Part II*;
- *Ontario Ministry of the Environment, Conservation and Parks Acts and Regulations*; and
- *Environment and Climate Change Canada Acts and Regulations*.

Part (ii) of the Licensing Basis

Part (ii) of the licensing basis refers to the conditions and the safety and control measures included in the licence and in the documents directly referenced in the licence.

Under the standardized format and content, the licence requires the licensee to implement and maintain certain programs. There are no documents directly referenced in the standardized BWXT licence. For the purpose of licence requirement, a program may be a series of documented, coordinated activities, not necessarily a single document.

Part (iii) of the Licensing Basis

Part (iii) of the licensing basis consists of the safety and control measures described in the licence application and in the documents in support of that licence application. The safety and control measures include important aspects of that documentation, as well as important aspects of analysis, design, operation, etc. They may be found in high-level, programmatic licensee documents but might also be found in lower-level, supporting licensee documentation. LC G.1 requires the licensee to conform to, and/or implement, all these safety and control measures.

Part (iii) of the licensing basis also includes the safety and control measures in the standards, codes and CNSC regulatory documents referenced in the application or in the licensee's supporting documentation. Note, however, this does not mean that all details in these referenced documents are part of the licensing basis; some of these documents may contain administrative, informative or guidance sections that are not considered to be part of the licensing basis.

Applicable licensee documents are listed in the LCH under the heading "Licensee Documents that Require Notification of Change". Applicable CNSC regulatory documents, CSA standards and other documents are listed in the LCH under the heading "Licensing Basis Publications". The documents listed in the LCH could cite other documents that also contain safety and control measures. Applicable licensing basis publications are listed in tables in this LCH under the most relevant LC. All "shall" or normative statements in licensing basis publications are considered CVC unless stated otherwise. If any "should" or informative statements in licensing basis publications are also considered CVC, this is also explained under the most relevant LC.

Details that are not directly relevant to safety and control measures for facilities or activities authorized by the licence are excluded from the licensing basis. Details that are relevant to a different safety and control area (i.e., not the one associated with the main document), are only part of the licensing basis to the extent they are consistent with the main requirements for both safety and control areas.

In the event of any perceived or real conflict or inconsistency between two elements of the licensing basis, the licensee shall consult CNSC staff to determine the approach to resolve the issue.

This LC is not intended to unduly inhibit the ongoing management and operation of the facility or the licensee's ability to adapt to changing circumstances and continuously improve, in accordance with its management system. Where the licensing basis refers to specific configurations, methods, solutions, designs, etc, the licensee is free to propose alternate approaches as long as they remain, overall, in accordance with the licensing basis and have a neutral or positive impact on health, safety, the environment, security, and safeguards. However, the licensee shall assess changes to confirm that operations remain in accordance with the licensing basis.

Changes to certain licensee documents require written notification to the CNSC, even if they are in accordance with the licensing basis. Further information on this topic is provided under LC G.2.

Regulatory Role of the Licensing Basis

The licensing basis is established when the Commission renders its decision regarding the licence application. Licence condition G.1 requires the licensee to conduct the licensed activities in accordance with the licensing basis. For activities that are not in accordance with the licensing basis, the licensee shall take action as soon as practicable to return to a state consistent with the licensing basis, taking into account the risk significance of the situation.

CNSC Staff's Approach to Assessing the Licensing Basis for BWXT

For any proposed activity/facility to be carried out, CNSC staff will review the information submitted by BWXT to determine if the proposed activity/facility remains within the licensing basis. BWXT may proceed with the proposed initiatives if they are found to be within the licensing basis. CNSC staff assess a proposed facility/activity as being within the licensing basis based on changes or impact on the overall safety at the BWXT.

CNSC staff will submit to the Commission for consideration any proposed activity or facility which CNSC staff consider to be outside the licensing basis. If the Commission grants approval to such an activity/facility, this activity/facility will become part of the licensing basis for BWXT and reflected in updates to LCH as appropriate.

Submission Date	Document Title	e-Doc
November 9, 2018	BWXT Nuclear Energy Canada Inc. FFOL-3620.01/2020 Renewal Application – Cover Letter	5714814
November 9, 2018	BWXT Nuclear Energy Canada Inc. – 2018 Fuel Facility Operating Licence Renewal Application	5714817
March 7, 2019	BWXT Nuclear Energy Canada Response to CNSC Staff Sufficiency Check of Licence Renewal Application and Request for Additional Information	5837803

Guidance:

Guidance Documents

Document Number	Document Title	Version
REGDOC- 3.5.3	Regulatory Fundamentals	2018

When the licensee becomes aware that a proposed change or activity might not be in accordance with the licensing basis, it should first seek direction from CNSC staff regarding the potential acceptability of this change or activity. The licensee should take into account that certain types of proposed changes might require significant lead times before CNSC staff can make recommendations and/or the Commission can properly consider them. Guidance for notifications to CNSC related to licensee changes are discussed under LC G.2.

Licence Condition G.2: Notification of Changes

The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

Preamble:

CNSC staff tracks, in e-Doc xxxxxxx the version history of licensee documents that require notification of change (with the exception of security-related documents).

Compliance Verification Criteria:

Written notification is a physical or electronic communication from a person authorized to act on behalf of the licensee to the CNSC.

In general, the changes for which the licensee shall notify the CNSC are captured as changes to specific licensee documents. The LCH identifies them under the most relevant LC. However,

the licensee documents identified in the LCH only represent the minimum subset of documents that require notification of change. For any change that is not captured as a change to a document identified in the LCH, if it negatively impacts designs, operating conditions, policies, programs, methods, or other elements that are integral to the licensing basis, the licensee shall provide written notification of the change. For example, if a licensee document in the CVC refers to another document, including a third-party document, without citing the revision # of that document, if that document changes and the licensee uses the revised version, the licensee shall determine if it is necessary to notify the CNSC of the change.

The documents needed to support the licence application may include documents produced by third parties (e.g., reports prepared by third party contractors). Changes to these documents require written notification to the CNSC only if the new version continues to form part of the licensing basis. That is, if the licensee implements a new version of a document prepared by a third party, it shall inform the CNSC of the change(s), per LC G.2. On the other hand, if a third party has updated a certain document, but the licensee has not adopted the new version as part of its safety and control measures, the licensee is not required to inform the CNSC that the third party has changed the document.

Licensee documents listed in the CVC of the LCH are subdivided into groups having different requirements for notification of change.

PN prior notification - the licensee shall submit the notice to the CNSC prior to implementing the change; typically, the requirement is to submit the proposed changes 30 days prior to planned implementation; however the licensee shall allow sufficient time for the CNSC to review the change proportionate to its complexity and the importance of the safety and control measures being affected

NT notification at time of making the change

Written notifications shall include a summary description of the change, the rationale for the change, expected duration (if not a permanent change), and a summary explanation of how the licensee has concluded that the change remains in accordance with the licensing basis (e.g., an evaluation of the impact on health, safety, security, the environment and Canada's international obligations). A copy of the revised WN document shall accompany the notification. All written notifications shall be transmitted to CNSC per established communications protocols.

Changes that are not clearly in the safe direction require further assessment of impact to determine if Commission approval is required in accordance with LC G.1.

Guidance:

For proposed changes that would not be in accordance with the licensing basis, the Guidance for LC G.1 applies.

Licence Condition G.3: Financial Guarantee

The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

Preamble:

The *General Nuclear Safety and Control Regulations* requires that a licence application contain a description of any proposed financial guarantee relating to the activity to be licensed. The licensee is responsible for all costs of decommissioning at the facility. All such costs are included in the licensee's decommissioning cost estimates and are covered by the licensee's financial guarantee for decommissioning.

The licensee's decommissioning cost estimate is provided in the facilities preliminary decommissioning plans. The facility's current financial guarantee is covered by a letter of credit and a surety bond.

Compliance Verification Criteria:

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
CNSC G-206	Financial Guarantee for the Decommissioning of Licensed Activities	2000	Implemented

The licensee shall submit annually to the Commission a written report confirming that the financial guarantee for decommissioning costs are continuously updated, valid, in an appropriate format to meet the decommissioning needs and that the issuer of the financial guarantee is in good standing with a rating as accepted by the Commission. The licensee shall submit this report as part of the Annual Compliance Report, or at any time as the Commission may request.

Guidance:

None provided.

Licence Condition G.4: Public Information and Disclosure

The licensee shall implement and maintain a public information and disclosure program.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that an application for a licence contain the proposed program to inform persons living in the vicinity of the site of the general nature and

characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed.

The primary goal of a public information and disclosure program is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of the nuclear facilities are effectively communicated to the public. In addition, the program shall include a commitment to a disclosure protocol for ongoing, timely communication of information related to the licensed facility during the course of the licence period.

This licence condition requires the licensee to implement and maintain a public information and disclosure program to improve the public's level of understanding about BWXT's facilities and activities.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-RPM-003	Public Information and Disclosure Program	NT

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
CNSC REGDOC-3.2.1	Public Information and Disclosure	2018	Implemented

Guidance:

None provided.

SCA – MANAGEMENT SYSTEM

Licence Condition 1.1: Management System

The licensee shall implement and maintain a management system

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application shall contain information on the proposed management system for the activity to be licensed, including the measures to promote and support safety culture.

The *General Nuclear Safety and Control Regulations* requires that a licence application contain the applicant's organizational management structure, including the internal allocation of functions, responsibilities and authority.

CSA standard N286, *Management System Requirements for Nuclear Facilities* contains the requirements for a management system throughout the life cycle of a nuclear facility and extends to all safety and control areas.

CSA standard N286.0.1, *Commentary on N286-12* provides background information concerning certain clauses and requirements in CSA N286. This background information can help the user clarify the context of the CSA N286 requirements.

Compliance Verification Criteria:

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
CSA N286	Management System Requirements for Nuclear Facilities	2012 (R2017)	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
BMS-BP-001	Business Management System (BMS) Manual	NT
BMS-BP-004	Licensed Activity Quality Assurance Program	NT

Guidance:

Guidance Documents

Document Number	Document Title	Version
CNSC REGDOC-2.1.2	Safety Culture	2018
CSA N286.0.1	Commentary on N286-12, Management system requirements for nuclear facilities	2014

SCA – HUMAN PERFORMANCE MANAGEMENT

Licence Condition 2.1: Human Performance Management

The licensee shall implement and maintain a training program.

Preamble:

This licence condition requires the licensee to develop and implement training programs for workers. It also provides the requirements regarding the program and processes necessary to support responsibilities of, qualifications and requalification training of persons at the nuclear facility.

As defined by the *General Nuclear Safety and Control Regulations*, a worker is a person who performs work that is referred to in a licence. This includes contractors and temporary employees. Training requirements apply equally to these types of workers as to the licensee's own employees.

The *General Nuclear Safety and Control Regulations* requires that licensees ensure there are a sufficient number of properly trained and qualified workers to safely conduct the licensed activities.

The *Class I Nuclear Facilities Regulations* requires that applicants for a Class I facility licence describe the training programs which have been implemented, and that licence applications include the proposed responsibilities, qualification requirements, training program and requalification program for workers; along with the results that have been achieved in implementing the program for recruiting, training and qualifying workers.

The *Class I Nuclear Facilities Regulations* requires every licensee to keep a record of the status of each worker's qualifications, requalification and training, including the results of all tests and examinations completed in accordance with the licence.

Compliance Verification Criteria:

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
CNSC REGDOC-2.2.2	Personnel Training	2016	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
BMS-P-005	Training	NT
TR-P-001	Systematic Approach to Training	NT

Guidance:

None provided.

SCA – OPERATING PERFORMANCE

Licence Condition 3.1: Operating Program

The licensee shall implement and maintain an operating program, which includes a set of operating limits.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility. The *Nuclear Substances and Radiation Devices Regulations* has requirements for records to be kept and retained for nuclear substances.

An operating program includes an up-to-date set of operating limits for the facility and activities authorized under the licence, including: production limits and limits for the possession, use, management, transfer, storage of nuclear substances, and an inventory of nuclear substances possessed under the licensees' operating licence.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-RPM-001	Radiation Protection Manual	PN
BMS-BP-004	Licensed Activity Quality Assurance Program	NT

The possession and production limits for the Toronto and Peterborough facilities are:

- BWXT may possess up to a maximum of 700 Mega grams (Mg) of Uranium at the Toronto facility in any form at any given time.
- BWXT may possess up to a maximum of 1500 Mg of Uranium at the Peterborough facility in any form at any given time.
- BWXT shall not process more than 150 Mg of Uranium at each facility, in any form and in any calendar month.

Guidance:

None provided.

Licence Condition 3.2: Reporting Requirements

The licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission.

Preamble:

This licence condition requires the licensee to implement and maintain a program for reporting information to the Commission. This includes compliance monitoring, operational performance, event reporting, and various types of notifications.

The *Nuclear Safety and Control Act* and its applicable regulations describe reporting to the Commission or a person authorized by the Commission. Reporting requirements are found in sections 29-32 of the *General Nuclear Safety and Control Regulations* and section 27 of the NSCA.

Compliance Verification Criteria:

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
CNSC REGDOC-3.1.2	Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills	2018	Implemented

Guidance:

None provided.

SCA – SAFETY ANALYSIS

Licence Condition 4.1: Safety Analysis Program

The licensee shall implement and maintain a safety analysis program.

Preamble:

The *General Nuclear Safety and Control Regulations* requires that a licence application contains information that includes a description and the results of any test, analysis or calculation performed to substantiate the information included in the application.

The *Class I Nuclear Facilities Regulations* requires that a licence application contains information that includes a final safety analysis report demonstrating the adequacy of the design of the nuclear facility.

The implementation and maintenance of a safety analysis program includes a process to identify and assess hazards and risks on an ongoing basis. This includes identifying and evaluating new or unforeseen risks that were not considered at the planning and design stages and updating previous risk assessments by replacing important assumptions with performance data. The results of this process will be used to set objectives and targets and to develop preventative and protective measures.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
N/A	Safety Analysis Report, Peterborough Operations (Fuel and Fuel Handling & Engineered Solutions)	NT
N/A	Safety Analysis Report, Nuclear Fuel Pelleting Operation	NT

The licensee shall maintain the safety analysis report described below to ensure they adequately consider the hazards associated with the facility. The safety analysis shall be a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and consider the effectiveness of preventative measures and strategies in reducing the effects of such hazards.

The licensee shall establish and maintain a process to periodically review and revise existing risk assessments to ensure, at a minimum of every five years, new risks and lessons learned are incorporated into an updated safety analysis report. This report shall be provided to CNSC staff for review.

Guidance:

Guidance Documents

Document Number	Document Title	Version
IAEA SSR-4	Safety of Nuclear Fuel Cycle Facilities	2017
IAEA SSG-6	Safety of Uranium Fuel Fabrication Facilities	2010

SCA – PHYSICAL DESIGN

Licence Condition 5.1: Design Program

The licensee shall implement and maintain a design program.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain a description of the structures, systems and components, and relevant documentation of the facility design.

A design program ensures that the design of the facility is managed using a well-defined systematic approach. This licence condition requires that the licensee implement and maintain a design program to confirm that safety-related systems, structures and components (SSC) and any modifications to them continue to meet their design basis given new information arising over time and taking changes in the external environment into account. It also confirms that SSCs continue to be able to perform their safety functions.

This licence condition requires that the licensee implement and maintain a design control process to ensure that design outputs (both interim and final) are reviewed, verified and validated against the design inputs and performance requirements, and to ensure that the design inputs are selected such that safety, performance and dependability of the design item are achieved.

The licensee is encouraged to make continuous improvements to the design of the facility and equipment, as long as the changes remain within the licensing basis authorized by the Commission.

The *National Fire Code of Canada* sets out technical provisions regulating (a) activities related to the construction, use or demolition of buildings and facilities; (b) the condition of specific elements of buildings and facilities; (c) the design or construction of specific elements of facilities related to certain hazards; and (d) protection measures for the current or intended use of buildings.

The *National Building Code of Canada* sets out technical provisions for the design and construction of new buildings. It also applies to the alteration, change of use and demolition of existing buildings.

The CSA standard N393, *Fire protection for facilities that process, handle, or store nuclear substances* provides the minimum fire protection requirements for the design, construction, commissioning, operation, and decommissioning of facilities which process, handle, or store nuclear substances, and other hazardous substances that directly relate to the nuclear substances being regulated.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
NBCC	National Building Code of Canada	2015	Implemented
NFCC	National Fire Code of Canada	2015	Implemented
CSA N393	Fire Protection for facilities that process, handle or store nuclear substances	2013 (R2018)	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
BMS-P-008	Business Wide Change Control	NT
108E1425	Peterborough Facility CNSC Licensed Areas 1160 Monaghan Road Peterborough ON K9J 0A8	PN
NFL 4012	1025 Lansdowne Avenue Site Plan	PN

Guidance:

None provided.

Licence Condition 5.2: Pressure Boundary Program and Authorized Inspection Agency

The licensee shall implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency.

Preamble:

A pressure boundary is a boundary of any pressure retaining vessel, system or component of a nuclear or non-nuclear system, where the vessel, system or component is registered or eligible for registration. This licence condition provides regulatory oversight with regards to the licensee's implementation of a pressure boundary program and holds the licensee responsible for all aspects of pressure boundary registration and inspections. A pressure boundary program is comprised of processes and procedures and associated controls that are required to ensure

compliance with the requirements set out in CSA B51, *Boiler Pressure Vessel and Pressure Piping Code.*

This licence condition also ensures that an Authorized Inspection Agency (AIA) will be subcontracted directly by the licensee. An AIA is an organization recognized by the CNSC as authorized to register designs and procedures, perform inspections, and other functions and activities as defined by CSA B51 and its applicable referenced publications

Compliance Verification Criteria:

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
CSA B51	Boiler Pressure Vessel and Pressure Piping Code	2014	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
N/A	Services Agreement between BWXT and Technical Standards and Safety Authority	NT*

* Termination of the agreement is considered a change that requires prior notification to CNSC.

Formal Agreement with an Authorized Inspection Agency

The licensee shall always have a valid AIA agreement, and shall adhere to the following:

(a) The licensee shall arrange for the AIA inspectors to have access to all areas of BWXT's facilities and records, and to the facilities and records of the BWXT's pressure boundary contractors and material organizations, as necessary for the purposes of performing inspections and other activities required by the standards;

(b) The licensee shall provide the inspectors of the AIA with: information, reasonable advance notice and time necessary to plan and perform inspections and other activities required by the standards;

(c) Where a variance or deviation from the standard exists, the licensee shall submit the proposed resolution to the AIA for evaluation; and

(d) Design registration services shall be provided by an AIA legally entitled under the applicable provincial boilers and pressure vessels acts and regulations to register designs in the province of installation.

The licensee shall obtain AIA acceptance for implementation of the licensee's programs and procedures for:

(a) calibration, repair and maintenance of overpressure protection devices;

(b) repair and maintenance of mechanical joints; and

(c) periodic inspection of boilers and pressure vessels designed according to CSA standard B51.

The licensee shall provide a copy of the signed AIA agreement to the CNSC. The licensee shall notify the CNSC in writing of any change to the terms and conditions of the agreement, including termination of the Agreement.

Guidance:

None provided.

SCA – FITNESS FOR SERVICE

Licence Condition 6.1: Fitness for Service Program

The licensee shall implement and maintain a fitness for service program.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain information including the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility. It is expected that the licensee will conduct routine maintenance, inspection and testing to ensure that the availability, reliability and effectiveness of facilities and equipment that may impact the health, safety and protection of the environment.

The *National Fire Code of Canada* sets out technical provisions regulating (a) activities related to the construction, use or demolition of buildings and facilities; (b) the condition of specific elements of buildings and facilities; (c) the design or construction of specific elements of facilities related to certain hazards; and (d) protection measures for the current or intended use of buildings.

The CSA standard N393, *Fire protection for facilities that process, handle, or store nuclear substances* provides the minimum fire protection requirements for the design, construction, commissioning, operation, and decommissioning of facilities which process, handle, or store nuclear substances, and other hazardous substances that directly relate to the nuclear substances being regulated.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
NFCC	National Fire Code of Canada	2015	Implemented
CSA N393	Fire Protection for Facilities that Process Handle or Store Nuclear Substances	2013 (R2018)	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
FM-P-006	Fuel Critical to Safety Program	NT
BMS-P-016	Enterprise Asset Management Program	NT

The maintenance program shall include testing and inspection and shall be performed in such a manner that the availability, reliability, and effectiveness of the facility remain consistent with the design and safety analysis documents submitted in support of the licence application.

The program shall document the frequency that the various maintenance, inspection, and testing are performed.

Guidance:

None provided.

SCA – RADIATION PROTECTION

Licence Condition 7.1: Radiation Protection Program

The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

Preamble:

The *Radiation Protection Regulations* requires that the licensee implement a radiation protection program and also ascertain and record doses for each person who performs any duties in connection with any activity that is authorized by the *Nuclear Safety and Control Act* or is present at a place where that activity is carried on. This program must ensure that doses to workers do not exceed prescribed dose limits and are kept as low as reasonably achievable (ALARA), social and economic factors being taken into account. The regulatory dose limits are explicitly provided in the *Radiation Protection Regulations*.

Action levels (ALs) are designed to alert licensees before regulatory dose limits are reached. By definition, if an action level is reached, a loss of control of some part of the associated radiation protection program may have occurred, and specific action is required, as defined in the *Radiation Protection Regulations*. ALs are not intended to be static and are to reflect operating conditions in the facility.

Compliance Verification Criteria:

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
G-129	Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"	2004	Implemented
G-228	Developing and Using Action Levels	2001	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-RPM-001	Radiation Protection Manual	PN

ALs for radiation protection are included in the tables below. In the event of a discrepancy between the tables and the licensee documentation upon which they are based, the licensee

documentation shall be considered the authoritative source considering that the licensee has followed its own change control process.

The action levels for the Peterborough facility are shown in the table below:

Nuclear Energy Worker	**Period**	**Action Level (mSv)**
Effective dose	Quarter of a year	4.0
Effective dose	1 year	12.0
Effective dose	5 years	60.0
Skin dose	1 year	100
Extremity dose	1 year	200
Pregnant nuclear energy worker	Balance of the pregnancy	3.5
Parameter		**Action Level**
Urinalysis		10 µg/L for any period

Nuclear Substance and Form	**Action Level**		
U in Airborne Contamination	Unclassified Area	R1 Area	R2 Area
	12 dpm/m^3	12 dpm/m^3	36 dpm/m^3

The action levels for the Toronto facility are shown in the table below:

Nuclear Energy Worker	**Period**	**Action Level (mSv)**
Effective dose	Quarter of a year	6.0
Effective dose	1 year	15.0
Effective dose	5 years	60.0
Skin Dose	1 year	350
Extremity dose	1 year	350
Pregnant nuclear energy worker	Balance of the pregnancy	3.5
Parameter		**Action Level**
Urinalysis		10 µg/L for any period

Nuclear Substance and Form	**Action Level**		
U in Airborne Contamination	Unclassified Area	R2 Area	R3 Area
	36 dpm/m^3	180 dpm/m^3	270 dpm/m^3

The licensee shall review and, if necessary, revise the action levels specified above at least once every five years in order to validate their effectiveness. The results of such reviews shall be provided to CNSC staff.

Guidance:

Guidance Documents

Document Number	**Document Title**	**Version**
CNSC G-91	Ascertaining and recording radiation doses to individuals	2003

SCA – CONVENTIONAL HEALTH AND SAFETY

Licence Condition 8.1: Conventional Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain information including the proposed worker health and safety policies and procedures. As a federal regulated site, BWXT is also subject to the requirements of the *Canada Labour Code* and *Canada Occupational Health and Safety Regulations*.

CSA Z94.4, *Selection, Use and Care of Respirators* sets out requirements for the selection, use, and care of respirators and for the administration of an effective respiratory protection program in the workplace.

Compliance Verification Criteria:

Licensing Basis Publication

Document Number	Document Title	Version	Implementation Date
CSA Z94.4	Selection, Use and Care of Respirators	2018	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS Policy	Environmental Health & Safety Policy	PN
EHS-P-H&S-1.0T	Toronto Pellet Operations: Environment, Health and Safety Plan	PN
EHS-P-H&S-1.0P	Peterborough Operations (Fuel & Services): Environment, Health and Safety Plan	PN
EHS-P-BSM-001P	Beryllium Safety Manual – Program Administration	PN

Employment and Social Development Canada is mandated with overseeing and enforcing compliance with the *Canada Labour Code* (CLC) and its regulations. CNSC staff monitor licensee compliance with its conventional health and safety program, and will take regulatory actions for any potential unsafe work practice situations.

The licensee shall ensure compliance to all applicable requirements under the CLC including all Occupational Exposure Limits (OEL) for chemical compounds listed under its regulations.

Guidance:

None provided.

SCA – ENVIRONMENTAL PROTECTION

Licence Condition 9.1: Environmental Protection Program

The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed environmental protection policies, procedures, effluent and environmental monitoring programs. The *General Nuclear Safety and Control Regulations* requires that every licensee take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities and of nuclear substances The *Radiation Protection Regulations* prescribe the radiation dose limits for the general public of 1 mSv per calendar year.

The release of hazardous substances is regulated by the CNSC as well as both the Ontario Ministry of the Environment and Climate Change (MOECC) and Environment and Climate Change Canada (ECCC) through various acts and regulations.

CSA standard N288.1 provides guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities.

CSA standard N288.4 provides requirements for the design and implementation of an environmental monitoring program at nuclear facilities.

CSA standard N288.5 provides requirements for the design and implementation of an effluent monitoring program at nuclear facilities.

CSA standard N288.6 provides requirements for the performance and maintenance of an environmental risk assessment at nuclear facilities.

CSA standard N288.8 provides requirements for establishing and implementing action levels at nuclear facilities.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
CSA N288.1	Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities	2014	Implemented
CSA N288.4	Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2010	Implemented
CSA N288.5	Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2011	Implemented
CSA N288.6	Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills	2012	Implemented
CSA N288.8	Establishing and implementing action levels for releases to the environment from nuclear facilities	2017	
CNSC REGDOC-2.9.1	Environmental Protection: Environmental Principles, Assessments and Protection Measures, version 1.1	2017	

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
N/A	Environmental Risk Assessment Report, Nuclear Fuel Pellet Operation	NT
N/A	Environmental Risk Assessment Report, Peterborough Facility	NT
N/A	Environmental Risk Assessment Report, Peterborough Consolidated Operations	NT
EHS-P-EMS-001P	Peterborough Environmental Management System	PN
EHS-P-EMS-001T	Toronto Pellet Operations, Environmental Management System	PN
EHS-P-RPM-001	Radiation Protection Manual (Contains EMP)	PN
EHS-P-BSM-001P	Beryllium Safety Manual – Program Administration	PN
EHS-P-H&S-1.0T	Toronto Pellet Operations: Environment, Health and Safety Plan	PN
EHS-P-H&S-1.0P	Peterborough Operations (Fuel & Services): Environment, Health and Safety Plan	PN

The licensee's environmental protection program shall ensure control, monitoring and recording of environmental emissions from the Peterborough facility such that the releases do no exceed operating limits defined below:

Substance	Source	Release Limit
Uranium	Water	0.14 g/L (weekly composite)
	Air	410 $\mu g/m^3$ (annual average)
Beryllium	Water	26 mg/L (individual sample)
	Air	2.6 $\mu g/m^3$ (weekly sample)

The licensee's environmental protection program shall ensure control, monitoring and recording of environmental emissions from the Toronto facility such that the releases do no exceed operating limits defined below:

Substance	Source	Release Limit
Uranium	Water	1 g/L (weekly composite)
	Air – Furnace Exhaust 1	437 µg/m^3
	Air – Furnace Exhaust 2/4	55 µg/m^3
	Air – Furnace Exhaust 5/6	52 µg/m^3
	Air - Rotoclone	65 µg/m^3
	Air – 6H68	47 µg/m^3
	Air – 4H48	97 µg/m^3

The licensee's environmental protection program shall have action levels for environmental emissions.

The environmental emissions action levels for the Peterborough facility are:

Release	Action Level
U in water (single batch)	6 ppm uranium in solution
U in water (annual average)	3 ppm uranium in solution
U in Stack Measurement	1 microgram (µg) uranium / m^3
Be in Stack Measurement	0.03 microgram (µg) beryllium / m^3
Be in water (single measurement)	40 microgram (µg) beryllium / m^3

The environmental emissions action levels for the Toronto facility are:

Release	**Action Level**
U in water to sewer (single batch)	6 ppm uranium in solution
pH of water to sewer	Less than 6.65 and above 9.0
U in water (annual average)	3 ppm uranium in solution
U in Stack Measurement	1 microgram (µg) uranium / m^3
Facility Perimeter Air Quality Monitor	0.08 microgram (µg) uranium / m^3

The licensee shall review and, if necessary, revise the action levels specified above at least once every five years in order to validate their effectiveness. The results of such reviews shall be provided to CNSC staff.

Guidance:

None provided.

SCA – EMERGENCY MANAGEMENT AND FIRE PROTECTION

Licence Condition 10.1: Emergency Preparedness Program

The licensee shall implement and maintain an emergency preparedness program.

Preamble:

This licence condition requires the licensee to establish an emergency preparedness program to prepare for, to respond to, and to recover from the effects of accidental radiological/nuclear and/or hazardous substance release. As part of the emergency preparedness program, the licensee shall prepare an onsite emergency plan and establish the necessary organizational structure for clear allocation of responsibilities, authorities, and arrangements for coordinating onsite activities and cooperating with external response organizations throughout all phases of an emergency.

The *Class I Nuclear Facilities Regulations* requires measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of national security, including measures to assist, notify, report to off-site authorities including the testing of the implementation of these measures.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
CNSC REGDOC-2.10.1	Nuclear Emergency Preparedness and Response	2016	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-H&S-25.0T	Toronto Pellet Operations – Emergency Plan	NT
EHS-P-H&S-11.0P	Peterborough Operations (Fuel & Services) – Emergency Preparedness and Fire Prevention	NT

Guidance:

None provided.

Licence Condition 10.2: Fire Protection Program

The licensee shall implement and maintain a fire protection program.

Preamble:

Licensees require a comprehensive fire protection program (the set of planned, coordinated, controlled and documented activities) to ensure the licensed activities do not result in an unreasonable risk to the health and safety of persons and to the environment due to fire and to ensure that the licensee is able to efficiently and effectively respond to emergency fire situations.

The *National Fire Code of Canada* sets out technical provisions regulating (a) activities related to the construction, use or demolition of buildings and facilities; (b) the condition of specific elements of buildings and facilities; (c) the design or construction of specific elements of facilities related to certain hazards; and (d) protection measures for the current or intended use of buildings.

The *National Building Code of Canada* sets out technical provisions for the design and construction of new buildings. It also applies to the alteration, change of use and demolition of existing buildings.

The CSA standard N393, *Fire protection for facilities that process, handle, or store nuclear substances* provides the minimum fire protection requirements for the design, construction, commissioning, operation, and decommissioning of facilities which process, handle, or store nuclear substances, and other hazardous substances that directly relate to the nuclear substances being regulated.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
NBCC	National Building Code of Canada	2015	Implemented
NFCC	National Fire Code of Canada	2015	Implemented
CSA N393	Fire Protection for facilities that process, handle or store nuclear substances	2013 (R2018)	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-H&S-11.0P	Peterborough Operations (Fuel & Services) – Emergency Preparedness and Fire Prevention	NT
EHS-P-H&S-11.0T	Toronto Pellet Operations – Fire Protection Program	NT
N/A	Fire Hazards Analysis – Peterborough, Building 21	NT
N/A	Fire Hazards Analysis – Peterborough, Building 24	NT
N/A	Fire Hazards Analysis – Peterborough, Buildings 26 and 28	NT
N/A	Fire Hazards Analysis – Toronto, Building 7	NT
N/A	Fire Hazards Analysis – Toronto, Building 9	NT

Guidance:

None provided.

SCA – WASTE MANAGEMENT

Licence Condition 11.1: Waste Management Program

The licensee shall implement and maintain a waste management program.

Preamble:

The *General Nuclear Safety and Control Regulations* requires that a licence application contain information related to the in-plant management of radioactive waste or hazardous waste resulting from the licensed activities.

The *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.

CSA standard N292.0, *General principles for the management of radioactive waste and irradiated fuel* specifies common requirements for the management of radioactive waste and irradiated fuel from generation to storage or disposal.

CSA standard N292.3, *Management of Low- and Intermediate–level Radioactive Waste* provides requirements specific to the management of low- and intermediate-level radioactive waste in solid, liquid, or gaseous states.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
CSA N292.0	General Principles for the Management of Radioactive Waste and Irradiated Fuel	2014	Implemented
CSA N292.3	Management of Low- and Intermediate–level Radioactive Waste	2014	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-E-3.0T	Toronto Pellet Operations – Waste Management	NT
EHS-P-E3.0P	Peterborough Operations (Fuel & Services) – Waste Management	NT
EHS-P-RPM-001	Radiation Protection Manual, Volume 1	PN

Guidance:

Guidance Documents

Document Number	Document Title	Version
P-290	Managing Radioactive Waste	2004

Licence Condition 11.2: Decommissioning Plan

The licensee shall maintain a decommissioning plan.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain information including the proposed plan for the decommissioning of the nuclear facility or of the site. This licence condition requires that the licensee maintain a decommissioning plan.

A decommissioning strategy provides an overview of the proposed decommissioning approach that is sufficiently detailed to assure that the proposed approach is, in the light of existing knowledge, technically and financially feasible and appropriate in the interests of health, safety, security and the protection of the environment. The decommissioning strategy defines areas to be decommissioned and the general structure and sequence of the principle work packages. The decommissioning strategy forms the basis for establishing and maintaining a financial arrangement (financial guarantee) that will assure adequate funding of the decommissioning plan.

The decommissioning plans for BWXT's Toronto and Peterborough facilities are documented in the comprehensive preliminary decommissioning plans and the associated cost estimates. It is expected that the PDP will be revised as the conditions at the facilities change. When the PDP is revised, the cost of decommissioning must be reviewed. At a minimum, the PDP must be reassessed every five years.

The CSA standard N294, *Decommissioning of Facilities Containing Nuclear Substances* specifies requirements for the decommissioning of licensed facilities and other locations where nuclear substances are managed, possessed, or stored.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
CSA N294	Decommissioning of Facilities Containing Nuclear Substances	2009	Implemented
CNSC G-219	Decommissioning Planning for Licensed Activities	2000	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
164071-DCE-024	BWXT NEC Peterborough Fuel Assembly Preliminary Decommissioning Plan	NT
164071-DCE-023	BWXT NEC Toronto Fuel Pellet Operations Preliminary Decommissioning Plan	NT

Guidance:

None provided.

SCA – SECURITY

Licence Condition 12.1: Security Program

The licensee shall implement and maintain a security program.

Preamble:

The *General Nuclear Safety and Control Regulations* requires that a licence application contain information including the proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information.

The *Class I Nuclear Facilities Regulations* requires that a licence application contain information including the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility, including measures to alert the licensee to such acts.

The *Nuclear Security Regulations* describes the application of Part 2 of these regulations, which is relevant to this licensee.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-SEC-001T	Toronto Pellet Operation - Security Manual	NT
EHS-P-SEC-001P	Peterborough Operations – Security Manual	NT

Guidance:

None provided.

SCA – SAFEGUARDS AND NON-PROLIFERATION

Licence Condition 13.1: Safeguards Program

The licensee shall implement and maintain a safeguards program.

Preamble:

The *General Nuclear Safety and Control Regulations* requires the licensee to take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement, and defines reporting requirements for safeguards events.

The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the licensee's proposed measures to facilitate Canada's compliance with any applicable safeguards agreement.

This LC requires that the licensee implement and maintain a safeguards program. Safeguards is a system of inspection and other verification activities undertaken by the IAEA in order to evaluate a Member State's compliance with its obligations pursuant to its safeguards agreements with the IAEA.

Canada has entered into a Safeguards Agreement and an Additional Protocol (hereafter referred to as "safeguards agreements") with the IAEA pursuant to its obligations under the *Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/140). The objective of the Canada-IAEA safeguards agreements is for the IAEA to provide assurance on an annual basis to Canada and to the international community that all declared nuclear materials are in peaceful, non-explosive uses and that there is no indication of undeclared nuclear materials or activities. This conclusion confirms that Canada is in compliance with its obligations under the following Canada-IAEA safeguards agreements:

- *Agreement between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*; and
- *Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons.*

These are reproduced in information circulars INFCIRC/164 and INFCIRC/164/Add. 1.

In addition, the import and export of controlled nuclear substances, equipment and information identified in the *Nuclear Non-proliferation Import and Export Control Regulations* requires separate authorization from the CNSC, consistent with subsection 3(2) of the GNSCR.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
CNSC REGDOC-2.13.1	Safeguards and Nuclear Material Accountancy	2018	Implemented

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
SG-01	Toronto - Safeguards Procedure	PN
SG-01	Peterborough - Safeguards Procedure	PN

Guidance:

None provided.

SCA – PACKAGING AND TRANSPORT

Licence Condition 14.1: Packaging and Transport Program

The licensee shall implement and maintain a packaging and transport program.

Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain information on the proposed procedures for transporting nuclear substances and hazardous substances.

The transport of nuclear substances or hazardous substances must be done in accordance with the requirements of the *Packaging and Transport of Nuclear Substances Regulations, 2015*, (PTNSR) and *Transportation of Dangerous Goods Regulations* (TDGR) set out by Transport Canada.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change

Document Number	Document Title	Notification
EHS-P-RPM-002	Peterborough Operations and Toronto Operations - Transport Regulations for Nuclear Substances	NT

The licensee shall implement and maintain a packaging and transport program that will be in compliance with all the regulatory requirements set out in the Transport Canada TDGR and in the CNSC PTNSR.

Every person who transports or causes to be transported radioactive nuclear substances (included in Class 7 of the Schedule to the *Transportation of Dangerous Goods Act*) shall act in accordance with the requirements of the TDGR set out by Transport Canada.

As used in the PTNSR, the *IAEA Regulations* means the IAEA requirements document SSR-6 *Regulations for the Safe Transport of Radioactive Material (2012 Edition)* as amended from time to time.

The PTNSR provides specific requirements for the design of transport packages, the packaging, marking and labeling of packages and the handling and transport of nuclear substances.

Guidance:

Guidance Documents

Document Number	Document Title	Version
REGDOC-2.14.1	Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substances Regulations, 2015	2016

FACILITY SPECIFIC

Licence Condition 15.1: Environmental Monitoring

The licensee shall submit and implement an updated environmental monitoring program at the Peterborough facility prior to the commencement of production of fuel pellets as described in paragraph (iv) of Part IV of this licence.

Preamble:

The *General Nuclear Safety and Control Regulations* requires that every licensee take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities and of nuclear substances The *Radiation Protection Regulations* prescribe the radiation dose limits for the general public of 1 mSv per calendar year.

The release of hazardous substances is regulated by the CNSC as well as both the Ontario Ministry of the Environment, Climate and Parks (MOECP) and Environment and Climate Change Canada (ECCC) through various acts and regulations.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
CSA N288.1	Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities	2014	Implemented
CSA N288.4	Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2010	Implemented
CSA N288.5	Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2011	Implemented
CSA N288.6	Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills	2012	Implemented
CSA N288.8	Establishing and implementing action levels for releases to the environment from nuclear facilities	2017	

CNSC REGDOC-2.9.1	Environmental Protection: Environmental Principles, Assessments and Protection Measures, version 1.1	2017	

Deliverables under licence condition 15.1 would include updated radiation and environmental program manuals that ensures presence of monitoring of ambient air and soil as per the approved Environmental Risk Assessment at Peterborough as well as a facility modification plan that details additional internal air monitoring used for radiation dose assessment and additional external air emissions stacks, additional effluent treatment systems and associated monitoring confirming operating limits. The ambient monitoring program must be implemented prior to commencement of pelleting operations with baseline data submitted to CNSC staff for review.

Licensee shall also demonstrate compliance to MOECP and/or municipality requirements for air emissions and liquid effluents through updated ESDM, ECA as required.

Guidance:

Guidance Documents

None.

Licence Condition 15.2: Commissioning report

The licensee shall submit a commissioning report related to production of fuel pellets as described in paragraph (iv) of Part IV of this licence that is acceptable to the Commission, or a person authorized by the Commission.

Preamble:

This licence condition requires that the licensee confirms that the design outputs (both interim and final) are reviewed, verified and validated against the design inputs and performance requirements based on which the facility was modified to allow for conduct of pelleting operations, and to ensure that safety, performance and dependability of the facility and equipment design are achieved.

Compliance Verification Criteria:

Licensing Basis Publications

Document Number	Document Title	Version	Implementation Date
NBCC	National Building Code of Canada	2015	Implemented
NFCC	National Fire Code of Canada	2015	Implemented
CSA N393	Fire Protection for facilities that process, handle or store nuclear substances	2013 (R2018)	Implemented

Deliverables under licence condition 15.2 would include a revised fire hazard analysis, updated safety analysis, a third party review report detailing compliance with all applicable national codes of the facility modifications, confirmation of certification of all pressure bearing components from TSSA and updated program documents for individual Safety and Control Areas as applicable before the commencement of operations.

CNSC staff will require these deliverables at least 90 days prior to start of operation so as to plan and confirm through any compliance verification activities the safety envelope of the facility and its licensing basis.

Guidance:

Guidance Documents

Document Number	Document Title	Version
REGDOC-2.5.1	General Design Considerations: Human Factors	2019
IAEA SSG-6	Safety of Uranium Fuel Fabrication Facilities	2010
IAEA SSR-4	Safety of Nuclear Fuel Cycle Facilities	2017

APPENDIX A – DEFINITIONS AND ACRONYMS

1. DEFINITIONS

The following is a list of definitions of words or expressions used in the LCH that may need clarification; they are defined for the purpose of the LCH only. All other terms and expressions used in the LCH are consistent with the definitions provided in the NSCA, the regulations made pursuant to the NSCA, or in the CNSC regulatory document REGDOC-3.6 *Glossary of CNSC Terminology*.

Accept/ed/able/ance – meets regulatory requirements, which mean it is in compliance with the documents referenced in the LCH.

Approval – Commission's permission to proceed, for situations or changes where the licensee would be:

- not compliant with a regulatory requirement set out in applicable laws and regulations;
- not compliant with a licence condition; and
- not in the safe direction but the objective of the licensing basis is met.

Compliance Verification Criteria – regulatory criteria used by CNSC staff to verify compliance with the licence conditions.

Design Basis – the entire range of conditions for which the nuclear facility is designed, in accordance with established design criteria, and for which damage to the fuel and/or the release of radioactive material is kept within authorized limits.

Guidance – guidance in the LCH is non-mandatory information, including direction, on how to comply with the licence condition.

Implementation Date – the date that a given document is implemented by the licensee. If the licensee implements the document before or at the issuance of the licence then "implemented" will be stated.

Program(s) – a documented group of planned activities, procedures, processes, standards and instructions coordinated to meet a specific purpose.

Qualified Staff – trained licensee staff, deemed competent and qualified to carry out tasks associated with their respective positions.

Safe Direction – changes in facility safety levels that would not result in:

(a) a reduction in safety margins;

(b) a breakdown of barrier;

(c) an increase (in certain parameters) above accepted limits;

(d) an increase in risk;

(e) impairment(s) of safety systems;

(f) an increase in the risk of radioactive releases or spills of hazardous substances;

(g) injuries to workers or members of the public;

(h) introduction of a new hazard;

(i) reduction of the defence-in-depth provisions;

(j) causing hazards or risks different in nature or greater in probability or magnitude than those stated in the safety analysis of the nuclear facility.

Safety and Control Measures – measures or provisions which demonstrate that the applicant:

(i) is qualified to carry on the licensed activities; and

(ii) has made adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and any measures required to implement international obligations to which Canada has agreed.

Written Notification – a physical or electronic communication between CNSC staff and a person authorized to act on behalf of the licensee

2. ACRONYMS LIST

Acronym	Definition
AIA	Authorized Inspection Agency
AL	Action level
ALARA	As Low As Reasonably Achievable
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CVC	Compliance Verification Criteria
dpm	Disintegrations per minute
EMS	Environmental Management System
FFOL	Nuclear Fuel Facility Operating Licence
g	gram
IAEA	International Atomic Energy Agency
L	Litre
LC	Licence Condition
LCH	Licence Conditions Handbook
NFPA	National Fire Protection Association
NSCA	*Nuclear Safety and Control Act*
m^3	Metres cubed
mg	Miligram
Mg	Megagram
ppm	Parts per million
PTNSR	*Packaging and Transport of Nuclear Substances Regulations*
SCA	Safety and Control Area
SSCs	Systems, Structures and Components
µg	Microgram
mSv	Millisievert
U	Uranium

APPENDIX B – LIST OF VERSION CONTROLLED DOCUMENTS

Document Number	Document Title	Revision	LC
G-206	Financial Guarantee for the Decommissioning of Licensed Activities	2000	G.3
REGDOC-3.2.1	Public Information and Disclosure	2018	G.4
CSA N286	Management systems requirements for nuclear facilities	2012 (R2017)	1.1
REGDOC 2.2.2	Personnel Training	2016	2.1
REGDOC 3.1.2	Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills	2018	3.2
NBC	National Building Code of Canada 2015	2015	5.1 10.2
NFC	National Fire Code of Canada 2015	2015	5.1 6.1 10.2
CSA N393	Fire Protection for Facilities that Process, Handle or Store Nuclear Substances	2013 (R2018)	5.1 6.1 10.2
CSA B51	Boiler and Pressure Vessel and Pressure Piping Code	2014	5.2
G-129	Keeping Radiation Exposures and Doses “As Low as Reasonably Achievable (ALARA)”	2004	7.1
G-228	Developing and Using Action Levels	2001	7.1
CSA Z94.4	Selection, Use and Care of Respirators	2018	8.1
REGDOC 2.9.1	Environmental Protection Policies, Programs and Procedures	2013	9.1
CSA N288.1	Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities	2014	9.1

Document Number	Document Title	Revision	LC
CSA N288.4	Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2010	9.1
CSA N288.5	Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2011	9.1
CSA N288.6	Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills	2012	9.1
CSA N288.8	Establishing and implementing action levels for releases to the environment from nuclear facilities	2017	9.1
REGDOC 2.10.1	Nuclear Emergency Preparedness and Response	2016	10.1
CSA N292.0	General Principles for the Management of Radioactive Waste and Irradiated Fuel	2014	11.1
CSA N292.3	Management of Low-and Intermediate-Level Radioactive Waste	2014	11.1
P-290	Managing Radioactive Waste	2004	11.1
CSA N294	Decommissioning of Facilities Containing Nuclear Substances	2009	11.2
CNSC G-219	Decommissioning Planning for Licensed Activities	2000	11.2
REGDOC 2.13.1	Safeguards and Nuclear Material Accounting	2018	13.1

Document Number	Document Title	Notification	LC
N/A	Financial Guarantee – Letter of Credit	N/A	G.3
N/A	Financial Guarantee – Surety Bond	N/A	G.3
BMS-BP-001	Business Management System (BMS) Manual	NT	1.1
BMS-BP-004	Licensed Activity Quality Assurance Program	NT	1.1
BMS-P-005	Training	NT	2.1
TR-P-001	Systematic Approach to Training	NT	2.1

N/A	Safety Analysis Report, Peterborough Operations (Fuel and Fuel Handling & Engineered Solutions)	NT	4.1
N/A	Safety Analysis Report, Nuclear Fuel Pelleting Operation	NT	4.1
BMS-P-008	Business Wide Change Control	NT	5.1
108E1425	Peterborough Facility CNSC Licensed Areas 1160 Monaghan Road Peterborough ON K9J 0A8	PN	5.1
NFL 40121	1025 Lansdowne Avenue Site Plan	PN	5.1
N/A	Services Agreement between BWXT and Technical Standards and Safety Authority	NT	5.2
FM-P-006	Fuel Critical to Safety Program	NT	6.1
BMS-P-016	Enterprise Asset Management Program	NT	6.1
EHS-P-RPM-001	Radiation Protection Manual	PN	7.1 9.1
EHS Policy	Environmental Health & Safety Policy	PN	8.1
EHS-P-H&S-1.0T	Toronto Pellet Operations: Environment, Health and Safety Plan	PN	8.1
EHS-P-H&S-1.0P	Peterborough Operations (Fuel & Services): Environment, Health and Safety Plan	PN	8.1
EHS-P-BSM-001P	Beryllium Safety Manual – Program Administration	PN	8.1 9.1
N/A	Environmental Risk Assessment Report, Nuclear Fuel Pellet Operation	NT	9.1
N/A	Environmental Risk Assessment Report, Peterborough Facility	NT	9.1
N/A	Environmental Risk Assessment Report, Peterborough Consolidated Operations	NT	9.1
EHS-P-EMS-001P	Peterborough Environmental Management System	PN	9.1
EHS-P-EMS-001T	Toronto Pellet Operations, Environmental Management System	PN	9.1
EHS-P-H&S-1.0T	Toronto Pellet Operations: Environment, Health and Safety Plan	PN	9.1

EHS-P-H&S-1.0P	Peterborough Operations (Fuel & Services): Environment, Health and Safety Plan	PN	9.1
EHS-P-H&S-25.0T	Toronto Pellet Operations – Emergency Plan	NT	10.1
EHS-P-H&S-11.0P	Peterborough Operations (Fuel & Services) – Emergency Preparedness and Fire Prevention	NT	10.1
EHS-P-H&S-11.0P	Peterborough Operations (Fuel & Services) – Emergency Preparedness and Fire Prevention	NT	10.2
EHS-P-H&S-11.0T	Toronto Pellet Operations – Fire Protection Program	NT	10.2
N/A	Fire Hazards Analysis – Peterborough, Building 21	NT	10.2
N/A	Fire Hazards Analysis – Peterborough, Building 24	NT	10.2
N/A	Fire Hazards Analysis – Peterborough, Buildings 26 and 28	NT	10.2
N/A	Fire Hazards Analysis – Toronto, Building 7	NT	10.2
N/A	Fire Hazards Analysis – Toronto, Building 9	NT	10.2
EHS-P-E-3.0T	Toronto Pellet Operations – Waste Management	NT	11.1
EHS-P-E3.0P	Peterborough Operations (Fuel & Services) – Waste Management	NT	11.1
164071-DCE-024	BWXT NEC Peterborough Fuel Assembly Preliminary Decommissioning Plan	NT	11.2
164071-DCE-023	BWXT NEC Toronto Fuel Pellet Operations Preliminary Decommissioning Plan	NT	11.2
EHS-P-SEC-001T	Toronto Pellet Operation - Security Manual	NT	12.1
EHS-P-SEC-001P	Peterborough Operations – Security Manual	NT	12.1
SG-01	Toronto - Safeguards Procedure	PN	13.1
SG-01	Peterborough - Safeguards Procedure	PN	13.1
EHS-P-RPM-002	Peterborough Operations and Toronto Operations - Transport Regulations for Nuclear Substances	NT	14.1

CURRENT LICENCE

e-Doc 5151105

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PDF Ref: e-Doc 5151105
Word Ref: e-Doc 5103298
File / dossier: 2.02

NUCLEAR FUEL FACILITY OPERATING LICENCE

BWXT NUCLEAR ENERGY CANADA INC.
TORONTO AND PETERBOROUGH FACILITIES

I) LICENCE NUMBER: **FFOL-3620.01/2020 (Effective date: December 16, 2016)**

II) LICENSEE: Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:

BWXT Nuclear Energy Canada Inc.
(corporation # 3303655)
1160 Monaghan Road
Peterborough, Ontario
K9J 7B5

III) LICENCE PERIOD: This licence is valid from **December 16, 2016** to **December 31, 2020**, unless otherwise suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee at the Toronto facility to:

(a) operate and modify its nuclear fuel facility for the production of natural and depleted uranium dioxide pellets (hereinafter "the facility") located at 1025 Lansdowne Avenue, Toronto in the province of Ontario, specifically identified as buildings 7 and 9 on the Engineering Drawing of the licensed facility titled: "1025 Lansdowne Avenue site plan; Dated 2016-09-22, Drawing number NFL 4012 Revision 1"; and

(b) possess, transfer, use, process, import, package, transport, manage, and store the nuclear substances that are required for, associated with or arise from the activities referred to in paragraph (a) of this Part.

This licence authorizes the licensee at the Peterborough facility to:

(c) operate and modify its nuclear fuel facility for the production and testing of fuel bundles from natural and depleted uranium dioxide pellets, (hereinafter "the facility") located within the main GE Canada plant complex at 107 Park Street North, Peterborough, in the province of Ontario, as more particularly described in Appendix B to this licence;

(d) receive, repair, modify and return contaminated equipment from off site nuclear facilities; and

(e) possess, transfer, use, process, import, package, transport, manage, and store the nuclear substances that are required for, associated with or arise from the activities referred to in paragraph (c and d) of this Part.

V) EXPLANATORY NOTES:

a) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations;

b) The content of Appendix A, "RELEASE LIMITS", attached to this licence forms part of the licence;

c) The contents of Appendix B "DESCRIPTION OF THE PETERBOROUGH LICENSED FACILITY", attached to this licence forms part of the licence; and

d) The BWXT Nuclear Energy Canada Inc. Facilities Licence Conditions Handbook (LCH) provides compliance verification criteria in order to meet the conditions listed in the licence.

VI) CONDITIONS:

The licensee shall comply with the following conditions, established pursuant to subsection 24(5) of the *Nuclear Safety and Control Act*.

1. GENERAL

1.1 The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis described in the LCH.

1.2 Changes to the safety and control measures described in the application and the documents needed to support that application are permitted provided that the objective of the licensing basis is met.

1.3 Changes that are outside of the licence conditions are not permitted without the prior written approval of the Canadian Nuclear Safety Commission (hereinafter "the Commission").

1.4 The licensee shall, in the event of any conflict or inconsistency between licence conditions or codes, standards or regulatory documents referenced in this licence, direct the conflict or inconsistency to the Commission or a person authorized by the Commission, for regulatory interpretation.

2. MANAGEMENT SYSTEM

2.1 The licensee shall implement and maintain a management system for the facilities.

2.2 The licensee shall give written notification to the CNSC of any changes to the programs or documents referenced in the management system section of the licence applications.

2.3 The licensee shall implement and maintain a process for reporting to the Commission that includes reporting of all events required by the *Nuclear Safety and Control Act* and its Regulations, and routine reports on the results of monitoring programs. The process shall define the frequency of the routine reports.

2.4 The licensee shall prepare an annual compliance and performance report.

2.5 The licensee shall implement and maintain a program for public information for the facility, including a public disclosure protocol.

3. HUMAN PERFORMANCE MANAGEMENT

3.1 The licensee shall implement and maintain a program for training staff for the facilities.

4. OPERATING PERFORMANCE

4.1 The licensee shall implement and maintain a program for operation of the facilities.

4.2 The operating program shall provide direction for safely operating the facilities and shall reflect the safety analysis referred to in condition 5.1.

4.3 The licensee shall ensure that its workers handle radioactive nuclear substances in accordance with written work procedures. These procedures shall be provided to all workers and shall be available wherever radioactive nuclear substances are handled or stored.

4.4 The licensee shall establish and maintain, in addition to any record required to be maintained pursuant to the *Nuclear Safety and Control Act* and its Regulations, full and accurate records to show:

a) the acquisition of nuclear substances including the quantity received, the form of the substance, and the name of the vendor;

b) the inventory of all radioactive nuclear substances at the facilities; and

c) the disposition of all nuclear substances acquired for use or processed by the facilities, including the name and address of the recipient, a copy of the recipient's licence (if applicable), the quantity of radioactive nuclear materials, and the date of shipment.

4.5 The licensee shall produce an interim report to the Commission summarizing operational performance during the course of this licence.

4.6 The licensee shall implement and maintain a pressure boundary program for the facilities.

4.7 The licensee shall have a formal agreement with an Authorized Inspection Agency, designated by the Commission as authorized to register designs and procedures, perform inspections, and perform other applicable functions at the licensed facilities.

5. SAFETY ANALYSIS

5.1 The licensee shall have safety documentation that describes the safety analysis for the facilities.

6. PHYSICAL DESIGN

6.1 The licensee shall not make any change to the design, or equipment at the nuclear facility, that would introduce hazards different in nature or greater than those considered by the safety analysis, without the prior written approval of the Commission or a person authorized by the Commission.

7. FITNESS FOR SERVICE

7.1 The licensee shall implement and maintain a program for maintenance for the facilities.

7.2 The licensee shall implement and maintain a program for periodic inspection and testing for the facilities.

8. RADIATION PROTECTION

8.1 The licensee shall implement and maintain a program for radiation protection for the facilities.

8.2 The licensee shall notify the Commission within 24 hours of becoming aware that an action level has been exceeded and shall file a written report within 21 working days of becoming aware of the matter.

9. CONVENTIONAL HEALTH AND SAFETY

9.1 The licensee shall implement and maintain a program for occupational health and safety for the facilities.

10. ENVIRONMENTAL PROTECTION

10.1 The licensee shall implement and maintain an environmental protection program for the facilities.

10.2 The licensee shall control, monitor and record releases of uranium to the environment from the nuclear facility such that the releases do not exceed the release limits specified in Appendix A.

10.3 The licensee shall control and monitor the releases of hazardous substances.

10.4 The licensee shall notify the Commission within 24 hours of becoming aware that an action level for environmental releases has been exceeded and shall file a written report within 21 working days of becoming aware of the matter.

10.5 All follow-up monitoring programs identified as a result of Environmental Assessments shall be progressed to completion and the progress reported to the Commission in accordance with condition 2.4 of this licence.

11. EMERGENCY MANAGEMENT AND FIRE PROTECTION

11.1 The licensee shall implement and maintain a program for emergency preparedness to address on-site and off-site events which can affect the facilities.

11.2 The licensee shall implement and maintain a program for fire protection for the facilities.

12. WASTE MANAGEMENT

12.1 The licensee shall implement and maintain a program for waste management for the facilities.

12.2 The licensee shall maintain a preliminary decommissioning plan for decommissioning the facilities. This shall be reviewed every five years or when requested by the Commission or a person authorized by the Commission.

13. SECURITY

13.1 The licensee shall implement and maintain a program for nuclear security at the facilities.

14. SAFEGUARDS

14.1 The licensee shall implement and maintain a safeguards program and undertake all measures required to ensure safeguards implementation at the nuclear facilities.

14.2 The licensee shall not make changes to operation, equipment or procedures that would affect the implementation of safeguards measures, except with the prior written approval of the Commission, or a person authorized by the Commission.

15. PACKAGING AND TRANSPORT

15.1 The licensee shall implement and maintain a packaging and transport program.

16. NUCLEAR FACILITY SPECIFIC

16.1 The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

SIGNED at OTTAWA, this 21st day of December 2016

M. Binder

Michael Binder, President,
on behalf of the Canadian Nuclear Safety Commission

APPENDIX A

RELEASE LIMITS

Peterborough Facility Release To Atmosphere:

Nuclear Substance and Form	Limit
Total Uranium	550 g/year

Peterborough Facility Release To Sewer System:

Nuclear Substance and Form	Limit
Total Uranium	760 kg/year

Toronto Facility Release To Atmosphere:

Nuclear Material and Form	Limit
Total Uranium	760 g/year

Toronto Facility Release To Sewer System:

Nuclear Material and Form	Limit
Total Uranium	9000 kg/year

APPENDIX B

DESCRIPTION OF THE PETERBOROUGH LICENSED FACILITY

The BWXT Nuclear Energy Canada Inc. nuclear facility located in Peterborough, Ontario, as more particularly described below:

Buildings located within the a total plant complex registered as lots 6 to 30 inclusive of plan 30 North side of Albert Street dated 24 October 1868.

Specifically identified as buildings 21, 24A, 26 and 28 and their parking areas only on the Engineering Drawing of the licensed facility titled "GE Hitachi Nuclear Energy Canada Inc. Peterborough Facility CNSC Licensed Areas 1160 Monaghan Road Peterborough ON K9J 7B5. Dated 2016-08-22:- Drawing number 108E1425 Revision 1".