BWXT NUCLEAR ENERGY CANADA INC.

2018 FUEL FACILITY OPERATING LICENCE RENEWAL APPLICATION

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1.0 INTRODUCTION

BWXT Nuclear Energy Canada Inc. (BWXT NEC) (formerly known as GE-Hitachi Nuclear Energy Canada Inc.) has been involved with the Canada Deuterium Uranium (CANDU) industry from its earliest years. BWXT NEC produces nuclear fuel bundles used by the CANDU fleet to generate clean electricity that powers homes, businesses and the Canadian economy. BWXT NEC operates in three plant locations: Arnprior, Toronto and Peterborough, Ontario.

The current Nuclear Fuel Facility Operating Licence (FFOL-3620.01/2020) issued by the Canadian Nuclear Safety Commission (CNSC) authorizes BWXT NEC to operate and modify its nuclear fuel facility to produce natural and depleted Uranium Dioxide (UO_2) pellets (herein referred to as pelleting) in Toronto at 1025 Lansdowne Avenue; and to produce and test fuel bundles in Peterborough at 1160 Monaghan Rd. The Peterborough facility is also authorized to receive, repair, modify and return contaminated equipment from off-site nuclear facilities.

1.1 Application for Licence Renewal

BWXT NEC's current Nuclear Fuel Facility Operating Licence (FFOL-3620.01/2020) is valid until December 31, 2020. This application for early licence renewal by October 2019 for a period of 10 years, is intended to provide the basis for the renewal of the operating licence and demonstrate BWXT NEC's compliance with the Nuclear Safety and Control Act (NSCA) and associated Regulations, including, but not limited to the following:

- General Nuclear Safety and Control Regulations;
- Radiation Protection Regulations;
- Class I Nuclear Facilities Regulations;
- Nuclear Substances and Radiation Devices Regulations;
- Packaging and Transport of Nuclear Substances Regulations;
- Nuclear Security Regulations; and
- Nuclear Non-Proliferation Import and Export Control Regulations.

Appendix B shows where in this application the information required by the NSCA and associated Regulations can be found.

CNSC regulatory documents, Canadian Standards Association (CSA) standards and other regulatory documentation are used to provide direction for BWXT NEC's programs to ensure they meet the requirements of CNSC's Safety and Control Areas (SCA) and maintain operation within the licensing basis.

BWXT NEC has demonstrated strong performance in all SCAs throughout the licence period as noted in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] (2011-2017 reporting period) and as demonstrated in BWXT's 2017 Annual Compliance Report [4]. Throughout the current licencing period, CNSC staff has recommended the implementation of additional regulatory documents and CSA standards and BWXT NEC has integrated these new requirements on an ongoing basis as part of its continual improvement program.

In addition to continuing its current activities, BWXT NEC is also seeking the flexibility during the proposed next licence period to conduct pelleting operations at both the Toronto and Peterborough facilities with no change to the current overall throughput level (further details provided in Section 1.4).

1.2 Facility Location and Layout

The Toronto facility is located in a mixed industrial, commercial, and residential area in West-Central Toronto (refer to Figure 1). The licensed facility consists of two separate buildings, which are identified as Building 7 and Building 9 (copies of leases are maintained at site) [5].

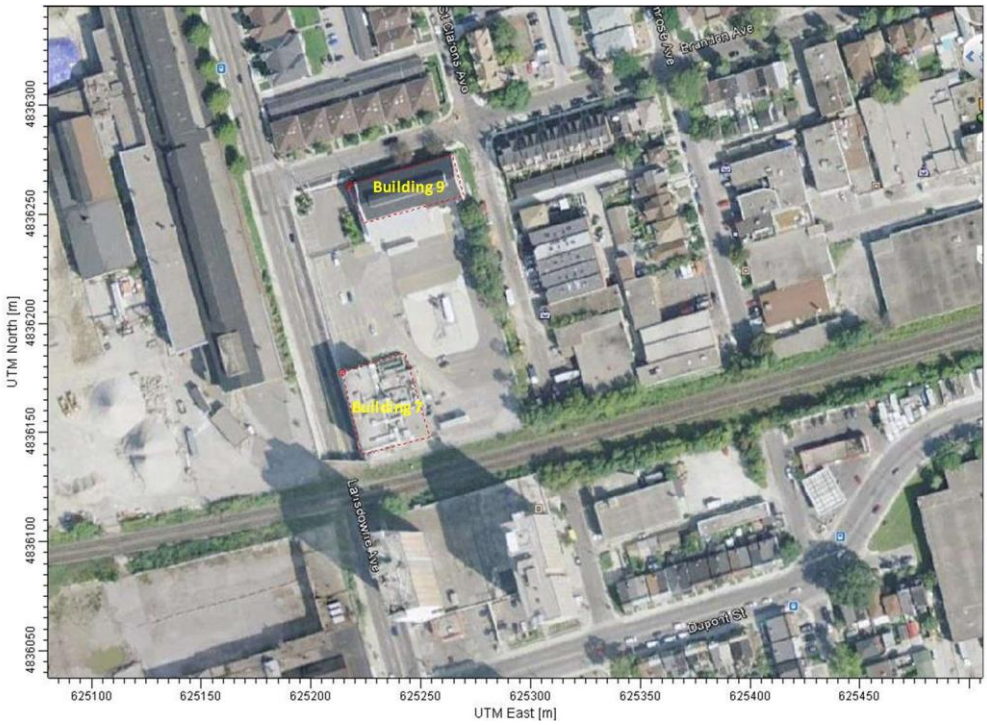

Figure 1 – Toronto Facility

Building 7, which was constructed in 1907, is a 4-floor building, housing Uranium Dioxide pellet manufacturing on the first, second and third floors. The fourth-floor houses BWXT NEC Toronto office personnel, conference rooms and a laboratory.

Building 9 which was constructed in 1920, is a one floor warehouse used for the following:

- Storage of Uranium Dioxide as miscellaneous scrap, awaiting reprocessing or shipment for disposal; and
- Storage of scrap waste contaminated with trace quantities of Uranium Dioxide powder for compaction in the waste compactor, decontamination activities, or for ongoing storage awaiting shipment for disposal.

The Peterborough facility is located in a mixed industrial, commercial, and residential area in West-Central Peterborough (Figure 2). The buildings are located within a total Plant Complex

registered as Lots 14 to 17 and Lots 6 to 30 inclusive (copies of leases are maintained at site). The licensed facility consists of four separate buildings, which are identified as Building 21, 24A, 26 and 28 and their parking areas [6].

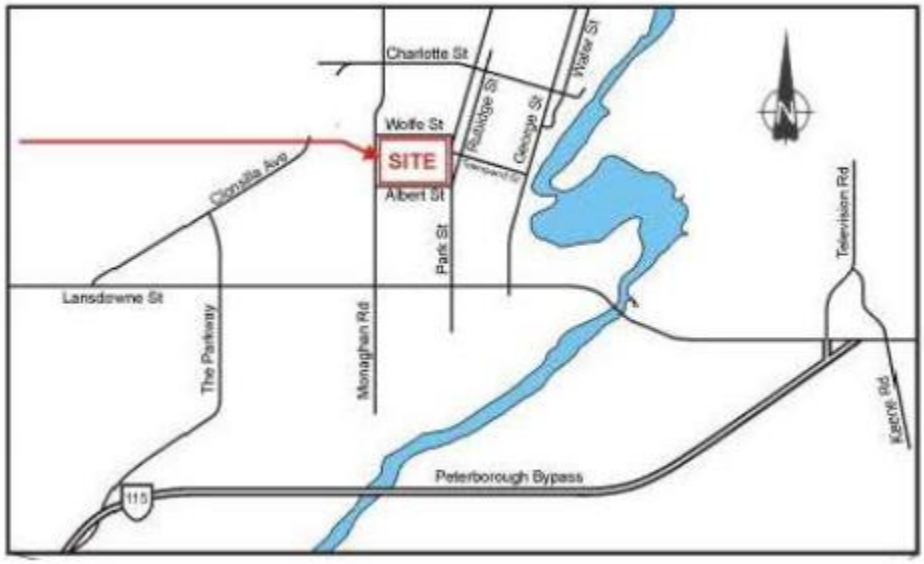

Figure 2 – Peterborough Facility

Building 21 which was constructed in 1952, is a two-floor building. The first floor houses the Uranium fuel bundle manufacturing operation and the second-floor houses office personnel.

Building 24 which was constructed in three stages between 1961 and 1981, is a one floor warehouse used to store radioactive material including completed Uranium fuel bundles up to a maximum of 1000 Mg UO_2, drums of Uranium Dioxide powder up to a maximum of 200 Mg UO_2, and contaminated equipment as required.

Building 26 which was constructed in 1944, houses BWXT NEC's manufacturing and equipment and facilities for the repair of contaminated equipment.

Building 28, which was constructed in 1982, houses the main shipping and receiving docks. It is directly accessible through Building 26.

1.3 Processes and Materials

The Toronto Facility processes natural Uranium Dioxide powder (UO_2) into fuel pellets. Specifically, UO_2 powder is received in standard steel drums and the powder is compressed into "slugs" and granulated to a free-flowing powder. This powder is pressed into a pellet shape and the sintered pellets are ground to the required diameter, inspected and wrapped for shipment to the Peterborough Facility (CANDU Pellets) or General Electric (GE) Wilmington North Carolina Facility (Boiling Water Reactor (BWR) Pellets) (refer to Figure 3 for a process schematic).

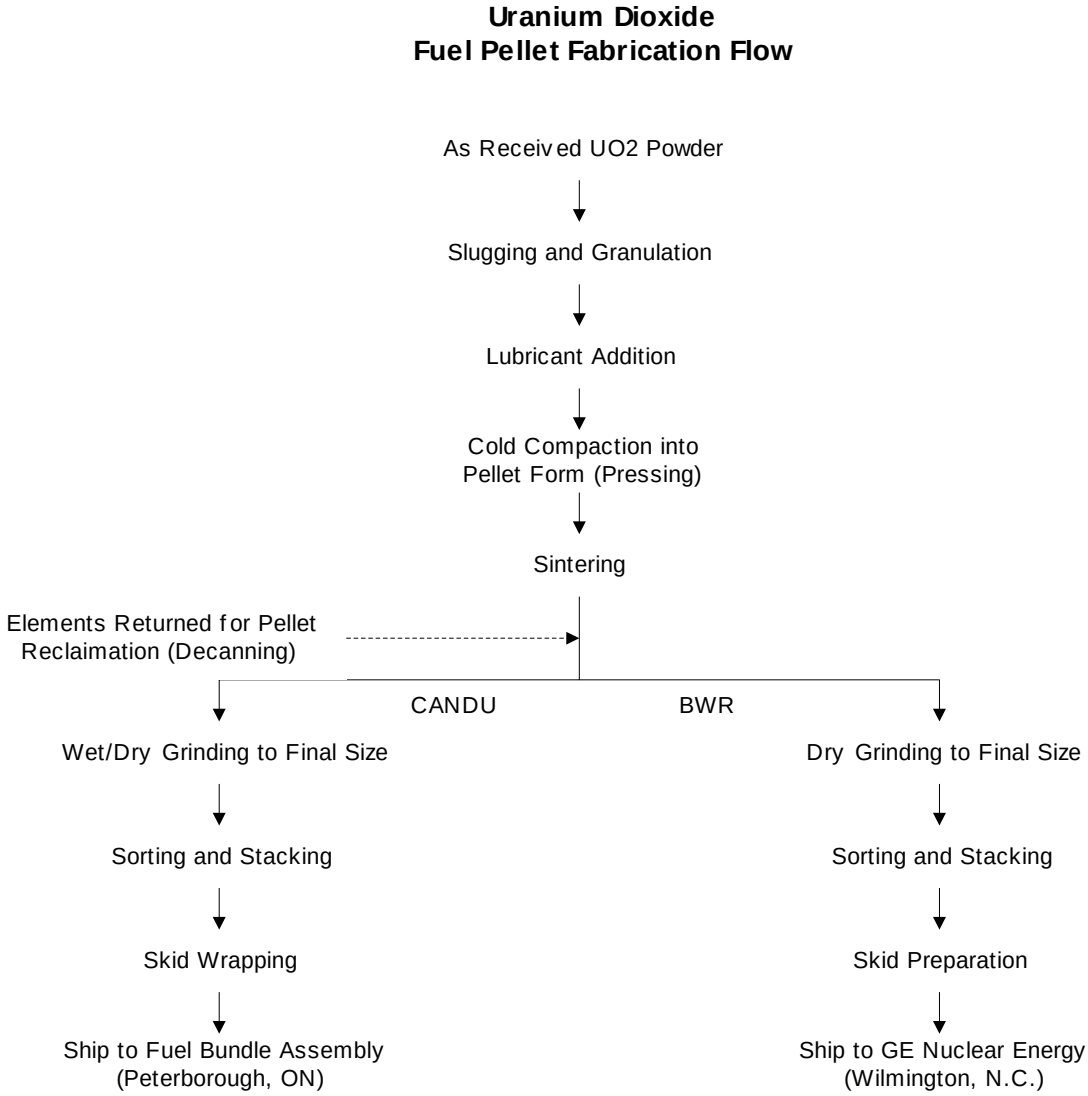

Figure 3 – Uranium Fuel Pellet Manufacturing Process

At the Peterborough Facility, fuel manufacturing operations involve the loading of fuel pellets into Zircaloy tubes, sealing, machining and welding of the tubes to produce fuel elements and the assembly of the fuel elements into fuel bundles. The basic assembly process is described in Figure 4.

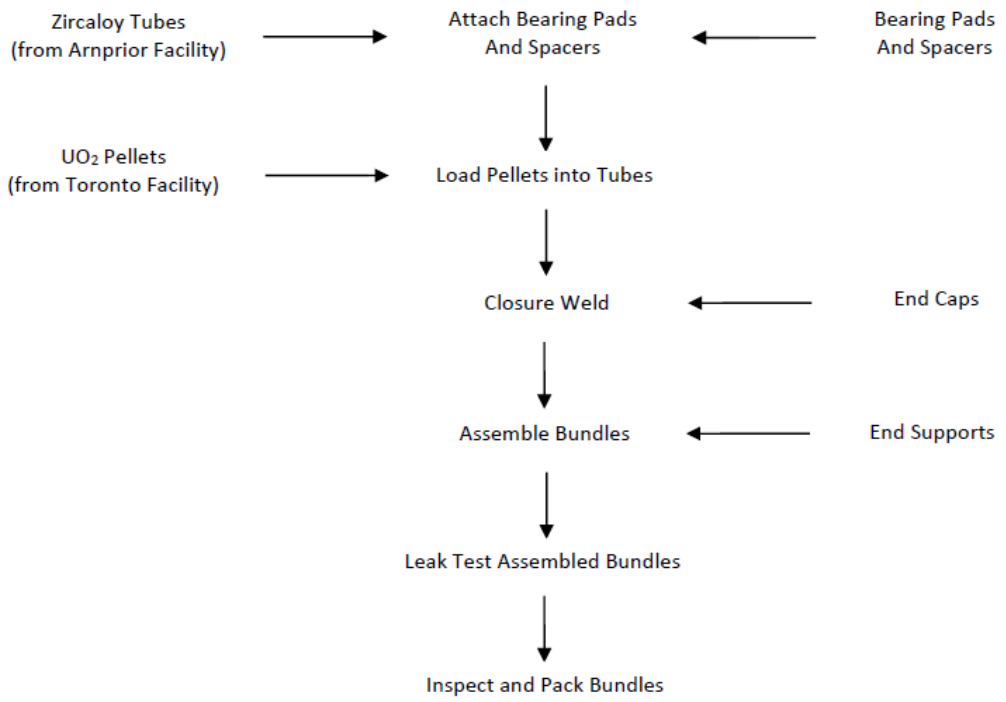

Figure 4 – Process Schematic for Nuclear Fuel Bundle Fabrication

In addition, contaminated equipment from off-site nuclear facilities is periodically received at the Peterborough facility for repair and/or modification.

1.4 Pelleting Operation in Peterborough

BWXT NEC is seeking the additional flexibility during the proposed next licence period to conduct pelleting operations at both facilities, with no change to the current overall throughput level. While there has been no formal business decision to conduct pelleting at the Peterborough facility, BWXT NEC wishes to pursue Licence Conditions and associated Licence Conditions Handbook (LCH) Compliance Verification Criteria to permit such activities during the proposed next licence period (note, a revised bounding Environmental Risk Assessment (ERA) for the Peterborough facility has been submitted in conjunction with this licence application and is summarized in Section 2.9.4).

Any pelleting at the Peterborough facility would be conducted within the existing licensed facility via a re-configuration of existing space. As air and water emissions are routinely measured at both the Toronto and Peterborough facilities and historically are shown to be only a fraction of the annual regulatory limits, the anticipated additional environmental emissions and monitoring practices at the Peterborough facility would be similar to those at the Toronto facility.

With respect to emission limits at the Peterborough facility, it is anticipated that there will be little or no change from the current licensed limits for the Peterborough facility. Also, the

current licensing basis for the Peterborough facility permits the possession of up to 1500 megagrams (Mg) of Uranium and the processing of up to 150 Mg of Uranium per calendar month and no changes to these limits are expected.

Should the decision be made to conduct pelleting operations at the Peterborough facility under the proposed amended licence the changes would be made under the approved change management program and prior notification requirements within the LCH. Program documents and assessment reports affected by the project would be revised at that time and those subject to prior notification would be submitted to CNSC staff as required.

1.5 Request for Renewal

BWXT NEC is seeking a 10-year renewal of its Fuel Facility Operating licence with the flexibility to conduct pelleting operations at both the Toronto and Peterborough facilities based on the current possession and processing limits of Uranium as follows:

- Possess up to a maximum of 700 megagrams (Mg) of Uranium at the Toronto facility in any form at any given time;
- Possess up to a maximum of 1500 Mg of Uranium at the Peterborough facility in any form at any given time; and
- Shall not process more than 150 Mg of Uranium at each facility in any form in any calendar month.

BWXT NEC believes this is an appropriate licence term for the following reasons:

- BWXT NEC has demonstrated that its performance has met CNSC staff expectations in all SCAs over the current licence period;
- CNSC staff's annual performance report on fuel cycle facilities provides the Commission with the opportunity to review BWXT NEC's performance in a public meeting; and
- Strong community engagement has been developed and maintained for BWXT NEC's operations within Toronto and Peterborough.

2.0 SAFETY AND CONTROL AREAS

2.1 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.

Design and implementation of BWXT NEC's Business Management System (BMS) began in 2009 over the course of two to three years. The top-level document consists of the BMS Manual which contains the organizational vision and strategy as well as the scope of responsibility for each function across the BWXT NEC business. The BMS includes assurance mechanisms, such as audits, self-assessments and management reviews, to ensure continuous improvement and effectiveness.

The structure below the BMS Manual is grouped into either a business wide category or individual functional groups as follows (note, further details are provided in Section 2.1.1):

a) Policies – relevant guiding principles and broad guidelines to decision making.
b) Procedures - describes the program or system process.
c) Work Instructions - Lists the steps and performers required to complete an individual task or set of tasks

In 2010, a Licenced Activity Quality Assurance (LAQA) program [7] was added to the BMS. The LAQA program references procedures and work instructions which contain procedural requirements and work steps assigned to individuals across several functions within the BMS. New tools were added since 2010, such as benchmarking (Operating Experience (OPEX)) and Nuclear Safety Culture (Human Performance Improvement) programs to assist in maintaining improvements in key process indicators. Three notable areas of additional assurance in the BMS which have been included since 2010 are as follows:

- An improved program of work planning, control and independent verification was implemented, supported by a new Preventive Maintenance Software System;
- An improved configuration control program was implemented to ensure the original design intent of Critical to Safety (CTS) systems and equipment is maintained; and
- BWXT NEC's training program was redesigned to comply with Systematic Approach to Training (SAT) guidelines.

CNSC staff have assessed the Management System SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e., Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.1.1 Licensed Activity Quality Assurance

BWXT NEC document BMS-BP-004, "Licensed Activity Quality Assurance Program" [7], describes the requirements of BWXT NEC's Quality Assurance (QA) program for the licensed activity in Section IV of the CNSC Licence. This policy document resides at the Level 1 of documents (refer to Figure 5) within BWXT NEC's BMS structure and applies across the entire BWXT NEC business. It also encompasses all licensed activity QA requirements, which ensure applicable buildings and facilities, process equipment, and processes used in support of licensed activities are conducted in accordance with the NSCA and associated Regulations, as well as other jurisdictional requirements.

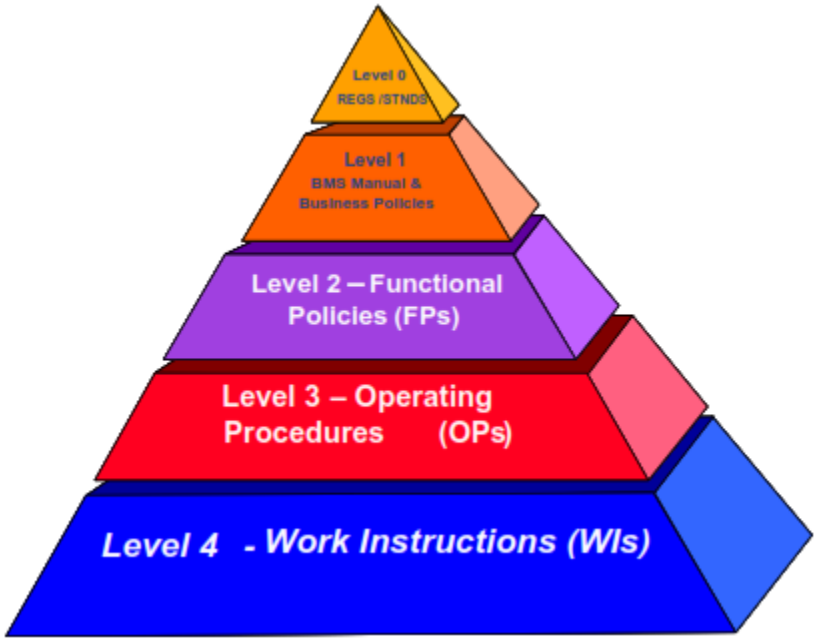

Figure 5 – Business Document Structure Chart

The LAQA program [7] complies with CSA standard N286-12, "Management System Requirements for Nuclear Facilities" [8] and consists of the following key elements:

- *Organization and Responsibilities* – The President of BWXT NEC is responsible for all activities within BWXT NEC. Operations and the various functional groups, such as Human Resources, Environment Health and Safety, and Quality Assurance, report directly or indirectly to the President.

  Senior Management accountability for the effectiveness of the management systems has also been defined. For example, the Director, OPEX and Quality has been assigned the responsibility for monitoring and assessing the effectiveness of the business Licensed Activity management system and is responsible for identifying problems, initiating or recommending solutions, and confirming their implementation and effectiveness.

  Figure 6 outlines the Canadian senior leadership organization, in the which the President of BWXT NEC is responsible for total operations of BWXT NEC (reporting to the President of BWXT Canada Ltd.); and the Director, EHS and Regulatory (who reports to the Vice President, Strategy and Business Services) is the Licensing Authority.

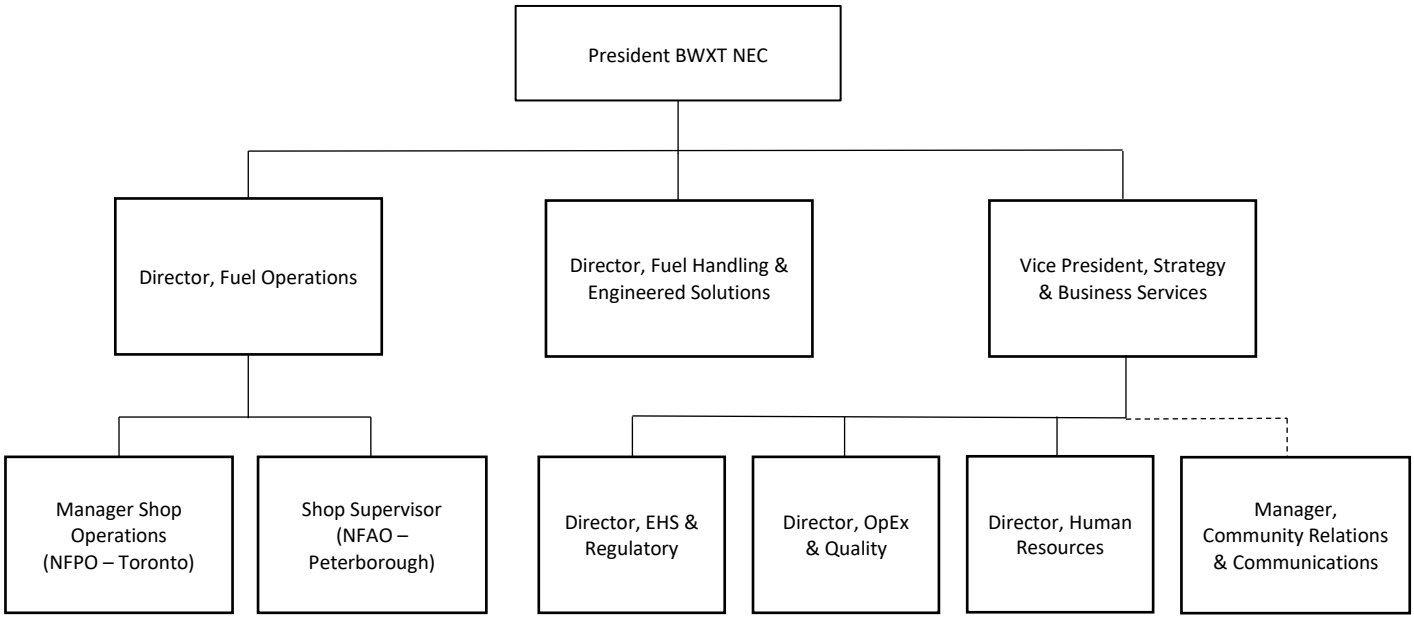

Figure 6 – Canadian Senior Leadership Organization

- *Personnel Capability* - Qualifications and training requirements are identified and personnel are given the appropriate training to ensure they are competent at the work they do. Tasks are assigned to personnel who have been properly trained. The competency of personnel is reviewed to maintain their effectiveness and skill levels. Records of training, qualification, and experience are maintained.
- *Use of Experience* – BWXT NEC has an information gathering and review process to identify and evaluate in-house and external experience gained during the term of the licence and the facility life cycle. The results of the analysis of this information are used to improve safety, quality and management process through the development of new procedures and practices, and revision of existing procedures and practices.
- *Work Planning Control* – Work is planned and controlled so that it is performed precisely and systematically. Work activities are identified, sequenced, and defined in approved plans, procedures, instructions, and drawings. Procedures, instructions, drawings, programs and tools are identified, prepared and approved for use. Independent verification is scheduled, when appropriate, to verify that specified requirements are being met.
- *Work Processes Control Practices* - Work is assigned to qualified personnel and carried out according to the requirements that are specified in the latest revision of approved instructions, procedures, drawings, or other appropriate media. The preparation, issue, and revision of these requirements are controlled to ensure that it is correct, and that the correct information is available for use.
- *Verification* - Work that is identified to be associated with higher risk activities or processes, is identified as requiring verification to confirm that specified requirements are being met, and that the work is completed correctly. Verification is performed by personnel who have

not performed the work, and who have appropriate independence from those who did perform the work.

- *Non-conformances* – Deficiencies are identified and remedied. When non-conformances are found, they are identified, recorded, and reported using an action tracking system. Further work, processing or use does not proceed without authorization when deficiencies in higher-risk activities or processes are found. Non-conformances are reviewed to determine their significance, and to decide on corrective action. Non-conformances that affect or can affect safety and operability are reported to the appropriate levels of management to initiate the process of correcting their cause.
- *Corrective Action* - The root cause of deficiencies is identified and corrected through the implementation of corrective action to prevent recurrence. Those responsible for the analysis, for initiating and implementing the correction of the cause, and for taking follow-up action are identified through the action tracking system.
- *Change Control* – Before a change can be made, it is subjected to a level of review and approval commensurate with the degree of safety risk in the process being changed, and is subjected to the same level of review and approval as was originally obtained. Persons reviewing and approving a proposed change understand the original intent and the associated requirements, and can assess the effect the proposed change will have on both.
- *Document Control and Records* – Systems are established to ensure that only approved and current documents are issued and used, that obsolete documents are withdrawn, that documents and records are available when they are needed, and that appropriate records are produced, are acceptable, and are retained and protected.
- *Audits* – Periodic assessment of program effectiveness is conducted through internal audits that are planned and carried out on behalf of management to measure performance, the effectiveness of the management processes and to promote improvement. The QA function is responsible for conducting audits and has sufficient authority and organizational freedom to carry out its responsibilities. Results are reported to and assessed by management, and actions are taken to correct unsatisfactory conditions or to implement improvements. Follow-up action is scheduled to confirm the accomplishment of corrective measures.
- *Management Self-Assessment* – The Self-Assessment program is a management tool used to engage the workforce in early and proactive detection of organizational weaknesses. It is a functional manager's opportunity to take a structured look at their own function. Self-Assessments help identify low level issues or trends for early resolution before more significant problems occur. Each Self-Assessment is completed to a written plan and a report is issued upon completion of the Self-Assessment which includes deficiencies and recommendations for improvement.
- *Management Program Review* - Senior BWXT NEC management reviews the LAQA program annually to ensure its continuing suitability, adequacy and effectiveness. This review includes assessing opportunities for improvement and the need for changes to the QA program including quality policy and procedures.

2.1.2 Safety Culture

BWXT corporate policy describes BWXT's commitments to the establishment and continuous improvement of a safety culture. The safety culture refers to the core values and behaviors resulting from a collective commitment by BWXT NEC leaders and individuals to emphasize safety, quality, ethics and security over competing goals to ensure protection of people and the environment.

BWXT NEC document BMS-P-017, "Conduct of Operations" [9], identifies the guidelines for conduct of operations at BWXT NEC, further emphasizes the company's commitment to maintaining a strong safety culture and clearly states the expected safety culture behavior. For example, the promotion of a standard set of human error reduction tools for job-site workers and knowledge workers, which include 1.) Procedure Use and Adherence 2.) Questioning Attitude and 3.) Situational Awareness and Self-Checking.

BWXT NEC's commitment to a strong safety culture is measured by BMS tools such as audits and self-assessments and continuous improvement program metrics which measure the effects of safety culture improvements. External agencies such as the CNSC as well as customers audit BWXT NEC operations against CSA standards which include Safety Culture requirements (e.g., CSA N286-12 [8]).

2.1.3 Public Information and Disclosure Program

BWXT NEC is committed to connecting with the communities in which it operates in a timely, transparent and meaningful way. BWXT NEC recognizes that the most effective way to build and sustain public trust is to maintain environmental excellence while fostering an atmosphere of openness and transparency with stakeholders and other interested parties. This requires a demonstrated commitment to operating in accordance with the highest environment, health and safety standards, while at the same time, sharing information concerning anticipated effects on the environment, health, and safety of persons that may result from the activity.

BWXT NEC's Public Information and Disclosure program document [10] has been developed in accordance with CNSC REGDOC-3.2.1, "Public Information and Disclosure" [11]. The public information program (PIP) provides the strategy and methodologies to be employed for public communications, information distribution and feedback, and how these activities will be managed.

BWXT NEC's PIP activities include:

- Maintaining a BWXT NEC public information website;
- Maintaining information pamphlets with current information about the facilities of interest to a member of the public;
- Providing a toll-free communication line and general email address for members of the public to submit comments/questions. The number and address are provided on the BWXT NEC website and materials distributed to the public;
- Communicating public CNSC licensing hearings;
- Issuing public disclosure of events;
- Holding or participating in public/community meetings and open houses;

- Mailings to stakeholders to communicate public information and solicit comments and questions;
- Providing facility tours to selected groups, media and elected officials;
- Meeting with designated elected officials, public agencies and other stakeholders;
- Establishing a Community Liaison Committee in Toronto to engage interested immediate neighbours and representatives of recognized residents' groups and local community organizations;
- Supporting local community-based initiatives through volunteerism, sponsorship or other activities;
- Requesting annual meetings with local municipal councillors to provide an update on BWXT NEC's communications activities, facility activities and receive feedback on local community interests regarding the facility; and
- Other outreach activities as determined by BWXT NEC.

2.2 Human Performance Management

The "Human Performance Management" SCA covers activities that enable effective human performance through the development and implementation of processes that ensure personnel have the necessary knowledge, skills, procedures, and tools in place to safely carry out their duties.

CNSC staff have assessed the Human Performance Management SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.2.1 General Training

The BWXT NEC training program is described in the LAQA program [7] and implemented through business-wide training procedures. Qualifications and training requirements are identified and personnel are given the appropriate training to ensure they are competent in the work they do. Such training includes on-the-job training, radiation protection, and safety risk assessment training. Workers only perform functions for which they are qualified.

Up to June 2017, tracking of training was accomplished via the tracker tool *Gensuite*, which was used to track Environment, Health and Safety (EHS) related training. Subsequently, BWXT NEC has transitioned to a new learning management system, *SAP SuccessFactors,* which is a global provider of human resource software and fully integrated management systems.

2.2.2 Systematic Approach to Training

In 2015, BWXT NEC began implementation of a SAT program which is described in BWXT NEC procedure TR-P-001, "Systematic Approach to Training" [12]. The procedure applies to new training and the revision of existing training, including continuing training and applies to training managed internally by BWXT NEC or externally through vendors or contractors. BWXT NEC has

made the business decision to implement the SAT methodology beyond that required by CNSC REGDOC-2.2.2, "Personnel Training" [13] and to apply it to all areas and locations of the business, in support of consistent high-quality training across the organization.

The SAT-based training system is a cyclical process, allowing for training to be systematically analyzed, designed, developed, implemented, evaluated, documented and managed in order to meet operational and organizational requirements and to react quickly to changes to those requirements. The application of SAT at BWXT NEC is done in a manner commensurate with the risks and characteristics of the business activity. Programs that have been developed in compliance with SAT include:

- Training on knowledge areas such as Respiratory Protection Awareness, Transportation of Dangerous Goods, Security Awareness, Radiation Protection & Emergency Response for Class 7 Carriers, Uranium Emergency Response Assistance, Canada Labour Code Part II, and Radiation Safety;
- Training on tasks such as External & Internal Radiation Hazard Monitoring, First Aid/Automated External Defibrillator/Cardiopulmonary Resuscitation, B3 Area Donning & Doffing; and
- Training for roles such as Material Handling – Shipping/Receiving, Material Handling – Janitorial, and Facilities Coordinator.

Implementation of the SAT principles to existing and new training roles and programs will continue through 2018 and 2019.

2.2.3 Supervisor and Management Training

As required by the Canada Labour Code-II [14], Managers and Supervisors are trained to ensure that workers use prescribed protective equipment; workers are advised of potential and actual hazards; and that every reasonable precaution is taken for the protection of workers.

In addition, to protect workers and to ensure nuclear security, Supervisors and Managers are trained to anticipate and respond to changes in employee behavior in accordance with both the Violence Prevention requirements under the Canada Labour Code-II [14] and the Nuclear Security Regulations [15].

2.2.4 Radiation Protection Training

A well-established radiation protection training program is in place at both the Toronto and Peterborough facilities. Each new employee is provided with radiation protection training prior to commencing work at the facility and employees are retrained on a schedule.

2.3 Operating Performance

The "Operating Performance" SCA covers the overall conduct of the licensed activities and the activities that enable effective performance.

BWXT NEC has successfully implemented and maintained over the course of the licence period, a program for the operation of its Toronto and Peterborough facilities, which provides direction for safe operation and reflects the Facility Safety Analysis. BWXT NEC has established essential documentation (as specified by the BMS) including procedures describing the program or

system process and work instructions outlining the steps required to complete an individual or set of tasks. This includes the written work instructions for handling of radioactive materials by workers to ensure activities are conducted in a manner that is protective of workers, the public and the environment; as well as full and accurate records to show the acquisition of nuclear substances, inventory of all radioactive nuclear substances and the disposition of all nuclear substances acquired for use or processed by BWXT NEC.

CNSC staff have assessed the Operating Performance SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.3.1 Operational Reviews

Management conducts routine meetings to review operations at each facility including a discussion of health and safety concerns. Reporting of EHS-related concerns are encouraged and tracked to completion in the Gensuite software system, which is also used as a measure of employee engagement.

Operating performance is monitored with key performance indicators and program goals. In accordance with EHS program requirements internal audits are conducted annually to assess conformance to internal and external requirements. The EHS Management reviews encompass the following items:

- Status of actions from previous management reviews;
- Follow-up actions from previous management reviews.
- Results of external agency audits where applicable;
- Open regulatory compliance obligations;
- Results of QA for licensed activity internal and external audits (where applicable);
- Results of QA for licensed activity management self-assessments;
- Trends in non-conformances for closure metrics;
- EHS related Quality Assurance Actions;
- Trends in Incident and Measurement (Gensuite) items for root cause;
- Status of EHS training activities;
- Procurement process;
- Extent to which Environmental, Health and Safety and As Low As Reasonably Achievable (ALARA) objectives and targets have been met;
- Radiation dose trends;
- Communications and changes in the needs and expectations of interested parties, including complaints;
- Changing external and internal issues, including compliance obligations;
- Changes in risks and opportunities;

- Opportunities for continual improvement; and
- Evaluation of the effectiveness and continuing suitability of the EHS Mission Statement and the Environment, Health and Safety program.

2.3.2 Pressure Boundary

BWXT NEC pressure boundary systems at the Toronto and Peterborough facilities are operated and controlled in compliance with CSA B51-09 [16]. BWXT NEC also maintains an Authorized Inspection Agency agreement with the Technical Standards and Safety Authority (TSSA) [17]. As documented in the service agreement between BWXT NEC and TSSA, the TSSA provides design registration services, quality system accreditation and authorized inspection services in accordance with the requirements of the Technical Standards and Safety Act, 2000, the Boilers and Pressure Vessel Regulation, the American Society for Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes and/or CSA B51, and CSA N285 and/or the National Board Inspection Code as applicable.

2.3.3 Reporting and Trending

The management system and other program level documents have parameters that are routinely monitored, measured and tracked to ensure the facility is operated as intended. Additionally, annual compliance and performance reports are submitted to the CNSC as required by the current operating Licence and LCH, in order to demonstrate BWXT NEC's compliance with the NSCA, applicable Regulations and licence conditions specified by the CNSC.

2.4 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.

BWXT NEC has successfully implemented and maintained documentation which describes the safety analysis for the Toronto and Peterborough facilities which have been updated over the course of the licence period.

CNSC staff have assessed the Safety Analysis SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.4.1 Safety Analysis Overview

The safety analysis completed for the Toronto and Peterborough facilities utilizes a combination of What-if Analysis, Hazards and Operability and Quantitative Risk Analysis and documents a systematic evaluation of hazards associated with the licensed facilities.

Modifications to the facilities are made in accordance with the business-wide Change Control program, which requires review of EHS parameters for new or modified facilities, processes, and new or relocated machinery, apparatus and equipment. Under this process, a proposed

modification is screened for potential impact on the facility safety analysis. Where screening identifies a potential impact, a more detailed review of the proposed modification is conducted to identify if the change impacts a safety system, or the basis of the safety assessment (e.g. materials, quantities, locations, etc.). Third-party reviews or regulatory approvals are conducted as required. Impacts on the safety analysis are identified and the safety analysis is validated and updated where necessary (note, additional details on the Change Control Procedure are captured in Section 2.5.1).

2.4.2 Toronto Facility Safety Analysis

BWXT NEC completed a hazard and operability (HAZOP) study for the Toronto facility [18], in order to identify hazard scenarios at the facility. The hazard scenarios identified in the HAZOP study [18] underwent a detailed review in the form of a Quantitative Risk Assessment (QRA) as described in Reference [19]. The QRA was designed to provide a clear definition of the potential hazard scenarios and to provide a framework for quantifying and mitigating risks from the identified hazards.

The calculated probabilities and concentrations of Uranium oxide at the receptor locations for the applicable hazard scenarios were determined and the QRA concluded that the risks associated with all the hazard scenarios generated for the Toronto facility are low with existing safeguards in place.

2.4.3 Peterborough Facility Safety Analysis

The Peterborough Facility Safety Analysis (FSA) [20] identifies hazard scenarios and ranking of risks for operations at the facility. The What-if Analysis method was largely used, which consists of identifying an event, the event initiators and consequences of the event. Existing features or attributes of the facility are considered as well as any existing safeguards. There were no sequences that were carried to QRA for the Peterborough site.

The FSA concluded that for all hazard scenarios, existing safeguards resulted in Low or Intermediate Risk. Additional safeguards were recommended for hazard scenarios with intermediate risk to reduce the risk to Low, which have been dispositioned/implemented accordingly.

2.5 Physical Design

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

Significant facility improvements which occurred over the course of the licence period include:

- 2011 – Radiation Refurbishment Facility constructed (within Building 26 Peterborough)
- 2011 – New modular office building (adjacent to Building 21 Peterborough)
- 2013 – Fire safety and powder storage upgrades (Building 24 Peterborough)
- 2013/2014 – Security and monitoring system upgrades (Toronto)
- 2015 – Natural gas supply upgrade, including header replacement and piping (Building 7 Toronto)

- 2014/2015 – Test rig refurbishment (Building 21 Peterborough)
- 2016 - Fire separation enhancements (Building 24/22 Peterborough)
- 2017 - Installation of an Emergency Operations Centre trailer outside Building 9 (Toronto)

CNSC staff have assessed the Physical Design SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e., Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.5.1 Physical Design Change Control

Changes made to the physical facilities, equipment, processes, procedures or practices that could adversely affect product quality, employee health and safety, the environment or the public due to the operation of BWXT NEC's facilities are assessed through BWXT NEC procedure BMS-P-008, "Business Wide Change Control" [21]. Any changes to the design basis are identified and assessed through this program, including third-party reviews as required. Adequate mitigations are applied including modification of the proposed change, up to rejection of the proposed change.

The change control fundamentals as described in Reference [21] include:

- Recognition of the need for Change Control and detailed description of the change;
- Thorough assessment of the change impact on the original system design intent and development of any mitigation requirements (i.e., to manage any effects of unsuccessful changes and unforeseen events);
- Authorization to proceed with the change plan;
- Controlled implementation and communication of the change; and
- Update of associated documentation and training for the change(s).

2.5.2 Fire Protection System Design Changes

Prior to the implementation of any proposed modification to the Toronto or Peterborough facility with the potential to impact protection from fire, the following is completed:

- The proposed modification is submitted for third-party review;
- The review is carried out by one or more independent external reviewer(s) having specific expertise with such reviews; and
- Results of the review are submitted to the Commission or a person authorized by the Commission.

Plant modifications at the Toronto and Peterborough facility are also made in accordance with the National Building Code [22], the National Fire Code [23] and CSA N393, "Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances" [24] (note, Section 2.10 provides details on BWXT NEC's Fire Protection program).

2.6 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 ensure all equipment is available to perform its intended design function when called upon to do so.

Notable upgrades within the Fitness for Service SCA which occurred over the course of the licence period include:

- The upgrade of the routine preventive maintenance program to the Maintenance Connections platform (2014); and
- Implementation of the CTS program (2016).

Details of the Critical to Safety program are provided in Section 2.6.1, and the Maintenance Connections platform is discussed in Section 2.6.2.

CNSC staff have assessed the Fitness for Service SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.6.1 Fuel Critical to Safety Program

CTS items are those hardware items that directly ensure the safety of workers, protection of the environment, or regulatory compliance in the following three categories:

- Equipment and infrastructure identified as Safeguard Measures in the Facility Safety Analysis Reports;
- Respiratory personal protective equipment; and
- Instrumentation generating data to demonstrate Regulatory Compliance.

BWXT NEC document FM-P-006, "Fuel Critical to Safety Program" [25], describes the CTS program for the production of nuclear fuel, including CTS items common to both Fuel Operations and Fuel Handling and Engineered Solutions. Equipment identified on the CTS list is governed by a number of assurance procedures described in the LAQA program document [7].

The CTS program elements include the following:

- Process to identify CTS equipment;
- CTS inventory list revision control through the CTS/Critical to Quality workflow;
- Requirements in the established change management process [21] to adequately capture new additions and ensure sufficient detailed review of changes to existing CTS equipment; and
- The factors determining the Preventive Maintenance schedule of CTS Equipment.

2.6.2 Preventive Maintenance

Both the Toronto and Peterborough facilities utilize an asset management and preventive maintenance software system "Maintenance Connection", which is a web-based maintenance management software for work order and asset management. Maintenance Connection assists BWXT NEC in efficiently managing preventive maintenance tasks as well as to control and identify maintenance on CTS and Critical-to-Quality assets and parts. Preventive maintenance tasks on CTS equipment are designated in this system as described in the business wide Enterprise Asset Management Program (EAMP) procedure, BMS-P-016 [26].

The EAMP procedure [26] is utilized across BWXT NEC and provides an overview of the EAM implementation at BWXT NEC. The main purpose of the EAM system is consolidation of asset listing, tracking of asset condition, identification of asset preventive maintenance requirements/schedules, and issuing work orders. The EAM system at BWXT NEC is implemented via the Maintenance Connection web-based software suite.

2.7 Radiation Protection

The "Radiation Protection" SCA covers the implementation of a radiation protection program in accordance with the Radiation Protection Regulations [27]. The radiation protection program is required to ensure that contamination levels and radiation doses received by individuals are monitored, controlled, within regulatory limits, and maintained ALARA.

BWXT NEC has a well-established and effectively implemented radiation protection program, which includes a commitment to ALARA and continuous improvement. Over the course of the licence period, there were no worker doses in exceedance of regulatory dose limits.

CNSC staff have assessed the Radiation Protection SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.7.1 Radiation Protection Program

In accordance with the Radiation Protection Regulations [27] and CNSC Guidance document G-129, "Keeping Radiation Exposures and Doses As Low As Reasonably Achievable" [28], BWXT NEC has implemented a radiation protection program as described in EHS-P-RPM-001 Volume 1, "Radiation Protection Manual" [29]. This document establishes the Radiation Protection program in place at the Peterborough and Toronto facilities and identifies corresponding procedures to ensure that radiation exposures and doses are kept ALARA. Key components of the BWXT NEC radiation protection program include:

- Management control over work practices;
- Personnel qualification and training;
- Control of occupational and public exposure to radiation; and
- Planning for unusual situations.

The BWXT NEC radiation protection program includes all worker radiation safety elements that demonstrate compliance to relevant Regulations, codes and standards including:

- EHS policy commitment to ALARA;
- Area classifications and requirements;
- Material handling;
- Non-routine or high-risk work controls;
- Internal and external radiation hazard assessments; and
- Internal and external radiation monitoring and recording.

Continuous improvement of BWXT NEC's radiation protection program is also facilitated through an ALARA Committee consisting of both unionized and management employees. The ALARA Committee meets quarterly (at a minimum) and sets annual ALARA goals focused on reducing worker dose and surface contamination at both facilities. ALARA Committee goals that are not achieved are reviewed by the ALARA Committee to discuss probable causes. Continuous improvement of BWXT NEC's radiation protection program is also achieved through additional review processes including self-assessments and audits, reported safety concerns, near miss and incident investigations, and CNSC inspections.

2.7.2 Potential Radiological Hazards

BWXT NEC's radiation protection program addresses the hazards associated with UO_2, as the major potential worker hazard is inhalation of airborne UO_2 particles. Measurements are performed for airborne and surface traces of Uranium as an indicator of process containment efficiency. A respiratory protection program is in place and additionally, urine samples are regularly provided by employees to indicate if inhalation may have occurred and to monitor clearance of Uranium from the body. Sampling frequency ranges from weekly to once per three months, based on established criteria such as job function and worker location within the facility.

A lesser potential hazard exists in the form of low-level external gamma and beta doses to employees. Routine gamma surveys are conducted and Nuclear Energy Workers (NEWs) are issued thermoluminescent dosimeters (TLDs) to measure whole body, skin and extremity dose to ensure compliance with the regulatory radiation dose limits and the ALARA principle.

The BWXT NEC radiation protection program ensures that surface/airborne contamination and radiation doses to employees and the public are monitored and controlled (note, Section 2.7.4 provides details on Radiation Protection Control Measures).

2.7.3 NEW Designation

When a new employee is hired or an existing employee is transferred to a position that requires accessing or working in a Classified Radiation Area, the Supervisor in consultation with the EHS department, determines whether NEW status is required. NEW status is required for individuals who are likely to exceed the dose limits for an individual who is not a NEW (i.e., 1 mSv) as specified in the Radiation Protection Regulations [27].

All NEWs are required to undergo a medical examination on designation and are notified in writing of their NEW designation, the risks associated with radiation they may be exposed to over the course of their work and of the applicable dose limits. Female NEWs are also notified in writing of their rights and obligations related to pregnancy, including the requirement for female NEWs to inform BWXT NEC in writing if they are pregnant.

2.7.4 Radiation Protection Control Measures

The Director, EHS and Regulatory, has oversight of BWXT NEC's Radiation Protection program and dose records are regularly reviewed by the EHS department on receipt from the licensed dosimetry provider. In addition, the ALARA Committee reviews trending data from radiation monitoring (contamination and dose rate) and environmental monitoring through routinely scheduled meetings and provides recommendations to improve ALARA implementation.

As external radiation hazards from the storage and use of radioactive materials may result in radiation doses to workers, routine gamma radiation surveys are conducted within the Toronto and Peterborough facilities using portable handheld radiation detectors. Measured dose rates are compared to established dose targets for a given area based on area classification (see Section 2.7.5) and occupancy. When necessary, items are moved to alternative storage locations and/or shielded. Areas that appear routinely higher than target dose rates are investigated for improvements, such as reconfiguration.

Internal radiation hazards exist at both the Toronto and Peterborough facilities in the form of loose Uranium which may enter the body by inhalation, ingestion or absorption. As a result, continuous and/or periodic air monitoring is conducted at various work stations within the Peterborough and Toronto facilities as appropriate. Workstation air monitoring is a key performance indicator that speaks to effective administrative and engineered controls. Additionally, surface contamination measurements (swipes) are conducted in manufacturing areas of each facility to monitor and reduce the amount of loose radioactive material available for internal exposure of employees. As these monitoring processes produce large quantities of data, trending of data is performed at least annually and reviewed by the ALARA committees.

The measurement of Uranium in urine is also a key method of assessing whether inhalation of airborne UO_2 has occurred. Employees who in the course of their work, may be exposed to radioactive dust undergo a bioassay. Criteria which determine the frequency of urine sampling for an employee are documented in BWXT NEC's Radiation Protection Manual [29].

2.7.5 Zone Control

Areas within the Toronto and Peterborough facilities are classified according to the potential radiation hazard. Once classified, the specific area requires radioactive material handling procedures appropriate for the hazard, personnel monitoring and contamination monitoring programs, etc. These classifications are defined in the Radiation Protection Manual [29] as follows:

- Unclassified Area - these areas do not involve nuclear substances and are considered public domain. Incidental contamination does not exceed the unclassified area Internal Control Levels;

- Active Area - these areas are designed for handling materials with loose contamination that is potentially above unclassified area Internal Control Levels. External radiation hazards are not of significant concern;
- R1 Area - these areas are designed for operations where only external radiation is of concern, and loose contamination is below R1 area Internal Control Levels;
- R2 Area - these areas are designed for operations involving exposed non-dispersible nuclear substances, where external radiation is of concern and loose contamination may be above R1 Internal Control Levels; and
- R3 Areas - these areas are designed for operations involving exposed solid dispersible nuclear substances, where external radiation may be of concern and where the hazard of contaminant inhalation or ingestion is identified. Loose contamination may be above R2 Internal Control Levels and below R3 Internal Control Levels.

2.7.6 Radiation Protection Dose Limits and Action Levels

The annual dose assignment for employees at BWXT NEC consists of external (Toronto and Peterborough) and internal (Toronto) dosimetry inputs, for which dose summaries are tracked for quarterly, year-to-date and lifetime. All NEW employees who are monitored for radiation exposure receive an annual dose letter identifying their annual dose.

All fuel assembly NEWs at BWXT NEC are assigned TLDs, which measure the whole body and skin doses received in each monitoring period. At the end of each wear period (1 to 3-month period), TLDs are collected and sent to a CNSC licensed dosimetry service provider. The dosimetry service provider processes the TLDs and provides the results to BWXT NEC and the National Dose Registry.

BWXT NEC has established facility-specific CNSC approved Action Levels for various radiological and environmental parameters. An Action level is defined in the Radiation Protection Regulations [27] as "*a specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program, and triggers a requirement for specific action to be taken.*" Action Levels are established in accordance with the CNSC regulatory document G-228, "Developing and Using Action Levels" [30], which are approved by the CNSC and specified in the LCH (refer to Table 1 and Table 2 below). Although Action Levels are set below regulatory limits, exceeding an Action Level is considered a CNSC reportable event in which BWXT NEC must notify the Commission within 24 hours of becoming aware that an Action Level has been exceeded.

BWXT NEC has also established internal control levels for various radiological and environmental parameters which are set below Action Levels to give an indication of conditions prior to a potential loss of control. An internal control level exceedance results in an internal investigation and corrective actions as appropriate. Note, consistent with the operations at the Toronto facility, the current internal control levels and Action Levels for the Peterborough facility may be modified if a decision is made to consolidate pelleting and fuel assembly operations.

Details on the results of routine surface contamination measurements, workstation air sampling, routine dose rate measurements, Urinalysis, Radiation Dose Distributions, Whole Body Effective Dose and Equivalent Skin Dose, are captured in the Annual Compliance Reports issued to CNSC staff.

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 ug/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

Table 1 – Summary of Action Levels for the Radiation Protection Program at Peterborough Facility

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 ug/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

Table 2 – Summary of Action Levels for the Radiation Protection Program at Toronto Facility

2.8 Conventional Health and Safety

The "Conventional Health and Safety" SCA covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.

BWXT NEC has implemented a program for environmental, health and safety program excellence.

Most notably, in 2011 BWXT NEC undertook a comprehensive initiative to improve machine safeguarding. A risk assessment at both the Toronto and Peterborough facilities was completed by a third party. The study reviewed the hazards for every machine at the two facilities and assessed the risk to personnel. The output of the study was used to inform a multi-year project to upgrade the guarding of the machines. Over the course of the licence period, over 125 machines were upgraded or replaced to reduce the risks posed to the operator.

CNSC staff have assessed the Conventional Health and Safety SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e., Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.8.1 Health and Safety Program

As the Toronto and Peterborough facilities are federally regulated, in addition to complying with CNSC Regulations, BWXT NEC complies with the requirements of the Canada Labour Code Part II [14] as it relates to occupational health and safety.

BWXT NEC's Environmental Health and Safety Policy [31], identifies the EHS goals, objectives and guiding principles and the authority for implementing, maintaining and improving matters concerning EHS. This policy document summarizes the applicable EHS standards, and lists the procedures necessary to plan, execute, control, monitor, trend, document, review, record and report on EHS performance within the BMS. Senior management is required to ensure that measurable objectives, which are consistent with the EHS policy, are established at relevant functions and levels within the organization. The Director, EHS and Regulatory, has the authority on all matters pertinent to EHS at BWXT NEC including implementation, maintenance and improvement practices.

Both the Toronto and Peterborough facilities have a site Environment, Health and Safety Plan [32] [33], which re-enforces BWXT NEC's commitment to health, safety and environmental excellence, and to ensure all employees are accountable for EHS policy [31] implementation. Annual incident, injury and illness performance goals, and other EHS-related goals, are established as part of the health and safety plan. These goals strive to be at least as good as comparable industry averages and represent continuous improvement for the site. Management regularly reviews EHS performance (e.g., monthly management meetings).

Key components of the Health and Safety program include:

- Compliance with all safety and health-related regulatory requirements;
- The setting of EHS goals and objectives;
- Hazard recognition, risk assessment and change control processes;

- A comprehensive worker training program; and
- Documented safety concerns near misses and incidents with appropriate root-cause analysis, preventive and corrective actions.

The EHS program includes all worker safety elements that demonstrate compliance to relevant Regulations, codes and standards including:

- EHS Policy;
- Hazard Analysis and Regulatory Compliance;
- Employee Involvement;
- Accident/Incident Investigation;
- EHS Training;
- Housekeeping;
- Personal Protective Equipment;
- Contractor Safety;
- Emergency Preparedness/Response;
- Risk Assessments;
- High Risk Operations;
- Change Control and Preventative Maintenance;
- Industrial Hygiene;
- Chemical Management;
- Ergonomics; and
- Lock-Out Tag-Out.

Details on the results of BWXT NEC's Health and Safety program (e.g., recordable injuries, near miss events, Workplace Safety Committee (WSC) goals and results) are captured in the Annual Compliance Reports issued to CNSC staff.

2.8.2 Workplace Safety Committee

The WSC contributes to making the plant as safe as possible by promoting health and safety awareness, making recommendations to workers and management regarding safe work practices, and monitoring health and safety issues until resolved. All elements of the Health and Safety program are reviewed by the WSC. Committee members consist of both unionized and management employees. Each facility committee meets monthly, with a minimum of nine meetings required annually.

2.8.3 Hazards and Work Controls

Chemical management is an established health and safety program element at BWXT NEC. In 2015, the Workplace Hazardous Material Information System (WHMIS) legislation (Hazardous Products Regulations) was updated to require compliance to the Globally Harmonized System of

Classification and Labelling of Chemicals (GHS) for specified controlled or hazardous products. WHMIS is designed to address employers' and workers' right to know about the hazards and safe work practices related to certain chemicals. GHS defines and classifies the hazards of chemical products, and consistently communicates health and safety information on labels and safety data sheets.

A multi-year transition plan was announced giving suppliers until May 31, 2017 to use WHMIS 1988 or WHMIS 2015 to classify and communicate the hazards of their products. During this transition period, BWXT NEC has included both 1988 and 2015 systems in their employee training programs, and continues to update secondary labeling and provide Safety Data Sheets compliant with WHMIS 2015 as products come in. Into 2018, BWXT NEC will update the Chemical Management programs and associated labeling systems, perform site-wide chemical sweeps and revise education and training programs in consultation with the workplace safety committees to meet WHMIS 2015.

2.9 Environmental Protection Program

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.

BWXT NEC has an effective Environmental Protection program in place, which identifies and controls environmental aspects and drives continuous improvement to enhance performance and minimize risk to employees and the public. During the licence period, no environmental action levels or regulatory limits were exceeded and public doses from the operations at the Peterborough and Toronto facilities were only a fraction of the regulatory public dose limit.

CNSC staff have assessed the Environmental Protection SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as either exceeding requirements and CNSC expectations in specific areas (Fully Satisfactory) or meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.9.1 Environmental Management Program

BWXT NEC facilities operate an Environmental Management System, which ensures an effective environmental protection program is in place to achieve environmental goals and objectives. BWXT NEC's environmental protection program is in compliance with CSA N288.4-10, "Environmental monitoring programs at Class I nuclear facilities and Uranium mines and mills" [34], CSA N288.5-11, "Effluent monitoring programs at Class I nuclear facilities and Uranium mines and mills" [35], and CSA N288.6-12, "Environmental risk assessments at Class I nuclear facilities and Uranium mines and mills" [36].

Key components of the Environmental Protection program include:

- Compliance with all environmental-related regulatory requirements;
- The setting of environmental goals and objectives;
- Hazard recognition, risk assessment and change control processes;

- A comprehensive worker training program; and
- Documented environmental concerns, near misses and incidents with appropriate root-cause analysis, preventive and corrective actions.

BWXT NEC's Radiation Protection Manual [29], provides details of the Environmental Monitoring aspects for both Peterborough and Toronto. This includes emission source air sampling, air quality sampling, liquid effluent sampling, soil sampling as well as boundary monitoring.

As the Peterborough facility uses Beryllium as part of the fuel bundle manufacturing process, requirements for Beryllium safety are captured in EHS-P-BSM-001P, "Beryllium Safety Manual – Program Administration" [37]. Beryllium use in a federally regulated facility is governed by the Canada Labour Code Part II and the Canada Occupational Health and Safety Regulations. The Environmental Protection Act of Ontario [38] and Ontario Regulation 419/05 Air Pollution – Local Air Quality Regulation, determine the permitted concentration of contaminant release. BWXT NEC has established an Action Level (see Section 2.9.8) and an Internal Control Level at the stack exit, which are both very conservative.

As part of BWXT NEC's monitoring of the effectiveness of the Environmental Protection program, internal inspections are completed on a routine basis and focus on all areas of the plant. The purpose of these inspections is to identify environmental as well as health and safety issues. Workplace Safety Committee members carry out routine plant inspections and the findings are documented, corrective actions identified, and all actions are tracked to completion.

2.9.2 Toronto Environmental Risk Assessment

An Environmental Risk Assessment (ERA) [39] specific to the Toronto facility has been completed in accordance with CSA N288.6-12 [36]. The Toronto ERA concluded that emissions of radioactive material from the facility were very low and the maximum estimated annual effective dose as a result of direct gamma radiation and air releases from the facility, was approximately 1% of the CNSC public annual dose limit.

The emissions of non-radioactive contaminants from the facility were below the Ministry of the Environment, Conservation and Parks point of impingement standards; and exposure to water releases was also estimated to be minimal. Hence, it was concluded that the emissions of non-radiological substances resulting from the BWXT NEC Toronto facility pose no adverse effect to human health.

The ERA also concluded that emissions of radioactive and non-radioactive materials from the facility posed no adverse effects to non-human biota.

2.9.3 Peterborough Environmental Risk Assessment

An ERA specific to the Peterborough facility [40] has been completed in accordance with CSA N288.6-12 [36]. The Peterborough ERA concluded that emissions of radioactive material from the facility were very low and the estimated annual effective dose as a result of direct gamma radiation and air releases from the facility is estimated to be negligible (i.e. virtually zero µSv).

The emissions of non-radioactive contaminants from the facility were below the Ministry of the Environment, Conservation and Parks point of impingement standards; and exposure to water

releases was also estimated to be minimal. Hence, it was concluded that the emissions of non-radiological substances resulting from the BWXT NEC Peterborough facility pose no adverse effect to human health.

The ERA also concluded that emissions of radioactive and non-radioactive materials from the facility posed no adverse effects to non-human biota.

2.9.4 Peterborough Consolidated Operations Environmental Risk Assessment

As described in Section 1.4, BWXT NEC is seeking the additional flexibility during the proposed next licence period to conduct pelleting operations at the Peterborough facility. Hence, a revised ERA has been completed for the Peterborough facility [41] which identifies potential health and ecological risks associated with the consolidation of the BWXT NEC fuel pelleting operation in Toronto with the existing BWXT NEC fuel assembly operations in Peterborough. The revised ERA is considered bounding in nature based on the Toronto facility's pelleting operating experience and performance.

The consolidated ERA concluded that emissions of radioactive material BWXT NEC consolidated operations would be very low and the maximum estimated annual effective dose as a result of direct gamma radiation and air releases from operations would be 1% of the CNSC public annual dose limit.

The emissions of non-radioactive contaminants from the consolidated facility would be below the Ministry of Environment, Conservation and Parks point of impingement standards; and exposure to water releases was also estimated to be minimal. Hence, it was concluded that the emissions of non-radiological substances resulting from BWXT NEC consolidated operations pose no adverse effect to human health.

The consolidated ERA also concluded that emissions of radioactive and non-radioactive materials from BWXT NEC consolidated operations posed no adverse effects to non-human biota.

2.9.5 Airborne Emission Program

The Toronto facility performs continuous in-stack sampling and boundary air monitoring for Uranium. The facility performs continuous in-stack monitoring by drawing a sample of air across a filter capable of trapping Uranium dust. The samples are analyzed daily and verified externally by an independent laboratory. Boundary samples are high volume air samples drawn at five positions strategically located around the facility perimeter, which are analyzed externally by an independent laboratory. Results are compared to previous results, and to relevant Internal Control Levels and Action Levels, and corrective actions are generated as appropriate.

A single process Uranium air emission point exists in the Peterborough facility, which exhausts through a High Efficiency Particulate Air filter. The facility performs continuous in-stack monitoring by drawing a sample of air across a filter capable of trapping Uranium dust. The filter papers are analyzed in-house and verified externally by an independent laboratory. Results are compared to previous results, and to relevant Internal Control Levels and Action Levels and corrective actions are generated as appropriate.

Three Beryllium air emission points also exist at the Peterborough facility. The facility performs continuous in-stack monitoring drawing a sample of air across a filter capable of trapping Beryllium. The filter is analyzed for Beryllium at an external independent laboratory.

If a decision is made to incorporate pelleting at the Peterborough facility, additional monitoring practices will be incorporated at the Peterborough facility, which are expected to be similar to those at the Toronto facility. Additional monitoring practices would include boundary air monitoring and routine soil sampling for Uranium.

2.9.6 Water Effluent Monitoring

In Toronto, bulk quantities of UO_2 powder are handled, which requires frequent cleaning and washing protective clothing, walls, floors and equipment. The water is treated to remove Uranium Dioxide, and the concentration of UO_2 in waste water leaving the treatment system is measured in-house. The concentration of UO_2 in the total waste water leaving the plant premises is calculated and compared to the Internal Control Level of 3 ppm and the Action Level of 6 ppm (per batch). Each batch is only released when in-house sample results confirm the concentration is less than the Internal Control Level. A weekly composite sample is also prepared and sent for independent analysis at an external laboratory.

In Peterborough, all potentially Uranium-contaminated wastewater is held for determination of the quantity and concentration of Uranium prior to disposal. Liquid waste generated from routine activities, such as washing floors, walls and equipment in the Uranium pellet loading and end closure weld area, is held in a 205 litre (45-gallon) drum stored in the maintenance area. Most of the potentially contaminated waste water originates from floor washing. The water is filtered prior to sampling, and then sent for analysis at an external laboratory. After the water sample result is verified to be below the Internal Control Level of 3 ppm and the Action Level of 6 ppm (per batch), the wash water is filtered again and then discharged to the sanitary sewer.

A second liquid effluent from the Peterborough facility is Beryllium in water, which is generated from equipment use and washing. BWXT NEC has established an Internal Control Level of 4 µg/L, which is conservative and consistent with international drinking water guidelines for Beryllium. All potentially Beryllium contaminated water passes through a weir settling system prior to release to the sanitary sewer. Regular sampling of the Beryllium wastewater is conducted. The water sample consists of a 24-hour composite sample taken from the outflow lines which is sent for analysis at an external independent laboratory.

2.9.7 Terrestrial Monitoring

Naturally occurring Uranium may be detected at low levels in various rocks, ores, soil, water, air and plants (in Ontario, background levels of Uranium in soil are generally below 2.5 µg/g). The Canadian Council of Ministers of the Environment (CCME) has established soil quality guidelines to protect human health and the natural environment. The guidelines represent levels of Uranium in soil below which no risk to human health is expected. These guidelines have been adopted by the Ontario Ministry of the Environment, Conservation and Parks.

The Toronto and Peterborough facility UO_2 air emissions are the primary pathway for potential release into the natural environment by impingement on the ground surface in the immediate vicinity of the facility depending on the wind direction. UO_2 is insoluble in water but may be washed into the soil by rainfall, snow, etc. Depositions of Uranium are measured by taking small samples of surface soil and analyzing for natural Uranium. Soil sampling is conducted annually at the Toronto facility, in which samples of surface soil are retrieved from 49 locations in accordance with a documented plan by a third-party consultant. The samples are analyzed by an independent laboratory and if soil analysis indicates rising natural Uranium levels, further investigation into the cause(s) is carried out (note, the amount of Uranium released through air emissions from both facilities in any year, based on actual measurements, is extremely low).

Soil sampling is not conducted at the Peterborough facility due to the negligible air release amounts. However, if a decision is made to incorporate pelleting at the Peterborough facility, additional monitoring practices at the Peterborough facility would be incorporated similar to those at the Toronto facility.

2.9.8 Public Dose Assessment and Limits

The Public dose limit (i.e., 1 mSv) is specified in the Radiation Protection Regulations [27] and this requirement has been embedded as part of the BWXT NEC radiation protection program. To ensure compliance with the public dose requirements, BWXT NEC has established Derived Release Limits (DRLs) for Uranium emissions to the environment for both the Toronto and Peterborough facilities in accordance with CSA N288.1, "Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities" [42]. The facility DRLs account for realistic exposure pathways in order to restrict the dose to a member of the public to less than 1 mSv per year. Through direct correlation with the facility DRLs, the estimated effective dose as a result of air releases is calculated annually.

Additionally, environmental TLDs at the Toronto and Peterborough plant boundary are in place and are used to estimate the direct gamma dose to a member of the public. Estimated effective doses to the public are comprised of the summation of annual dose estimates resulting from air releases and direct gamma radiation. Estimated effective doses to the public from BWXT NEC operations are well below the public dose limit as captured in the Annual Compliance Reports issued to CNSC staff.

Action Levels as listed in Table 3 and Table 4 have also been set for the purpose of ensuring that releases remain ALARA and that pollution prevention principles are applied. Exceeding an Action Level is considered a CNSC reportable event in which BWXT NEC must notify the Commission within 24 hours of becoming aware that an Action Level has been exceeded. Over the course of the Licence period, there were no environmental Action Level exceedances.

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

Table 3 – Action Levels for Peterborough Facility

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

Table 4 – Action Levels for Toronto Facility

2.10 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 area also includes any results of participation in exercises.

Each facility has established emergency response plans that describe the actions to be taken to minimize the health and environmental hazards, which may result from fires, explosions or the release of hazardous materials. The plans include effects to the local area and members of the public.

BWXT NEC recently completed a project to address areas for improvement identified by the CNSC following an Emergency Response inspection in October 2016. A major revision of the Toronto Emergency Response program was completed to address CNSC comments and further implement the requirements of CNSC REGDOC-2.10.1, "Nuclear Emergency Preparedness and Response" [43], including redistribution of roles and responsibilities; and the formation of a designated Emergency Operations Centre (EOC) location in Toronto equipped with the tools and technology required to respond to an emergency event. The updated emergency response program and associated training was completed for the Toronto facility in 2018, which included four full-scale exercises involving coordination with outside response agencies.

The Fire Protection program at BWXT NEC is well-established and effective. The facility fire hazards analysis (FHA) for the Toronto and Peterborough facilities (References [44], [45], [46], [47], [48] and [49]) identifies the facility fire hazards and their potential impact on the worker and public safety and asset protection (note, the FHA's for both the Toronto and Peterborough facilities are currently being updated). The fire safety plans are based on the documented FHA

and ensures that measures are appropriate to the facility. It provides information on resources in the buildings, emergency procedures and actions to be taken in the event of a fire.

CNSC staff have assessed the Emergency Management and Fire Protection SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.10.1 Emergency Response Program

BWXT NEC's Emergency Response program is described in document EHS-P-H&S-25.0T, "Toronto Pellet Operations – Emergency Plan" [50] and document EHS-P-H&S-11.0P, "Peterborough Operations – Emergency Preparedness and Fire Prevention" [51]. Each facility Emergency Plan describes the organization and methods to prepare for, respond to and recover from emergencies and has been developed based on the requirements of CNSC REGDOC-2.10.1 [43]. The Emergency Plan describes the responsibilities assigned to various personnel and functions to ensure that proper planning, training, and equipment are maintained to manage and respond to emergencies. It documents methods used to respond to emergencies and to ensure the timely notification of off-site agencies and organizations that may be affected by such events or requested to provide assistance to supplement the emergency organization.

Emergency response training is achieved through response drills where actual responses are regularly critiqued to continually improve the effectiveness of the program. All employees are trained on established fire prevention measures, emergency situation responses, emergency evacuation routes and their responsibilities. Awareness training is conducted during new employee orientation and refreshed through response drills. Emergency responders are provided with the level of training necessary to allow them to effectively perform their designated functions.

Work instructions describe the development of drill and exercise scenarios, drill objectives, assigning competent drill observers, and a critique of drill performance. Drills that involve activation of the Emergency Organization are conducted annually. An evacuation drill is also conducted annually and is evaluated for adequacy of alarms and evacuation routes and time taken for evacuation. Triennially, a full-scale exercise is conducted at each site. The offsite emergency response organizations necessary to mitigate the consequences of the exercise scenarios participate in these drills.

2.10.2 Fire Protection Program

BWXT NEC's Fire Protection program is described in document EHS-P-H&S-11.0T, "Toronto Pellet Operations – Fire Protection Program" [52] and document EHS-P-H&S-11.0P, "Peterborough Operations – Emergency Preparedness and Fire Prevention" [51]. The primary goals of the Fire Protection program are to minimize the risk of radiological releases resulting from fire; protect facility occupants from death or injury due to fire; minimize economic loss resulting from fire damage to structures, equipment and inventories; and minimize the impact of radioactive or hazardous material on the environment as a result of fire. The program outlines key fire protection requirements intended to reduce the risk of fire and explosion at the facility.

The Fire Protection program has been developed based on the requirements of CSA N393, "Fire Protection for Facilities that Process, Handle, or Store Radioactive Substances" [24]. These standards specify the minimum fire protection requirements for the design, construction, commissioning, operation, and decommissioning of facilities that process, handle, or store nuclear substances, including structures, systems and components, and other hazardous substances that directly relate to the nuclear substances being regulated (note, the Toronto and Peterborough facility FHA's are captured in References [44], [45], [46], [47], [48] and [49] which are currently being updated as part of a routine update). The Fire Protection program describes the systems and resources available to prevent and detect fire and to minimize impact from a fire event and consist of the following key elements:

- Fire and Life Safety Features;
- Inspection and Maintenance;
- Fire Protection Assessment;
- Fire Protection;
- Housekeeping;
- Minimization of Combustibles;
- Ignition Source Control;
- Impairment;
- Design for the Prevention and Mitigation of Fires;
- Training;
- Outside Coordination; and
- Program Assessment.

Fire protection systems are inspected and tested in accordance with the National Fire Code of Canada [23] following an established schedule. A third-party review and internal self-assessment is conducted annually at each site and identified continuous improvements are tracked to completion.

Also, site familiarization tours are conducted annually with Peterborough and Toronto Fire Services as they are the primary responders for the facilities.

2.11 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.

BWXT NEC's Toronto and Peterborough facilities have an effective and well-established radioactive waste disposal program that ensures all radioactive waste disposals are conducted in accordance with the NSCA, associated Regulations and the facility operating licence conditions.

CNSC staff have assessed the Waste Management SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected

that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.11.1 Waste Management Program

BWXT NEC's waste management procedures EHS-P-E-3.0T [53] and EHS-P-E-3.0P [54] for the Toronto and Peterborough facilities respectively, apply to hazardous wastes (solid, liquid, and gaseous) generated on-site, including the management and disposal methods for that waste. Both procedures establish a cradle-to-grave approach with respect to waste management which includes waste collection, transportation, disposal, reduction and recycling; and ensures compliance with the Environmental Protection Act [38] and the Transportation of Dangerous Goods Act [55].

The radioactive waste program employed at BWXT NEC is described in the Radiation Protection Manual [29]. Radioactive wastes are managed in such a way as to ensure that they do not give rise to any unnecessary exposures to radiation or unacceptable effects on the environment. Any risks which arise in the management of radioactive wastes must be kept ALARA. Materials which need to be disposed of which have nuclear substances above internal control levels, one of the following is carried out:

1. Obtain approval in writing from the CNSC to dispose of the contaminated material in an unrestricted manner;
2. Send the waste for disposal to a licensed agency;
3. Return the waste to the customer for disposal according to their waste management program.

Radioactive solid wastes generated from fuel manufacturing (which consist of or are contaminated by Uranium) are accumulated in controlled and classified areas. A low volume of radioactive wastes from Peterborough are transported to and consolidated with the Toronto facility wastes. These are combined, compacted for volume reduction where possible, and shipped routinely to a licensed radioactive waste disposal facility. In Toronto, only about 0.01% of the Uranium that is processed ends up in waste streams. Nearly all nuclear material is used in the product or recycled back to the supplier.

2.11.2 Preliminary Decommissioning Plan

In accordance with CNSC Guidance document G-219, "Decommissioning Planning for Licensed Activities" [56] and CSA standard N294-09, "Decommissioning of Facilities Containing Nuclear Substances" [57], a Preliminary Decommissioning Plan (PDP) and associated cost estimate has been prepared for both the Toronto and Peterborough facilities [58] [59]. The decommissioning scenario for both facilities includes the full decommissioning of the entire licensed property to a condition of unconditional clearance with respect to radiological materials.

BWXT NEC undertakes periodic reviews of the PDP and updates as required. The updates reflect any changes to operations, conditions, evolving technologies and regulatory requirements. Unless otherwise dictated by significant changes to the facility, the PDP is updated every 5 years with an update currently under development.

2.12 Security Program

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.

A notable upgrade within the Security SCA which occurred over the course of the licence period include was the addition of a 24-hour, 7 day a week guard presence at the Toronto facility and physical guard house at the vehicle entrance.

CNSC staff have assessed the Security SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.12.1 Security Program Overview

The Toronto and Peterborough facilities each maintain a security program as described in BWXT NEC documents EHS-P-SEC-001T [60] and EHS-P-SEC-001P [61] respectively (note, these documents are BWXT NEC confidential and are Prescribed Information) in accordance with the General Nuclear Safety and Control Regulations [62], Class I Nuclear Facilities Regulations [63] and the Nuclear Security Regulations [15]. These documents identify the individual responsibilities for implementation and maintenance of the security program and include instructions for administering the security program and performing security operations.

Examples of security measures in place at both facilities include:

- Access control (access cards and locked restricted-access areas);
- Facility Access Security Clearance program;
- Security guards;
- Security barriers; and
- Intrusion detection systems.

2.13 Safeguards

The "Safeguards" 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.

BWXT NEC has implemented and maintained a well-established Safeguards program throughout the licence period and undertakes all required measures to ensure IAEA commitments and CNSC regulatory requirements are met.

CNSC staff have assessed the Safeguards SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e. Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.13.1 Safeguards Program Overview

BWXT NEC document SG-01 (Toronto) "Safeguards Procedure" [64] and SG-01 (Peterborough), "Safeguards Procedure" [65] are applicable to the Toronto and Peterborough facilities and outline the compliance requirements and related procedures to ensure that Safeguards obligations per IAEA commitments and RD-336, "Accounting and Reporting of Nuclear Material" [66] are met. Note, RD-336 has recently been superseded by REGDOC-2.13.1, "Safeguards and Nuclear Material Accountancy" [67] and the requirements of REGDOC-2.13.1 will be implemented by January 31, 2019.

The IAEA and CNSC also conduct periodic Safeguards audits which include an annual witnessed physical inventory and short-notice random inspections (SNRI) throughout the year.

2.14 Packaging and Transport

The "Packaging and Transport" SCA covers the safe packaging and transport of nuclear substances to and from the licensed facility.

Routine shipments of both dangerous goods and non-dangerous goods are made between suppliers, the Toronto and Peterborough facility and customer nuclear generating stations. Over the course of the licence period, packaging and shipments to and from both facilities have been conducted safely in accordance with relevant Regulations.

CNSC staff have assessed the Packaging and Transport SCA in the annual Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada [1], [2], [3] as meeting all regulatory requirements and expectations (i.e., Satisfactory rating). It is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.14.1 Packaging and Transport Program Overview

BWXT NEC procedure EHS-P-RPM-002, "Peterborough Operations and Toronto Operations Transport Regulations for Nuclear Substances" [68] outlines the relevant transportation Regulations (i.e. CNSC Packaging and Transport of Nuclear Substances [69] and Transport Canada's Transportation of Dangerous Goods Regulations [55]) that BWXT NEC must comply with when shipping, transporting or receiving nuclear substances routinely or non-routinely.

Shipments of prescribed substances are only made to:

- Persons in Canada, holding a valid CNSC Licence to possess such prescribed substances; or
- Persons in Canada, not requiring a valid CNSC Licence by virtue of the Nuclear Safety and Control Act and Regulations; or
- Persons outside Canada, as approved by an Export Permit, CNSC Export Licence, or combination of CNSC Export Licence and reference to General Export Permit as applicable.

BWXT NEC has an established Emergency Response Assistance Plan compliant with the Transportation of Dangerous Goods Regulations [55]. It is in place to ensure that timely and effective response protocols are in place with the intent to protect public safety, property and the environment in the event of an accident involving the transportation of natural or depleted

Uranium Dioxide. Transportation of Uranium materials to and from BWXT NEC is included in the plan.

3.0 NUCLEAR FACILITY SPECIFIC AREAS OF INTEREST

3.1 Public Engagement

As described in Section 2.1.3, BWXT NEC maintains a Public Information and Disclosure Program [10]. The following subsections provide examples of BWXT NEC's Public Engagement initiatives.

3.1.1 Government Stakeholders

BWXT NEC recognizes the importance of building and maintaining relationships with all levels of government in the communities in which it operates and proactively seeks to engage local elected officials to ensure representatives are aware of BWXT NEC's operating activities in Toronto and Peterborough. For example, in 2017, facility tours and/or meetings were conducted with:

- Member of Parliament (MP) for Peterborough-Kawartha;
- Mayor of Peterborough;
- Member of Provincial Parliament (MPP) for Peterborough;
- MP for Davenport; and
- Ontario Minister of Energy.

3.1.2 Community Volunteerism

BWXT NEC rebuilt all components of its volunteer program over the course of 2017 and officially launched the new program, called BWXT Volunteer Strong. The program has the full support of leadership and has been received positively by employees.

Through BWXT Volunteer Strong, all employees have the opportunity to help build stronger communities for those that live and work in them and can volunteer time and expertise to local causes that are important to the communities in areas such as education, health & wellbeing, arts & culture, environment and aboriginal.

3.1.3 Community Investment

The Peterborough facility has supported a range of community-based groups/initiatives that help improve community life in three key areas: community and cultural, charitable and health care support, education and vocational support. Examples include bursaries to local high school graduates, support for the Peterborough Science Fair and donations to assist local schools with purchasing tools/equipment that support Science, Technology, Engineering and Math learning.

Similarly, the Toronto facility has provided donations to local schools to enhance student learning experience in Science, Technology, Engineering and Math as well as other charitable organizations (e.g. United Way).

3.1.4 Community Barbecues

BWXT NEC has hosted community barbecues in Toronto since 2015 and Peterborough since 2016. These events create a platform for the exchange of information between BWXT NEC and community members and help to build positive relationships within the communities.

Senior leaders and managers staffed the barbeques and provided information about BWXT NEC's operations and talked with guests about the role of nuclear in Ontario. Visuals and information about BWXT NEC's history, highly- skilled workforce, engineering and manufacturing capabilities, track record of safety and regulatory compliance, public information program and facts about natural Uranium are provided during this event.

3.1.5 Community Newsletters

Community newsletters are used by BWXT NEC as a tool to share information with the local communities about the company's operational performance, health and safety, activities in the community and general information.

For example, in 2017 three newsletters were issued to the Toronto community. The distribution of Toronto newsletters was 1,700 in January and June, and then increased to 2,200 for the October issue. Similarly, in Peterborough, three newsletters were distributed to the community in 2017. Approximately 1,500 addresses were sent the newsletter in January, and this was increased to 1,700 for the June and October issues.

3.1.6 Community Liaison Committee – Toronto

The Toronto Community Liaison Committee (CLC) was established in 2013 and meets four times per year at the Toronto facility. The CLC is a forum for the exchange of information between the community and BWXT NEC. The CLC is not a decision-making body but provides a forum for members to bring forward questions, discuss concerns and identify opportunities to improve community relations. BWXT NEC seeks to learn more about community priorities, interests and activities, and improve how it shares information about work at the Lansdowne Avenue facility, health & safety initiatives and community activities.

Members meet with BWXT NEC staff to discuss the facility's operations and receive updates on topics such as emergency planning and training, community initiatives and environmental monitoring. CLC members provide input on BWXT NEC activities such as newsletter content, annual barbeque planning, community initiatives, etc. Their input is valuable in guiding communications efforts with area residents.

BWXT NEC proactively recruits for new CLC members on an annual basis in the fall. BWXT NEC promotes the recruitment through its community newsletter, letters to local organizations, website, social media and fence line banners.

3.1.7 Website

The BWXT NEC website is located at www.nec.bwxt.com. The rebranded website launched on December 19, 2016 and a redirection was implemented to point the old website to www.nec.bwxt.com. The website provides information about the company's operations and activities that can be accessed by members of the public and other key stakeholders 24/7.

In 2017, there were 12,017 total sessions from 8,132 users. Top pages visited were: Home page (54 per cent of all unique page views), Contact Us (9.5 per cent) and What We Do (8 per cent). Over the course of 2017, new information was updated on the website. The following represents some of the updates that were made to the website:

- The 2017 annual compliance report was posted;
- A call for applications to the Toronto CLC was posted;
- Copies of the Toronto (three) and Peterborough (two) newsletters were posted;
- Community barbeque information was posted; and
- The Independent Environmental Monitoring program results for Toronto 2016 were posted.

In 2017, BWXT NEC began work on redesigning and conducting further updates to the website, an effort that will launch in 2018.

3.1.8 Social Media

BWXT NEC leverages BWXT's social media channels which include Twitter, Linked-In and Facebook to share information about BWXT NEC activities. 2017 was the first year that BWXT NEC engaged via Facebook, enhancing its overall social media presence. Tweets were used to create awareness of the community barbeques and volunteer activities in the Peterborough and Toronto communities.

A variety of information was shared via social media such as:
- Job Opportunities;
- Engineering Monthly Employee Profiles;
- News;
- Community Activities (BBQs, CLC, etc.); and
- Information about BWXT NEC's capabilities, products and services.

3.1.9 Public Disclosures Protocol

BWXT NEC has a Public Disclosure Protocol [10] in place that sets out guidelines to providing timely information to interested members of the public and other stakeholders. Disclosures are posted to the Company website and emailed to a distribution list of interested individuals and groups.

Information about the Public Disclosure Protocol is made available on the website along with any disclosures made.

3.2 Indigenous Relations

BWXT Canada and BWXT NEC together joined the Canadian Council of Aboriginal Business (CCAB) in September 2017 and are actively working towards becoming Progressive Aboriginal Relations (PAR) certified. Currently the company is PAR Committed – which signifies commitment to continual improvement in Indigenous relations and intention to undergo external verification of performance in the future.

A PAR Committee was established and a Canada-wide company policy for Indigenous Relations was developed in 2017 which is publicly available on BWXT NEC's website. This program

supports BWXT NEC's commitment to engaging Indigenous stakeholders and building and sustaining meaningful long-term relationships. Additionally, the company joined the Indigenous Relations Suppliers Network established by Bruce Power in 2017.

3.3 Financial Guarantee

BWXT NEC is required to maintain a financial guarantee for decommissioning that is acceptable to the Commission. Since the last renewal, BWXT Canada Ltd. completed the acquisition of GEH-C and the Commission approved the transfer of GEH-C's operating licence to BWXT NEC. As a result of the amalgamation and formation of BWXT NEC in December 2016, a replacement financial guarantee reflecting the corporate name change was provided in January 2017 in accordance with CNSC guidance document G-206, "Financial Guarantees for the Decommissioning of Licensed Activities" [70]. The amount of the replacement financial guarantee was unchanged and is based on preliminary decommissioning plans previously accepted by the CNSC (note, plan updates are required every 5 years). The financial guarantee will be reviewed in conjunction with the update to the Preliminary Decommissioning Plans currently underway (reference Section 2.11.2).

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Appendix A: Acronyms and Abbreviations

ALARA	As Low As Reasonably Achievable
BMS	Business Management System
BWXT NEC	BWXT Nuclear Energy Canada Inc.
BWR	Boiling Water Reactor
CANDU	Canada Deuterium Uranium
CCAB	Canadian Council of Aboriginal Business
CCME	Canadian Council of Ministers of the Environment
CLC	Community Liaison Committee
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CTS	Critical to Safety
DRL	Derived Release Limit
EAM(P)	Enterprise Asset Management (Program)
EHS	Environment, Health and Safety
EMS	Environmental Management System
ERA	Environmental Risk Assessment
FHA	Fire Hazards Analysis
FSA	Facility Safety Analysis
GE	General Electric
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
IAEA	International Atomic Energy Agency
LAQA	Licenced Activity Quality Assurance
LCH	Licence Conditions Handbook
Mg	Megagrams
NEW	Nuclear Energy Worker
NFPA	National Fire Protection Association
NSCA	Nuclear Safety and Control Act
PAR	Progressive Aboriginal Relations

PIP	Public Information Program
OPEX	Operating Experience
QA	Quality Assurance
SAT	Systematic Approach to Training
SCA	Safety and Control Area
TLD	Thermoluminescent Dosimeter
UO_2	Uranium Dioxide
WHMIS	Workplace Hazardous Material Information System
WSC	Workplace Safety Committee

Appendix B: Licence Renewal Application Requirements Matrix

Pursuant to subsection 3 of the General Nuclear Safety and Control Regulations Licences – General Application Requirements	
3 (1) An application for a licence shall contain the following information:	
a) the applicant's name and business address;	Application Section 1.2
b) the activity to be licensed and its purpose;	Application Section 1.2, 1.3, 1.4 and 1.5
c) the name, maximum quantity and form of any nuclear substance to be encompassed by the licence;	Application Section 1.5
d) a description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence;	Application Section 1.2, 1.3 and 1.4
e) the proposed measures to ensure compliance with the Radiation Protection Regulations, the Nuclear Security Regulations and the Packaging and Transport of Nuclear Substances Regulations, 2015;	Application Section 2.7, 2.12 and 2.14
f) any proposed action level for the purpose of section 6 of the Radiation Protection Regulations;	Application Section 2.7.6
g) the proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information;	Application Section 2.7 and 2.12
h) the proposed measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information;	Application Section 2.12
i) a description and the results of any test, analysis or calculation performed to substantiate the information included in the application;	Application Sections 2.4, 2.7, 2.9, and 2.11
j) the name, quantity, form, origin 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;	Application Section 2.4 and 2.11
k) the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the Act and the Regulations made under the Act, including the internal allocation of functions, responsibilities and authority;	Application Section 2.1.1
l) a description of any proposed financial guarantee relating to the activity to be licensed; and	Application Section 3.3
m) any other information required by the Act or the Regulations made under the Act for the activity to be licensed and the nuclear substance, nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence.	N/A

Pursuant to subsection 3(1.1) of the General Nuclear Safety and Control Regulations Other Information Requested by CNSC Staff	
N/A	N/A

Pursuant to subsection 15 of the General Nuclear Safety and Control Regulations Obligations – Representatives of Applicants and Licensees	
15 Every applicant for a licence and every licensee shall notify the Commission of:	
a) the persons who have authority to act for them in their dealings with the Commission;	Application Section 2.1.1
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; and	Application Section 2.1.1
c) any change in the information referred to in paragraphs (a) and (b), within 15 days after the change occurs.	Notification is provided within 15 days of any change of relevant information.

Pursuant to subsection 3 of the Class I Nuclear Facilities Regulations Licence Applications – General Requirements	
3 An application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the following information in addition to the information required by section 3 of the *General Nuclear Safety and Control Regulations*:	
a) a description of the site of the activity to be licensed, including the location of any exclusion zone and any structures within that zone;	Application Section 1.2, 1.3 and 1.4
b) plans showing the location, perimeter, areas, structures and systems of the nuclear facility;	Application Section 1.2 and 1.3
c) evidence that the applicant is the owner of the site or has authority from the owner of the site to carry on the activity to be licensed;	Application Section 1.2
d) the proposed management system for the activity to be licensed, including measures to promote and support safety culture; (d.1) the proposed human performance program for the activity to be licensed, including measures to ensure workers' fitness for duty.	Application Section 2.1 and 2.2
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;	Application Section 2.4
f) the proposed worker health and safety policies and procedures;	Application Section 2.8
g) the proposed environmental protection policies and procedures;	Application Section 2.9
h) the proposed effluent and environmental monitoring programs;	Application Section 2.9

Pursuant to subsection 3 of the Class I Nuclear Facilities Regulations Licence Applications – General Requirements	
i) if the application is in respect of a nuclear facility referred to in paragraph 2(b) of the Nuclear Security Regulations, the information required by section 3 of those Regulations;	N/A
j) 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; and	Application Section 2.1.3
k) the proposed plan for the decommissioning of the nuclear facility or of the site.	Application Section 2.11.2 and 3.3

Pursuant to subsection 6 of the Class I Nuclear Facilities Regulations Licence Applications – Licence to Operate	
6 An application for a licence to operate a Class I nuclear facility shall contain the following information in addition to the information required by section 3:	
a) a description of the structures at the nuclear facility, including their design and their design operating conditions;	Application Section 1.2, 1.3, 1.4, 2.4, 2.5, and 2.6
b) a description of the systems and equipment at the nuclear facility, including their design and their design operating conditions;	Application Section 1.2, 1.3, 1.4, 2.4, 2.5, and 2.6
c) a final safety analysis report demonstrating the adequacy of the design of the nuclear facility;	Application Section 2.4
d) the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility;	Application Section 2.1, 2.2, 2.3, 2.5, and 2.6
e) the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances;	Application Section 2.2, 2.3, 2.7, 2.14
f) the proposed measures to facilitate Canada's compliance with any applicable safeguards agreement;	Application Section 2.13
g) the proposed commissioning program for the systems and equipment that will be used at the nuclear facility;	Application Section 2.5
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;	Application Section 2.4, 2.7, 2.9
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;	Application Section 2.4, 2.9
j) the proposed measures to control releases of nuclear substances and hazardous substances into the environment;	Application Section 2.4, 2.9

Pursuant to subsection 6 of the Class I Nuclear Facilities Regulations Licence Applications – Licence to Operate	
k) the 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:	
i) assist off-site authorities in planning and preparing to limit the effects of an accidental release;	Application Section 2.4, 2.9, 2.10
ii) notify off-site authorities of an accidental release or the imminence of an accidental release;	Application Section 2.4, 2.9, 2.10
iii) report information to off-site authorities during and after an accidental release;	Application Section 2.4, 2.9, 2.10
iv) assist off-site authorities in dealing with the effects of an accidental release; and	Application Section 2.4, 2.9, 2.10
v) test the implementation of the measures to prevent or mitigate the effects of an accidental release;	Application Section 2.4, 2.9, 2.10
l) the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility, including measures to alert the licensee to such acts;	Application Section 2.12
m) the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers; and	Application Section 2.2
n) 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.	Application Section 2.2

Pursuant to subsection 3 of the Nuclear Substances and Radiation Devices Regulations Licence Applications – General Requirements	
3 (1) An application for a licence in respect of a nuclear substance or a radiation device, other than a licence to service a radiation device, shall contain the following information in addition to the information required by section 3 of the *General Nuclear Safety and Control Regulations*:	
a) the methods, procedures and equipment that will be used to carry on the activity to be licensed;	Application Section 2.4, 2.9, 2.10 Information provided in the Radiation Protection Program Manual [29]
b) the methods, procedures and equipment that will be used while carrying on the activity to be licensed, or during and following an accident, to:	
i) monitor the release of any radioactive nuclear substance from the site of the activity to be licensed;	Application Section 2.7, 2.9, 2.10

Pursuant to subsection 3 of the Nuclear Substances and Radiation Devices Regulations Licence Applications – General Requirements	
ii) detect the presence of and record the radiation dose rate and quantity in becquerels of radioactive nuclear substances at the site of the activity to be licensed;	Application Section 2.7
iii) limit the spread of radioactive contamination within and from the site of the activity to be licensed; and	Application Section 2.4, 2.7, 2.9, 2.10, and 2.11
iv) decontaminate any person, site or equipment contaminated as a result of the activity to be licensed;	Application Section 2.4, 2.7, 2.9, 2.10, and 2.11
c) a description of the circumstances in which the decontamination referred to in subparagraph (b)(iv) will be carried out;	Application Section 2.4, 2.7, 2.9, 2.10, and 2.11
d) the proposed location of the activity to be licensed, including a description of the site;	Application Section 1.2, 1.3, 1.4 and 1.5
e) the roles, responsibilities, duties, qualifications and experience of workers;	Application Section 2.2
f) the proposed training program for workers;	Application Section 2.2
g) the proposed instructions for dealing with accidents, including fires and spills, in which the nuclear substance may be involved;	Application Section 2.4, 2.7, 2.9, and 2.10
h) the proposed inspection program for the equipment and systems that will be used to carry on the activity to be licensed;	Application Section 2.5, 2.6, 2.7, and 2.9
i) the methods, procedures and equipment that will be used to calibrate radiation survey meters in accordance with these Regulations;	Information provided in the Radiation Protection program Manual [29] and applicable referenced documents
j) the methods, procedures and equipment that will be used to calibrate and verify the calibration of dosimeters referred to in paragraphs 30(3)(d) and (e);	Information provided in the Radiation Protection program Manual [29] and applicable referenced documents
k) the methods, procedures and equipment that will be used to conduct the leak tests and surveys required by these Regulations;	Information provided in the Radiation Protection program Manual [29] and applicable referenced documents
l) where the application is in respect of a nuclear substance that is an unsealed source and that is to be used in a room, the proposed design of the room;	Information provided in the Radiation Protection program Manual [29] and applicable referenced documents
m) if the application is in respect of a nuclear substance that is contained in a radiation device, the brand name and model number of the radiation device, and the quantity of the devices;	Information provided in the Radiation Protection program Manual [29] and applicable referenced documents
n) where the application is in respect of Category I, II or III nuclear material, as defined in section 1 of the Nuclear Security Regulations,	
i) the measures that will be taken to prevent nuclear criticality; and	N/A
ii) the information required by section 3 or 4 of the Nuclear Security Regulations, as applicable;	N/A
o) if the applicant will be manufacturing or distributing radiation devices referred to in paragraph 5(1)(c) or section 6 or 7, or check	N/A

Pursuant to subsection 3 of the Nuclear Substances and Radiation Devices Regulations **Licence Applications – General Requirements**	
sources mentioned in section 8.1, the proposed procedure for the disposal of each radiation device or check source or for its return to the manufacturer.	

Pursuant to part 2 of the Nuclear Security Regulations **PART 2 SECURITY OF NUCLEAR FACILITIES LISTED IN SCHEDULE 2 – LICENCE APPLICATIONS**	
41 An application for a licence in respect of a nuclear facility shall contain, in addition to the information required by sections 3 to 8 of the *Class I Nuclear Facilities Regulations*, a description of the physical protection measures to be taken to ensure compliance with sections 42 to 48.	Application Section 2.12