Nuclear Energy Canada Inc.

Annual Compliance Monitoring Report

January 1 to December 31

2019

The information contained in this report concerns the performance and operation of BWXT Nuclear Energy Canada Inc.'s (BWXT NEC) Class IB nuclear facilities located in Toronto and Peterborough, Ontario. This report is prepared to meet fuel fabrication operating licence FFOL-3620.01/2020 condition 2.4. The content demonstrates adherence to the BWXT NEC commitment to operate safe Class IB nuclear facilities, as well as demonstrate compliance with applicable regulations and licence conditions specified by the Canadian Nuclear Safety Commission.

Peterborough & Toronto

Revision	Description	Prepared by Date	Approved by Date
00	Initial Issue	S. Rheubottom 2020-03-30	D. Snopek 2020-03-30

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Submitted to:

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1 EXECUTIVE SUMMARY

BWXT Nuclear Energy Canada Inc. (BWXT NEC) 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, business and the Canadian economy. BWXT NEC operates in three plant locations: Arnprior, Toronto and Peterborough, Ontario. BWXT NEC's Toronto and Peterborough facilities are Class IB nuclear facility operations. The operating licence 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 in Toronto at 1025 Lansdowne Ave., and produce and test fuel bundles in Peterborough at 1160 Monaghan Rd. The Peterborough facility is additionally authorized to receive, repair, modify and return contaminated equipment from off-site nuclear facilities.

The purpose of this compliance report is to demonstrate that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, associated regulations and the Class IB Nuclear Fuel Facility Operating Licence FFOL-3620.01/2020 revised by the CNSC on December 16, 2016, and expiring December 31, 2020. This report is prepared based on the CNSC's *Annual Compliance Monitoring and Operational Performance Reporting Requirements for Class I A & B Nuclear Facilities* and REGDOC-3.1.2 *Reporting Requirements, Volume I: Non-Power Reactor Class 1 Nuclear Facilities and Uranium Mines and Mills*. Appendices containing confidential and proprietary information are submitted to the CNSC separately.

BWXT NEC is committed to continuously improve systems to protect employees, the environment and our communities against environmental, health and safety hazards. We work to implement programs and objectives to conserve natural resources, prevent pollution and minimize waste. Maintaining a safe and healthy work environment for our employees is a top business priority. BWXT has implemented a business management system that defines the requirements of the quality assurance program for the licensed activity, which ensures applicable buildings and facilities, process equipment, and processes used in support of licensed activities are conducted in accordance with the Nuclear Safety Control Act and regulations, applicable CNSC requirements, jurisdictional requirements and compliance best practices.

No significant operational changes occurred at either facility. Upgrades were made to programs with the objective of achieving continuous improvement and environmental health and safety excellence. Details are provided in the main sections of this report. Changes made to the physical facilities, equipment, processes, procedures or practices that could impact employee health and safety, the environment or the public as a result of the operation of the facilities are assessed through the business-wide Change Control program.

BWXT NEC has established facility specific CNSC approved A*ction Levels* for various radiological and environmental parameters. An Action Level is defined in the Radiation Protection Regulations "as 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 also applied to environmental protection. Action Levels are facility-specific and set below regulatory limits; however, they are CNSC reportable events. Accordingly, BWXT NEC has established *Internal Control Levels* for various radiological and environmental parameters that are set even lower than Action Levels to act as an early warning system. Internal Control Level exceedances result in internal investigation and correction and are not CNSC reportable events.

Employee workplace radiation exposures are measured by CNSC approved methods and systems. Overall, dose trends are favourable and consistent with an effective application of the ALARA (As Low as Reasonably Achievable - Social and Economic Factors considered) principle. All measured radiation exposures received by personnel in the reporting period were within regulatory limits and below Action Levels.

BWXT NEC has established conventional health and safety programs to manage the non-radiological workplace safety hazards to protect personnel. Key performance indicators are used to measure the success of the programs throughout the year. Both sites had zero lost time injuries in 2019.

BWXT NEC recognizes that an effective way of maintaining public trust is to maintain environmental excellence. This requires a demonstrated commitment to operating in accordance with the highest environment, health and safety standards. The facilities maintain effective environmental management systems to achieve environmental goals and objectives and keep all environmental impacts well within applicable standards and as low as reasonably achievable. These programs demonstrate compliance to relevant federal and provincial legislation. Environmental protection programs are also compliant with the following standards:

- CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*
- CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills*
- CSA N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*,

Air and water emissions are routinely measured from both facilities to demonstrate compliance with the CNSC's environmental protection requirements and the ALARA principle. Annual releases were a very small fraction of regulatory limits and all measurements were below Action Levels. Soil samples were taken surrounding the Toronto plant with all measurements within applicable guidelines.

Established emergency response plans are in place that describe the actions to be taken to minimize health, safety and environmental hazards to workers and local members of the public, which may result from fires, explosions, or the release of hazardous materials. The plans intend to reduce the risk of emergencies such as fires, and assist emergency staff and plant personnel in understanding key emergency response issues. The plans assist the facilities in protecting employees, the local community and the environment through sound emergency management practices. The emergency response plans were developed in accordance with CNSC operating licence requirements.

BWXT NEC has implemented and maintains a safeguards program and undertakes all required measures to ensure safeguards implementation in accordance with International Atomic Energy Agency (IAEA) commitments and CNSC regulatory document 2.13.1 *Safeguards and Nuclear Material Accountancy.* Movement (inventory changes) of natural and depleted uranium are documented and reported to the CNSC as required. The IAEA and the CNSC jointly conduct annual verifications.

BWXT NEC safely transports dangerous goods, including Class 7 radioactive material shipments as governed by the *Transportation of Dangerous Goods (TDG)* Act and Regulations and the Packaging and Transport of Nuclear Substances Regulations. Shipments occur routinely between suppliers and the Toronto and Peterborough facilities, customers and waste vendors.

BWXT NEC places great importance on its relationships with all levels of local government and residents in the communities in which it operates and works to ensure there is open communication and awareness of BWXT NEC's operating activities. The public information program defines the process for providing information about BWXT NEC operations. Public interest in both facilities was high during the reporting period. Enquiries were tracked and responded to as timely as possible. The Community Liaison Committee (Toronto), whose mandate is to provide a forum for a cross-section of neighbours and other community stakeholders to share information and ideas, continued to meet regularly.

This compliance monitoring report demonstrates that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, regulations and CNSC Class IB Nuclear Fuel Facility Operating Licence conditions.

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2 INTRODUCTION

The purpose of this compliance monitoring report is to demonstrate that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, associated regulations and the Class IB Nuclear Fuel Facility Operating Licence FFOL-3620.01/2020 revised by the Canadian Nuclear Safety Commission (CNSC) on December 16, 2016, and expiring December 31, 2020. This report is prepared based on the CNSC's *Annual Compliance Monitoring and Operational Performance Reporting Requirements for Class I A & B Nuclear Facilities* and REGDOC-3.1.2 *Reporting Requirements, Volume I: Non-Power Reactor Class 1 Nuclear Facilities and Uranium Mines and Mills*. Appendices containing confidential and proprietary information are submitted to the CNSC separately.

BWXT Nuclear Energy Canada Inc. (BWXT NEC) 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, business and the Canadian economy. BWXT NEC operates in three plant locations: Arnprior, Toronto and Peterborough, Ontario. BWXT NEC's Toronto and Peterborough facilities are Class IB nuclear facility operations. Nuclear substance use is regulated federally by the Nuclear Safety and Control Act and regulations through the CNSC. BWXT NEC's current licence was granted on January 1, 2011, revised by the CNSC on December 16, 2016 and expires on December 31, 2020. In November 2018, BWXT NEC submitted an application seeking a 10-year renewal of the licence. The current CNSC operating licence authorizes BWXT NEC to operate and modify its nuclear fuel facility to produce natural and depleted uranium dioxide (UO_2) pellets in Toronto at 1025 Lansdowne Avenue (Figure 1), and produce and test fuel bundles in Peterborough at 1160 Monaghan Road (Figure 2). Finished bundles are then shipped to various customers. The Peterborough facility is additionally authorized to receive, repair, modify and return contaminated equipment from off-site nuclear facilities.

The Toronto facility is located in a mixed industrial, commercial, and residential area in west-central Toronto (Figure 1). The facility consists of two separate buildings, which are identified as Building 7 and Building 9. Building 7 houses uranium dioxide pellet manufacturing on the first, second and third floors and office space on the fourth floor. Building 9 is a warehouse used for the storage of uranium dioxide as miscellaneous scrap awaiting reprocessing or shipment for disposal, compaction of waste, and decontamination activities.

Figure 1: BWXT NEC Toronto

The Peterborough facility is located in a mixed industrial, commercial, and residential area in west-central Peterborough (Figure 2). The buildings are located on the existing General Electric (GE) plant complex. The licensed facility consists of four buildings; Building 21, 24, 26 and 28, which are leased from GE. Building 21 is a two-floor building and houses the uranium fuel bundle manufacturing operation on the first floor and office personnel on the second floor. Building 24 is a one floor warehouse used to store radioactive material including completed uranium fuel bundles, sealed drums of Uranium Dioxide powder, and contaminated equipment as required. Building 26 is principally a conventional fabrication and assembly operation. It also houses manufacturing equipment and facilities for the repair of contaminated equipment. Building 28 houses the main shipping and receiving docks for Building 26 and non-radioactive materials. It is directly accessible through Building 26.

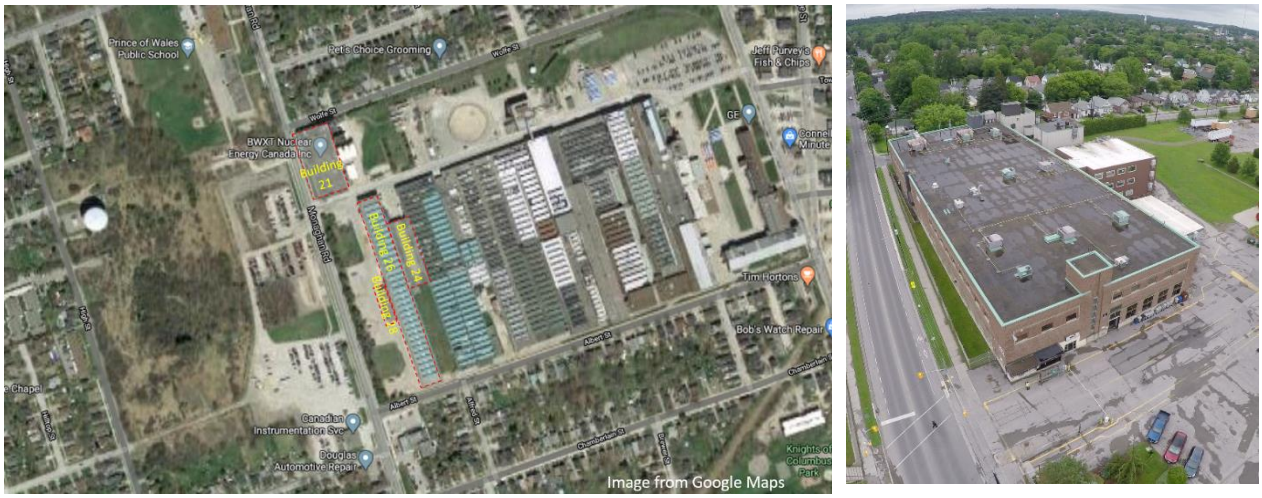

Figure 2: BWXT NEC Peterborough

There were no significant modifications or changes to the site or facilities. There were no changes to the facility operating licence in 2019.

2.1 Processes and Materials

The Toronto facility processes natural and depleted UO_2 powder 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. BWXT NEC also can periodically ship natural uranium pellets to the United States of America for use in Boiling Water (BWR) commercial power reactors. See Figure 3 for the process.

Uranium Dioxide
Fuel Pellet Fabrication Flow

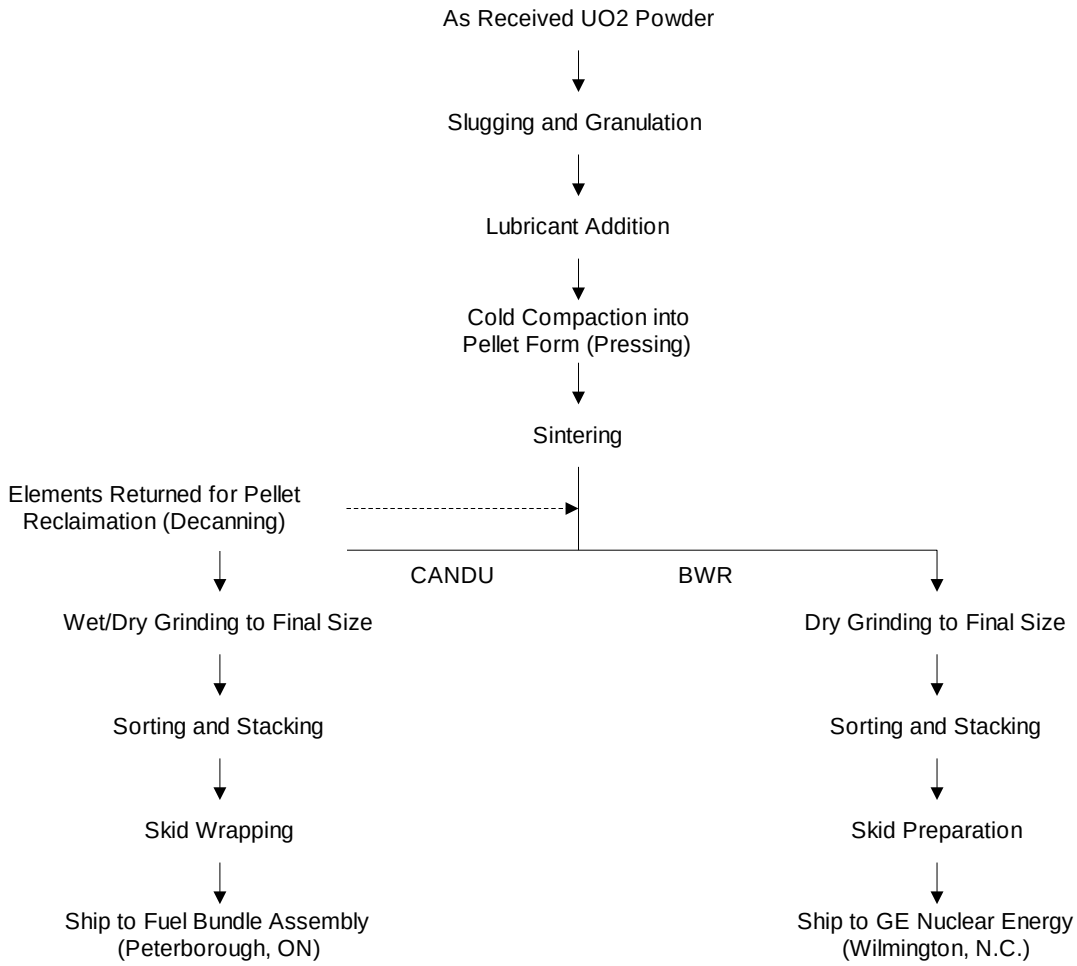

Figure 3: Uranium Fuel Pellet Manufacturing Process

At the Peterborough facility, fuel manufacturing operations involve the loading of fuel pellets into Zircaloy tubes, sealing, 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.

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

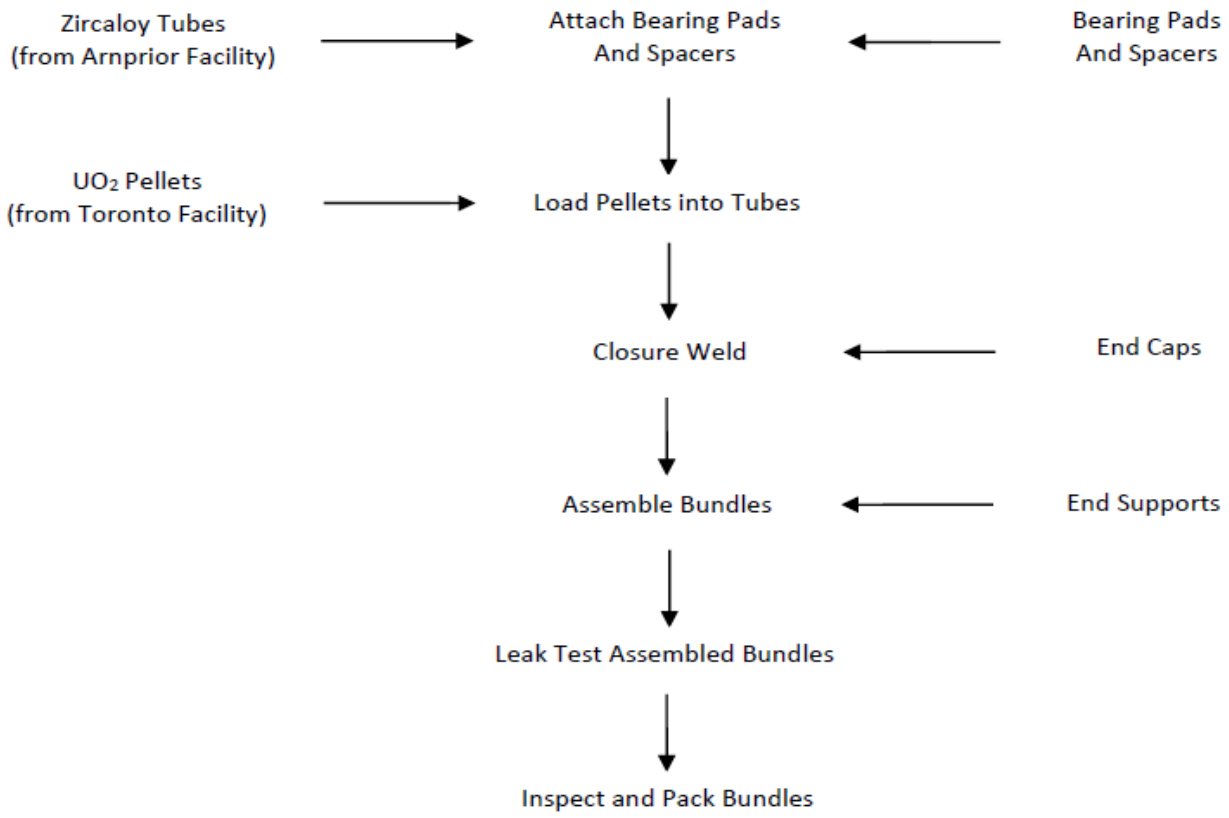

Figure 4: Fuel Bundle Fabrication Process

BWXT NEC is federally regulated for health and safety. The federal health and safety legislation is the Canada Labour Code Part II and the Canada Occupational Health and Safety Regulations. The Canada Labour Code is enforced by Employment and Social Development Canada. The purpose of Part II of the *Canada Labour Code* is to prevent accidents and injury to health arising out of, linked with or occurring in the course of employment. BWXT NEC facilities are also regulated federally by Transport Canada. BWXT NEC is additionally regulated environmentally through municipal Sewer Use Bylaws and provincially by the Ontario Ministry of the Environment, Conservation and Parks (MECP).

BWXT NEC is committed to the establishment and continuous improvement of a healthy Safety Culture. Safety Culture refers to the core values and behaviours resulting from a collective commitment by our company's leaders and individuals to emphasize safety, quality, ethics, and security over competing goals to ensure protection of people and the environment. The Environment, Health and Safety (EHS) Mission

Statement defines it as a top business priority to continuously improve our EHS systems to protect fellow employees, the environment, and our communities against known and potential environmental, health and safety hazards. The BWXT NEC management team reviews, prioritizes and controls workplace hazards and ensures compliance with the pertinent regulatory requirements, applicable codes and company policies.

The primary facility potential radiological hazard from uranium is the inhalation of airborne UO_2 particles. Measurements are performed for airborne and surface traces of uranium as an indicator of process containment efficiency. Urine samples provided by employees are used to indicate if inhalation may have occurred. A lesser potential radiological hazard exists in the form of low-level external gamma and beta radiation exposure to employees. Whole body, skin and extremity dose measurements are conducted to demonstrate compliance with the dose limits specified in the Radiation Protection Regulations and the ALARA principle. All dose measurement results for employees were below regulatory limits and Action Levels.

Air and water emissions are routinely measured to demonstrate regulatory compliance and the ALARA principle. Annual releases were a small fraction of regulatory limits and all measurements were below Action Levels.

Table 1 defines the acronyms used in this report.

Acronym	Definition
ALARA	As Low as Reasonably Achievable (social and economic factors considered)
ATS	Action Tracking System
BWXT NEC	BWXT Nuclear Energy Canada Inc.
CANDU	CANadian Deuterium Uranium
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
dpm	Disintegrations per minute
EHS	Environment, Health and Safety
FHA	Fire Hazards Analysis
IAEA	International Atomic Energy Agency
MECP	Ministry of the Environment, Conservation and Parks
mSv	milliSievert – unit of measure for radiation dose 1 mSv = 0.001 Sv
NEW	Nuclear Energy Worker
PDP	Preliminary Decommissioning Plan
POI	Point of impingement
ppm	Parts per million

Acronym	Definition
QA	Quality Assurance
RSI	Radiation Safety Instruction
SAT	Systematic Approach to Training
SSC	Systems, structures and components
TDG	Transportation of Dangerous Goods
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
UO_2	Uranium Dioxide
µSv	microSievert – unit of measure of radiation dose 1 µSv = 0.001 mSv = 0.000001 Sv
WSC	Workplace Safety Committee

Table 1: Definition of Acronyms

3 SAFETY AND CONTROL AREAS

3.1 Operating Performance

The "Operating Performance" Safety and Control Area covers an overall review of the operations licensed activities.

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 Business Management System) 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.

Over the reporting period, BWXT NEC continued to operate in a manner that supports the company mission to continuously improve EHS systems to protect fellow employees, the environment, and communities against known and potential environmental, health and safety hazards. Operating performance is monitored with key performance indicators and program goals. In accordance with EHS program requirements, internal audits and self-assessments are conducted routinely to assess conformance to internal and external requirements. Related licensed activity audits and self-assessments are summarized in subsequent sections.

The BWXT NEC management team continued to review, prioritize and control workplace hazards and ensure compliance with the pertinent regulatory requirements, applicable codes and company policies. Reporting of EHS-related concerns is encouraged through a rewards program. These are assigned and tracked to completion in the Gensuite® software system and is used as a measure of employee engagement.

Facility operations continued routinely and safely without any significant challenges. UO_2 pellets were shipped to BWXT NEC's Peterborough facility without incident. The pellets were assembled into CANDU reactor fuel bundles and were then safely shipped to customers. Plant personnel followed procedures satisfactorily, as reflected in internal and external audits, self-assessments, radiation surveys, contamination monitoring, air sampling measurements and other safety inspections. Details are provided in subsequent sections of this report. There were no Action Level exceedances. Unplanned events occurred over the reporting period, as follows (previously reported to the CNSC):

1) A personal air sample for an Operator in the Beryllium area was above the Occupational Exposure Limit. Subsequent investigation showed that the local ventilation equipment needed adjustment and was upgraded to increase the capture efficiency. This improvement was found to be effective and continues to be monitored.

During the reporting period, there were no significant modifications made to the Toronto facility. In Peterborough, a small ancillary area of building 21 was reconfigured to produce molybdenum metal targets for subsequent use in producing medical isotopes at a separately licensed nuclear facility.

The President of BWXT NEC is responsible for all activities within the company. The various functional groups, such as Human Resources, EHS, Quality and Communications report directly or indirectly to the President. Senior Management accountability for the effectiveness of the management systems is defined. The Director, EHS & Regulatory is responsible for the overall EHS program.

The following key position changes occurred:

- In February 2019 the Manager of Community Relations & Communications left the business and these responsibilities were assumed by Natalie Cutler, Director of Communications & Government Relations.
- In August 2019, the Director, Fuel Handling & Engineered Solutions role was vacated, filled temporarily by the President John MacQuarrie and filled permanently by Brett Jermyn in the first quarter of 2020. This role is lead for all of Fuel Handling & Engineered Solutions engineering, manufacturing and supporting teams.

During the reporting period, there were no pertinent modifications to the company organization structure. The company senior management organization structure is shown in Figure 5.

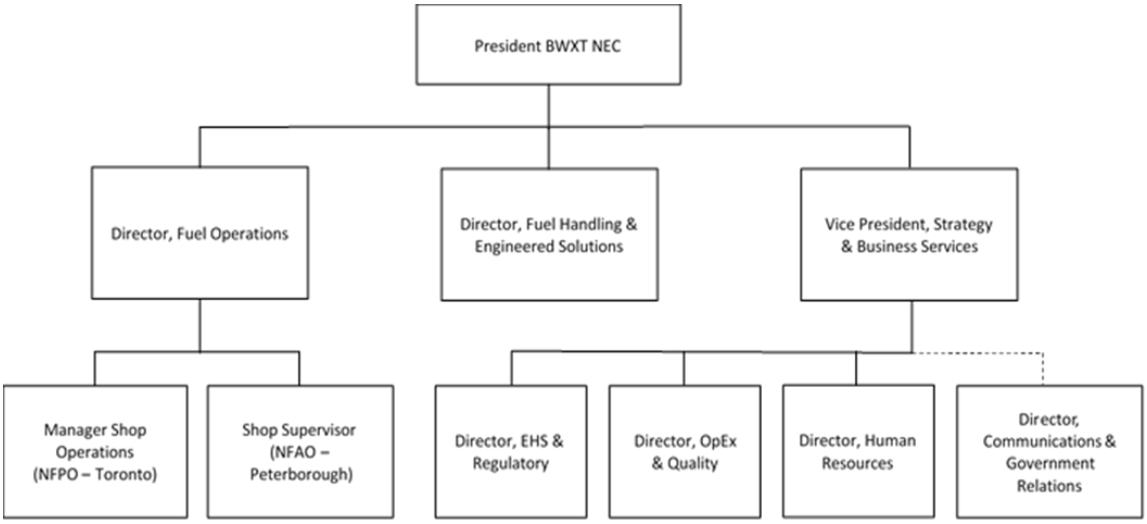

Figure 5: BWXT NEC Organization Structure

BWXT NEC maintains five EHS related committees that review activities including proposed changes to ensure safe plant operations. They are:

- Health and Safety Policy Committee - comprised of unionized workers and management to contribute to making the company as safe as possible by promoting health and safety awareness, making recommendations to workers and management regarding policies and procedures for safe working practices
- Workplace Safety Committee (WSC) - comprised of unionized workers and management to prevent accidents and occupational illness by promoting health and safety awareness, making recommendations to workers and management regarding safe work practices and monitoring health and safety issues until resolved
- As Low as Reasonably Achievable (ALARA) Committee - comprised of unionized workers and management to continuously improve the radiation safety program and implement ALARA practices where practical to ensure that radiation doses are as low as reasonably achievable.
- Beryllium Safety Committee – comprised of unionized workers and management to continuously improve the beryllium safety program and reduce potential beryllium hazards to workers at the Peterborough site.
- Ergonomics Committee - comprised of unionized workers and management to develop, monitor and administer the ergonomic procedure and recognize, reduce and where possible eliminate physical and cognitive ergonomic risk factors.

3.1.1 Possession and Processing

All possession and monthly processing limits, as specified in the CNSC facility operating licence were met. Production data is proprietary and is provided separately to the CNSC in Appendix A.

Production shutdowns are scheduled periodically throughout the year for engineering projects, equipment maintenance and continuous improvements. In the reporting period, there were five weeks of production shutdowns at each site. There was one week in the first quarter, one week in the second quarter, two weeks in the third quarter and one week in the fourth quarter.

3.1.2 Regulatory Inspections

Excluding safeguards related inspections, which are described in section 3.13 of this report, the CNSC completed three routine inspections at both Toronto and Peterborough sites.

1. The first was a general inspection with a focus on selected elements from the following safety and control areas: Operating Performance, Physical Design, Radiation Protection, Conventional Health & Safety, Environmental Protection, Emergency Management & Fire Protection. Two Action Notices were raised with respect to beryllium surface contamination Internal Control Levels (Peterborough) and labelling of waste containers (Toronto).
2. The second inspection was to provide an overall assessment of compliance with specific clauses of the *Nuclear Safety and Control Act*, and its regulations, the operating licence and associated licence conditions handbook, as well as BWXT's programs and procedures related to the Management System. The inspection also reviewed the implementation and effectiveness of corrective actions that arose from enforcement actions from previous inspections or past reported events and particularly focused on purchasing and inventory controls and the process for receiving critical to safety items. Three Action Notices were raised. These were related to both site's consistencies in documentation, processes for managing counterfeit, fraudulent and suspect items, and recordkeeping of packing slips in Peterborough.

3. The third inspection was a general compliance inspection with a focus on radiation protection. No Action Notices were raised.

Corrective and preventive actions related to Action Notices are submitted to the CNSC and tracked to closure in the site's Action Tracking System (ATS).

In addition, at the Toronto facility, Transport Canada assessed compliance with the Transportation of Dangerous Goods Act and regulations. There were no non-compliances identified.

3.2 Management System

The "Management System" Safety and Control Area covers the framework which establishes the processes and programs required to ensure that the organization achieves its safety objectives and continuously monitors its performance against these objectives, as well as fostering a healthy safety culture.

The management system defines the requirements of the quality assurance (QA) program for the licensed activity, which ensures applicable buildings and facilities, process equipment, and processes used in support of licensed activities are conducted in accordance with the Nuclear Safety Control Act and regulations, applicable CNSC requirements, jurisdictional requirements and compliance best practices. A graded approach is used in the application of the management system program elements, such that the requirements are applied in a manner commensurate with the safety significance of the licensed activity, system, component or structure. The management system is comprised of the following core program elements:

1. Organization and Responsibilities
2. Personnel Capability
3. Use of Experience
4. Work Planning Control
5. Work Processes Control
6. Verification
7. Problem Identification and Resolution
8. Corrective Action
9. Change Control
10. Document Control and Records
11. Audits
12. Management Self-Assessment
13. Management Program Review
14. Supply Chain

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. The company senior management organization structure is shown in Figure 5.

The management system is fully implemented and compliant with Canadian Standards Association (CSA) N286-12, *Management System Requirements for Nuclear Facilities*. All management system documentation required by operating licence condition 2.1 is in place. Continuous improvement is achieved through several review processes, including self-assessments, audits, incident investigations and management reviews. The EHS Policy establishes the direction for the management system. There were no major changes to the management system or responsibilities within during the reporting period.

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 is committed 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 3) Situational Awareness and 4) Self-Checking. BWXT NEC's commitment to a strong safety culture is measured by tools such as audits and self-assessments, use of experience and corrective action program metrics which measure the effects of safety culture improvements. External agencies such as the CNSC audit BWXT NEC operations against CSA standards which include Safety Culture requirements (e.g., CSA N286-12).

In the reporting period, the governing Licensed Activity QA program document was revised to improve compliance with CSA N286-12 requirements. Additionally, minor continuous improvements were made to the following procedures:

- Non-conformance and Corrective Action
- Change Control
- Document and Record Control
- Management Self-Assessment and Annual Management Program Review

Where required, revised documents were submitted to CNSC staff in accordance with the requirements in the Licence Conditions Handbook.

3.2.1 Licensed Activity Related Self-Assessments

The Self-Assessment program governs a proactive process for self-critical, candid and objective evaluation of performance by a functional area measuring their process performance against internal procedures, expectations, goals established from business plans or external benchmarking standards. The Self-Assessment Program is a management tool used to engage the workforce in early and proactive detection of organizational or systematic 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. A Self-Assessment schedule is prepared annually and ensures that each program element is reviewed periodically based on a risk-related approach. A summary of self-assessments conducted in the reporting period is provided in Table 2. The majority of identified non-conformances were related to improved documentation, new and improved training materials, improved implementation of administrative controls and improved consistency in procedures

between the two sites. All identified non-conformances are assigned and tracked to closure. There were no systemic deficiencies identified.

In addition to the Self-Assessment program, routine compliance reviews are completed against regulatory EHS requirements, such as general environmental, water management, safety management and emergency response. All identified non-conformances are assigned and tracked to closure.

Program Element		Number of Non-Conformances
Peterborough	Calibration Program	1
	Change Management	4
	Emergency Preparedness / Fire Protection	2
	Environmental Protection Program	0
	Hazardous Waste Management	1
	Procurement / Vendor Management	4
	Radiation Protection	1
Toronto	Calibration Program	2
	Change Management	4
	Emergency Preparedness / Fire Protection	1
	Environmental Protection Program	0
	Hazardous Waste Management	4
	Management Self-Assessments	2
	Radiation Protection	5
	Use of Experience	1
Total		32

Table 2: Summary of Self-Assessments

3.2.2 Licensed Activity Internal Audits

Internal auditing is an independent, objective activity designed to add value and continuously improve programs. Periodic assessment of program effectiveness is conducted through systematic internal audits that are planned and carried out on behalf of management to measure performance, the effectiveness of the program element processes and to promote continuous improvement. An audit schedule is prepared annually and ensures that each licensed activity program element is audited at least once every three years.

Table 3 provides a summary of internal audits conducted in the reporting period. The majority of identified non-conformances were related to the accuracy and detail in documentation, document and record control, non-conformance tracking, and improved consistency in procedures between the two sites. All identified non-conformances are assigned and tracked to closure. In addition, a review of all the findings is conducted as part of the management review to determine if any systemic deficiencies have been identified. Based on the review, continuous improvement opportunities are discussed and documented in the meeting minutes with actions tracked to closure.

	Audit Scope	Number of Non-Conformances
Peterborough	Critical to Safety Program	0
	Environmental Protection (Air Emissions)	1
	Radiation Protection (Dosimetry)	1
	Work Planning, Work Processes Control Practices and Verification	4
Toronto	Environmental Protection (Air Emissions)	2
	Management Self Assessments and Management Review	1
	Radiation Protection (Dosimetry)	2
	Total	11

Table 3: Summary of Internal Audits

BWXT NEC did not conduct any formal external audits of other facilities during the review period that related to the licensed activities at the facility.

3.2.3 Management Reviews

Management reviews for EHS program elements are conducted once annually before the end of April each year to review the previous calendar year activities. The EHS management reviews encompass the following items:

- Status and follow-up of actions from previous management reviews;
- Results of applicable external agency audits;
- Open regulatory compliance obligations;
- Results of “Reg Auditor” (Gensuite) compliance evaluations;
- 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 (Gensuite Action Tracking System items) for closure metrics;
- EHS related QA 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 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;
- Evaluation of the effectiveness and continuing suitability of the EHS Mission Statement and the Environment, Health and Safety Program, which includes the EHS management system and hazard prevention program.

The above inputs are reviewed to ensure continuing suitability, adequacy and effectiveness of the management system. The criteria for these are:

- **Suitable**: Does the system satisfy the requirements and represent the best way of doing things for our business?
- **Adequate:** Is the system fit for its current purpose?
- **Effective:** Does the system enable the right things to be done? Is it driving continuous improvement?

Formal meeting minutes are prepared. Actions are formally issued for follow-up by the applicable functional lead(s) and retained as a record. The previous management review meeting resulted in two actions that were formally issued for follow-up by the applicable functional lead(s), and tracked to closure in ATS. Overall, the implemented management system for the licensed activity program was considered suitable, adequate and effectively implemented at both facilities. Continuous improvement remains a priority.

3.3 Human Performance Management

The "Human Performance Management" Safety and Control Area covers activities that enable effective human performance, through the development and implementation of processes that ensure that BWXT NEC staff members are sufficient in numbers in all relevant job areas, and have the necessary knowledge, skills and tools in place to safely carry out their duties.

The training program is outlined in the Licensed Activity QA Manual, and business-wide training procedures. Qualifications and training requirements are identified and personnel are given the appropriate training to ensure they are competent at the work they do. This training includes on-the-job training, radiation protection and safety risk assessment training. Workers only perform functions for which they are qualified. Both facilities achieved 100% regulatory training completion in the reporting period. Compliance to regulatory training completion is a key performance indicator that is tracked throughout the year.

The focus for 2019 with respect to the Systematic Approach to Training (SAT) program was twofold. The first was to continue the effort to bring the remaining courses identified on the established schedule into compliance with SAT. The second was to continue to use the SAT program in the development of other new courses and when updating existing ones. Courses from the established schedule include Contamination Control, and Radiation Protection Manual Instrumentation & Quality Management. Other new courses included Contractor EHS Orientation, and WSC Responsibilities. Updated courses include Manufacturing Area Hazards Awareness, Local 524 (Assembly) Shop Operator role, and Manager of QA role.

During the reporting period, improvements were made to training content as a result of concerns, incidents or inspections. For example:

- The contractor training program was updated following a first aid which resulted from contractor equipment left on an overhead work surface at job completion (Peterborough).
- A new Hazardous Waste Management training course was implemented following repeated deficiencies in waste labelling by new employees (Peterborough).
- Additional training on emergency response protocols was provided following a drill (Toronto).

Key EHS course completion details are provided in Table 4.

Course Name	Number of Peterborough Employees Who Required Course (% Required Completed)	Number of Toronto Employees Who Required Course (% Required Completed)
Aerial Lift Practical	16 (100%)	8 (100%)
Aerial Lifts	19 (100%)	8 (100%)
Change Area Contamination Control	N/A	7 (100%)
Compressed Gas Safety	23 (100%)	7 (100%)
Electrical Safety 2.0 – Canada	74 (100%)	7 (100%)
Emergency and Disaster Preparedness – Canada	83 (100%)	9 (100%)
Emergency Response & Fire Prevention Awareness	N/A	7 (100%)
Fall Protection Advanced	20 (100%)	0
First Aid (Emergency)	14 (100%)	N/A
First Aid (Emergency Response Team)	12 (100%)	8 (100%)
Indoor Hoisting and Rigging – Canada	25 (100%)	0
Lockout Tagout (LOTO) Procedure	5 (100%)	0
Lockout/Tagout 2.0 – Canada	73 (100%)	8 (100%)
Lockout Tagout (LOTO) Try-Out Demonstration	22 (100%)	13 (100%)
Manufacturing Area Hazards Awareness (includes Radiation and Beryllium Safety)	270 (100%)	N/A
OHS for Managers and Supervisors (Canada Labour Code Part II)	0	0
Overhead Cranes Level 1 & Practical	0	N/A
Overhead Cranes Level 2 Fuel	2	N/A
Overhead Cranes Level 2 Services	22 (100%)	N/A

Course Name	Number of Peterborough Employees Who Required Course (% Required Completed)	Number of Toronto Employees Who Required Course (% Required Completed)
Overhead Cranes Level 2 Services Practical	20 (100%)	N/A
Portable Fire Extinguisher Training (Practical)	10 (100%)	N/A
Portable Fire Extinguishers – Canada	298 (100%)	48 (100%)
Powered Industrial Truck - Driving Evaluation	N/A	8 (100%)
Powered Industrial Truck Safety with Propane Handling	13 (100%)	N/A
Powered Walkie Stacker Safety	3 (100%)	N/A
Radiation Safety	N/A	48 (100%)
Respirator Selection Use and Care	0	2 (100%)
Respiratory Protection 2.0 - Canada	19 (100%)	7 (100%)
Security Awareness	51 (100%)	8 (100%)
Transportation of Dangerous Goods	10 (100%)	3 (100%)
Workplace Hazardous Materials Information System (WHMIS)	89 (100%)	8 (100%)
Workplace Hazardous Materials Information System (WHMIS) 2015	320 (100%)	49 (100%)

Table 4: Key Training Course Completion Summary

The facilities are staffed with a sufficient number of qualified workers as well as the minimum number of responsible people to carry on the licensed activities safely and in accordance with the Nuclear Safety and Control Act and its regulations. EHS and other staff are available after business hours as needed through cell phones and paging systems.

3.4 Safety Analysis

The "Safety Analysis" Safety and Control Area covers the maintenance of the safety analysis which supports the overall safety case for the facility. The safety analysis is a systematic evaluation of the potential hazards associated with the conduct of an activity or facility, and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards. The safety analyses utilize 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. In this way, impacts on the safety analysis are identified and the safety analysis is validated and updated, where necessary.

During the reporting period, a routine update of the safety analysis for the Toronto and Peterborough sites was completed. The molybdenum metal target operation, described in section 3.1, was included in the routine update. The safety analysis reports for both sites conclude that the engineered and administrative controls provide protection over a broad range of operating conditions that both restricts the likelihood of events and adequately protects the public and environment.

3.5 Physical Design

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

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 as a result of the operation of BWXT NEC's facilities are assessed through the Change Control program. Any changes to the design basis are identified and assessed by key stakeholders 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.

During the reporting period, there were no modifications to the physical plants that altered the design basis. The safety analyses for the facilities were updated during the period.

3.6 Fitness for Service

The "Fitness for Service" Safety and Control Area covers activities that impact on the physical condition of SSCs to ensure that they remain effective over time. This includes programs that ensure all equipment is available to perform its intended function when called upon to do so.

A Critical to Safety (CTS) program was implemented in 2016. 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 documentation 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.

The CTS program elements include the following:

- Process to identify CTS equipment;
- CTS inventory list revision control;
- Procurement controls governing ordering and incoming verification to confirm CTS equipment received matches the CTS equipment list requirements;
- Requirements in the established change management program 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.

Both facilities are using an asset management and preventive maintenance software system. Maintenance Connection® 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 components. Preventive maintenance tasks on CTS equipment are designated in this system as described in the business wide Enterprise Asset Management Program Procedure.

Certain CTS tasks have associated immediate independent post-maintenance verification or testing. For example, independent verification is in place on the ventilation systems during filter changes as well as following Toronto rotoclone ductwork maintenance.

In both Toronto and Peterborough, 99% of CTS tasks issued were completed within 14 days of the target completion date. All CTS tasks issued in the reporting period are closed.

Preventive maintenance is considered during the assessment of changes as part of the business-wide Change Control program. Additionally, in the event of a near miss, incident, injury, inspection or suggestion, the preventive maintenance program for related equipment is reviewed as applicable. As a result, during the reporting period, the following improvements to preventive maintenance tasks were implemented:

- A task to mop the floor following beryllium vacuum cleaner filter changes was added (Peterborough)
- A task to clean the downdraft table at the input end of the substrate furnace was added (Peterborough)
- A task to regularly replace the respirator cleaning scrub brush was added (Peterborough)
- A task to regularly wash the respirator cleaning bucket was added (Peterborough)
- A revision to the beryllium ventilation system inspection and filter change procedure to provide added detail of the safety related task steps was made (Peterborough)
- A revision to the coater cleaning procedure to provide clarity of cleaner and Technician task order was made (Peterborough)
- A new task for inspection and cleaning of the uranium pellet loading storage enclosures was added (Peterborough)
- New and revised tasks related to inspection and maintenance of the molybdenum metal target operation (Peterborough)
- A task was added to the monthly walkie-stacker (material handling equipment) procedure for maintenance to check the pins (Toronto)
- A new procedure was initiated to have maintenance check the press feed boot (Toronto)
- A new weekly maintenance task was initiated to conduct a functionality test on all the gas back-up generators (Toronto)

Managing aging means ensuring the availability of required safety functions throughout the service life of the plant, with account taken for changes that occur with time and use. Aging management applies to SSCs that can, directly or indirectly, have an adverse effect on the safe operation of the plant. The asset management program accounts for aging through the CTS program inspection, testing and maintenance

tasks. These processes provide warning signs and initiate corrective and preventive maintenance activities. Items identified for replacement are assessed through the Change Control program.

The preventive maintenance program is periodically assessed through self-assessments and internal audits, discussed in section 3.2 of this report. Key performance indicators are in place and are routinely reviewed. The program is adequate and effective and is continually improved.

3.7 Radiation Protection

The "Radiation Protection" Safety and Control Area covers the implementation of the radiation protection program, in accordance with the Radiation Protection Regulations. BWXT NEC has a well-established and effectively implemented radiation protection program, which includes a commitment to ALARA and continuous improvement. The program addresses the radiation hazards associated with UO_2. This program ensures that surface/airborne contamination and radiation doses to employees and the public are monitored and controlled. The Director, EHS and Regulatory, has oversight of BWXT NEC's radiation protection program.

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 facilities as appropriate. Workstation air monitoring is a key performance indicator that speaks to effective administrative and engineered controls. A respiratory protection program is in place in accordance with CSA Z94.4-18, *Selection, use, and care of respirators.* 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 potential 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.

Additionally, urine samples are regularly provided by employees to indicate if inhalation may have occurred. Sampling frequency ranges from weekly to once per three months, based on established criteria such as job function and worker location within the facilities. Criteria which determine the frequency of urine sampling for an employee are documented in the radiation protection program.

A lesser potential hazard exists in the form of low-level external gamma and beta radiation 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. Dose results are reviewed by EHS staff on receipt from the licensed dosimetry service provider. In addition, the ALARA Committee reviews trending data from radiation monitoring results 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 real-time portable handheld radiation detectors. Measured dose rates are compared to established dose rate targets for a given area based on area classification 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 permanent improvements, such as shielding or reconfiguration.

A component of the radiation protection program is area classification. Areas of each facility are classified into four different categories for the purpose of controlling the spread of radioactive contamination, and ensuring appropriate engineered and administrative controls are in place. These classifications are defined in the Radiation Protection Manual 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.
- 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. Where the inhalation hazard is high, respiratory protection is required for all area entries.

BWXT NEC has established facility specific CNSC accepted Action Levels for various radiological and environmental parameters. An Action Level is defined in the Radiation Protection Regulations 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 set below regulatory limits; however, they are CNSC reportable events. Action Levels are established in accordance with the CNSC regulatory document G-228, *Developing and Using Action Levels*, which are approved by the CNSC and specified in the Licence Conditions Handbook (refer to Table 4 and Table 5 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. Accordingly, BWXT NEC has established Internal Control Levels for various radiological and environmental parameters that are set even lower than Action Levels to act as an early warning system. An Internal Control Level exceedance results in internal investigation and corrective and preventive action. During the reporting period, all measurements were below regulatory limits and Action Levels.

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 NEW	Balance of the pregnancy	3.5

Parameter	Action Level
Urinalysis	10 μg/L for any period

Nuclear Substance and Form	Action Level

U in Airborne Contamination	Unclassified Area	R1 Area	R2 Area
	12 dpm/m^3	12 dpm/m^3	36 dpm/m^3

Table 4: 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 NEW	Balance of the pregnancy	3.5
Parameter		**Action Level**
Urinalysis		10 μg/L for any period

Nuclear Substance and Form	Action Level		
U in Airborne Contamination	Unclassified Area	R2 Area	R3 Area (non-mask)
	36 dpm/m^3	180 dpm/m^3	270 dpm/m^3

Table 5: Summary of Action Levels for the Radiation Protection Program at Toronto Facility

BWXT NEC has a well-established integrated management system for environmental, health and safety program excellence. The radiation protection program is effectively implemented. BWXT NEC has an established EHS Mission Statement that is reviewed and signed annually by the President of BWXT NEC. The Mission Statement includes a commitment to ALARA and continuous improvement. Elements of the radiation protection program such as dose monitoring, contamination monitoring, and radiation field surveys, etc. are conducted by qualified workers and reviewed internally by EHS staff and Committees on a regular basis. Details of the reviews are recorded in meeting minutes.

An internal audit and self-assessment of the radiation protection program, with a focus on elements of radiation protection program effectiveness and compliance, is conducted annually at each site. Non-conformances are addressed and tracked to completion in accordance with program requirements.

In accordance with the Radiation Protection Regulations and CNSC Guidance Document G-129, *Keeping Radiation Exposures and Doses As Low As Reasonably Achievable*, BWXT NEC has implemented a radiation rrotection program. This document establishes the radiation protection program in place at the Toronto and Peterborough facilities and identifies corresponding procedures to ensure that radiation exposures and doses are kept ALARA.

Key components of the radiation protection program include:

- Compliance with all relevant regulatory requirements;
- The setting of ALARA goals and objectives;

- Hazard recognition, risk assessment and change control processes;
- A comprehensive worker training program;
- Documented safety concerns, near misses and incidents with appropriate root-cause analysis, preventive and corrective actions.

The radiation protection program includes all worker radiation safety elements that demonstrate compliance to relevant regulations, codes and standards:

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

Continuous improvement is achieved through several review processes, including site inspections, reported safety concerns, near miss and incident investigations, self-assessments, internal and external audits. There were no major changes to the radiation protection program during the reporting period. Minor continuous improvements were instituted as follows:

- For Peterborough,
    - The breathing air work instruction was revised to confirm that the ventilation system is functioning adequately following unusual air sampling results (as applicable) and to note the pump flow deviation acceptance criteria.
    - The TLD work instruction was revised with an improved extremity dose correction factor calculation for accuracy and consistency with the Toronto program.
    - The urinalysis work instruction was revised to clarify that sample bottles should not be made available when work did not occur 24 to 48 hours prior.
- For Toronto,
    - The breathing air work instruction was revised to confirm that the ventilation system is functioning adequately following unusual air sampling results as applicable.
    - The Radiation Safety Instruction work instruction was revised to trigger post-maintenance verifications following work to ensure that the safety function as specified on the CTS list is achieved as applicable.
    - A new work instruction that details preparation steps for the uranium standard solution was released.
- Minor administrative edits were made to eight other work instructions across both sites.

The radiation protection program is well-established and effective. Radiation dose trends demonstrate the company's commitment to ALARA. Program goals are monitored through the site's ALARA Committees as summarized in section 3.7.1.

3.7.1 ALARA Committee Performance

The ALARA committees work to review and continuously improve elements of the radiation safety program, and implement ALARA practices where practical in order to ensure that radiation dose levels are as low as reasonably achievable. Committee members consist of both unionized and management employees. The ALARA committees target quarterly meetings at a minimum. The Peterborough committee met three times and the Toronto committee met four times during the reporting period. The Peterborough committee did not meet the minimum meeting requirement as a result of a failure in the electronic scheduling reminder system which has been corrected to prevent recurrence. Dose results, radiation protection related events, audits, and employee concerns were reviewed and discussed. Actions are assigned and tracked as part of the meeting minutes. Committee activities are communicated to all workers.

ALARA Committee goals and results for the reporting period are provided in Table 6 and Table 7 for Peterborough and Toronto respectively. Goals that are not achieved are informally reviewed by the ALARA Committee to discuss probable causes. The feasibility of achievement is discussed and implementation plans revised as needed. These are considered during future goal setting. As radiation doses continue to be well below the regulatory dose limits, dose reductions become increasingly challenging.

3.7.1.1 Peterborough ALARA Committee

Reporting period ALARA goals are summarized in Table 6. Peterborough did not achieve its year-over-year dose reduction goal. This dose reduction target is based on collective dose once it has been normalized with production quantities. This ensures the targets are based on reductions in dose and not reductions in production amounts. Overall both collective dose and production quantities were reduced from 2018. There was in increase in product movement and the number of bundles stored on the line, as well as Operator cross training initiatives which attributed to the overall unchanged dose per tonne. The shielding project goal was also missed as a result of personnel changes and conflicting priorities. The shielding material was received prior to year end and was installed in early 2020 and is now complete.

Peterborough ALARA Committee Goals	Actual	Result
3% reduction in collective whole body dose (normalized for production)	0% Change	Not Achieved
>99% compliance in TLD audits	100% compliance	Achieved
Complete one shielding project by year end	0/1	Not Achieved

Table 6: Peterborough ALARA Committee Goals and Results

2020 goals for Peterborough are established as follows:

1. >99% compliance in TLD audits
2. Complete a shielding project by year end
3. Provide additional training to interested ALARA committee members by year end

3.7.1.2 Toronto ALARA Committee

Reporting period ALARA goals are summarized in Table 7. Training for ALARA members was not achieved due to scheduling conflicts and will be revisited in 2020.

Toronto ALARA Committee Goals	Actual	Result
Swipe program involvement and improvements	Complete	Achieved
ALARA presentation at all employee communication meeting	Complete	Achieved
Training for ALARA committee members (supplement to Radiation Safety)	Postponed	Not Achieved

Table 7: Toronto ALARA Committee Goals and Results

2020 goals for Toronto are established as follows:

1. Review air sampling locations and positions
2. Complete one shielding project by year end
3. ALARA presentation at all employee communication meeting
4. Training for ALARA committee members (supplement to Radiation Safety)

3.7.2 Radiation Protection Training Program and Effectiveness

Radiation protection training programs are compliant with the SAT methodology. An internal or external specialist in radiation protection periodically provides classroom training to new and continuing NEWs or those working in areas with radioactive materials. Online training is also available to employees with computer access. Testing is performed on completion of the training to demonstrate employee understanding. In Peterborough, radiation protection training is rolled into the site-wide Manufacturing Area Hazards Awareness course. Course content includes general shop floor rules, radiation fundamentals, sources of ionizing radiation, health effects, emergency response and other safety-related content. Training completion is monitored using a learning management software system, which tracks and triggers retraining as required. Course completion details are provided in section 3.3. Training effectiveness is monitored through radiation dose results, internal inspections, self-assessments and audits as well as incident investigations.

3.7.3 Radiation Device and Instrumentation Performance

Radiation detection instrument error can occur due to a variety of factors: drift, environment, electrical supply, addition of components to the output loop, process changes, etc. Each site maintains a system for managing radiation detection instrument calibrations. Calibration is conducted to ensure accurate indication during field use. Calibrations are performed under environmentally controlled conditions suitable for the inspections, measurements, and tests being performed, as determined by the equipment manufacturer. Calibration intervals are established, so that calibration occurs before any anticipated significant changes occur in measurement capability. Radiation detection equipment calibrations are conducted within 12 months of the previous calibration as required by regulation.

All active radiation devices and instruments were maintained in a state of safe operation. Where calibration is expired or where detectors fail calibration, they are removed from service until they are repaired and meet radiation calibration expectations.

There were no changes to the calibration program during the reporting period.

3.7.4 Contamination Control Data

When radioactive material is handled in a non-sealed container, there is the potential for it to be spread onto other objects. This is known as radioactive contamination. Radioactive contamination refers to nuclear substances on surfaces or within the air, where its presence is unintended or undesirable.

Surface contamination measurements (swipes) are conducted in manufacturing areas of each facility. The potential for surface contamination is greater in the Toronto facility since UO_2 powder is received and handled. Contamination by itself is not necessarily an indicator of exposure potential but can be used as an indicator of housekeeping conditions; however significant amounts of loose surface contamination has the potential to become airborne. If this occurs, the air monitoring results will reflect the increased airborne concentration and appropriate corrective action is then taken. Internal Control Levels are applied to each area classification. In the event a swipe measurement exceeds an Internal Control Level; the area is cleaned and re-swiped to verify cleanliness. Trends are monitored. There were no significant personnel contamination events during the reporting period.

3.7.4.1 Peterborough Surface Contamination

Routine surface contamination measurement results are summarized in Table 8. Peterborough surface contamination remains very low. Surface contamination results are reviewed by EHS staff and discussed if necessary at ALARA Committee Meetings. Overall, 99.8% of routine swipes were within Internal Control Levels, indicative of effective contamination control measures and cleaning schedules.

Peterborough Surface Contamination					
Classification and Area Description	Internal Control Level	2018		2019	
		Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)	Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)
R2 - Pellet Loading, Element Welding and Pellet Storage	2,200 dpm/100 cm^2	515	0 (0%)	521	0 (0%)
R1 - Bundle Assembly, Inspection, Receiving, Building 24	220 dpm/100 cm^2	154	0 (0%)	183	0 (0%)
Active - Met Lab, Waste Room	220 dpm/100 cm^2	165	0 (0%)	164	1 (0.6%)
Unclassified - Items, Main Hallway	220 dpm/100 cm^2	471	1 (0.2%)	451	1 (0.2%)

Table 8: Peterborough Surface Contamination

3.7.4.2 Toronto Surface Contamination

Routine surface contamination measurement results are summarized in Table 9. Toronto surface contamination remains fairly steady in the number of samples exceeding the Internal Control Levels. Surface contamination results are reviewed by EHS staff and discussed at WSC Meetings. Overall,

99% of swipes were within Internal Control Levels, indicative of effective contamination control measures and cleaning schedules.

Toronto Surface Contamination					
Classification and Area Description	Internal Control Level	2018		2019	
		Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)	Total Number of Samples	Total Number Samples Exceeding Internal Control Level (%)
R3-Powder Preparation, Pressing, Grinding, Laboratory	22,000 dpm/100 cm^2	444	0 (0.0%)	447	3 (0.7%)
R2-Sintering, Sorting & Stacking, Laboratory	2,200 dpm/100 cm^2	508	7 (1%)	511	6 (1%)
Active - Plant Washrooms, Laundry Room	2,200 dpm/100 cm^2	145	0 (0%)	145	0 (0%)
Unclassified	220 dpm/100 cm^2	293	5 (2%)	294	6 (2%)

Table 9: Toronto Surface Contamination

3.7.5 Air Monitoring

As part of a well-established and implemented industrial hygiene programs, both facilities sample breathing air for measurement of uranium content. Workstation air monitoring is a key performance indicator that speaks to effective administrative and engineered controls. Respiratory protection programs are in place. Non-routine work functions, such as machine maintenance, modifications, etc. are controlled by EHS Work Permits (Peterborough) or Radiation Safety Instructions (RSI) (Toronto). The EHS Work Permit/RSI specifies protective measures, including those to reduce exposure to airborne UO_2. This may or may not include air monitoring and/or respirator use.

3.7.5.1 Peterborough Air Monitoring

In Peterborough, each process workstation where open UO_2 pellets are handled are periodically monitored during routine operations for airborne UO_2. All filter papers are counted in-house and verified by an independent external laboratory using delayed neutron activation analysis. Workstation air sampling results are summarized in Table 10.

Peterborough Workstation Air Monitoring	2016	2017	2018	2019
Number of Workstations Sampled	4	4	4	4
Total Number of Samples Collected	50	46	49	47

Peterborough Workstation Air Monitoring	2016	2017	2018	2019
Total Number of Samples Exceeding Internal Control Level (facility and area specific)	0	0	0	0
Total Number of Samples Exceeding Action Level (facility and area specific)	0	0	0	0
Average Concentration (dpm/m^3)	0.11	0.05	0.04	0.03
Maximum Value Recorded (dpm/m^3)	0.97	0.15	0.12	0.17

Table 10: Peterborough Workstation Air Monitoring Summary

In Peterborough, average and maximum workstation air monitoring results continue to remain negligible and below Internal Control Levels. No trends are discernible.

3.7.5.2 Toronto Air Monitoring

In Toronto, each process workstation is monitored continuously during routine operating conditions for airborne UO_2 and counted in-house. Internal dose to workers in Toronto is estimated and assigned based on these air monitoring results. Workstation air sampling results are summarized in Table 11.

Toronto Workstation Air Monitoring	2016	2017	2018	2019
Number of Workstations Sampled	21	21	21	21
Total Number of Samples Collected	5271	5208	5250	5292
Total Number of Samples Exceeding Internal Control Level (facility and area specific)	2	1	5	8
Total Number of Samples Exceeding Action Level (facility and area specific)	0	0	0	0
Average Concentration (dpm/m^3)	9.2	7.1	9.6	8.8
Maximum Value Recorded (dpm/m^3)	244	306	365	433

Table 11: Toronto Workstation Air Monitoring Summary

In the reporting period, eight workstation air samples exceeded an Internal Control Level in Toronto. The results were noticed during the daily air sample result reviews. Two were associated with Final Press Feed #2, five were for the Pre-Press Feed Room, and one was for the Recycle Room. All three air sample stations are located in rooms that require respiratory protection upon room entry. There are no associated Action Levels for this area classification.

The two elevated results for Final Press Feed #2 were associated with housekeeping and a loose-fitting vibrator on the equipment. Press feed operations require operators to remove the cap from a cone, hook up the cone to the press feed, and attach a vibrator to the cone's frame. Operators performing the task did not vacuum the cap, which had residual uranium powder. Furthermore, the vibrator came loose from the cone's cradle, which vibrated the cap causing airborne uranium powder. Housekeeping expectations were reviewed with the press operators and new vibrator clamps were placed into operation. Upon identifying and correcting the issue the results resumed back to normal.

Four of the five elevated results for the Pre-Press Feed Room were related to an issue with the 6H68 and TD1150 Torit system. A damper between both systems was found to be broken which partially

blocked the flow of the system. The blockage caused blow-back which escaped back into the Pre-Press Feed Room. The damper was fixed and reinforced, and a pressure gauge was installed in the ductwork to provide visual confirmation that the damper is open. The last elevated result for the Pre-Press Feed Room was related to housekeeping. Daily cleaning was missed which caused increased airborne uranium powder. The room was immediately cleaned and decontamination operators were advised to clean the room once per shift.

The one elevated result for the Recycle Room was associated with comiling and jaw crushing operations. The operator forgot to open the damper for local ventilation before starting the task, which resulted in airborne uranium powder. All operators performing comiling and jaw crushing reviewed training material and no further exceedances were noted for this air sampling location.

3.7.6 Facility Radiological Conditions

Radiation fields from use and storage of radioactive materials may result in external radiation doses to workers. In order to ensure that radiation dose rates are ALARA, routine gamma radiation surveys are conducted periodically within each facility using calibrated portable handheld radiation detectors. Measured dose rates are compared to targets for areas based on area classification and occupancy. When necessary, items are moved to alternative storage locations and/or temporarily shielded. Areas that appear routinely higher than target dose rates may be investigated for improvements, such as permanent shielding or reconfiguration. Routine dose rate measurements are summarized in Table 12 and Table 13 for Peterborough and Toronto respectively. Dose rates remain steady in both locations. The facility gamma surveys focus on radioactive material handling and storage areas and adjacent occupied locations. Variability due to the timing of the surveys is a factor in the results, as production levels and movement of materials vary over the course of a year.

Peterborough Dose Rates	2016	2017	2018	2019
Total Number of Locations Surveyed	373	360	384	370
Average Dose Rate (µSv/h) on Shop Floor	3.1	3.0	3.1	3.4
Average Dose Rate (µSv/h) in Storage Areas	5.6	4.3	4.2	5.5

Table 12: Peterborough Routine Dose Rate Survey Summary

Toronto Dose Rates	2016	2017	2018	2019
Total Number of Locations Surveyed	160	160	160	160
Average Dose Rate (µSv/h) on Shop Floor	2.7	2.6	3.0	2.4
Average Dose Rate (µSv/h) in Storage Areas	5.0	7.5	5.5	5.3

Table 13: Toronto Routine Dose Rate Survey Summary

3.7.7 Urinalysis Results

The presence of uranium in the urine is an indication of recent inhalation of UO_2 dust or the systemic clearance of an established thorax burden. At BWXT NEC, urinalysis is used as a screening tool to initiate further review of internal dose control measures and practices but is not used to estimate internal dose. In Toronto, internal dose is estimated based on workstation air monitoring (refer to section 3.7.9).

3.7.7.1 Peterborough Urinalysis Results

All Peterborough employees working where exposed UO_2 material is processed (R2 classified area) for a period greater than 30 hours per quarter, or working as a roving inspector during the quarter, submit urine samples for uranyl ion analysis. Samples are analyzed by an external laboratory for uranium content using Inductively Coupled Plasma - Mass Spectrometry with a minimum detectable concentration of 0.1 µg U/L. Results are compared to Internal Control Levels and Action Levels and entered and retained in an electronic database. Urinalysis results are summarized in Table 14.

Of all urinalysis samples from Peterborough processed between 2005 and 2019, only 0.3% of samples (6/1878) have measured above the minimum detectable concentration of 0.1 µg U/L, and all were less than 0.5 µg U/L. These occurrences were well below the Internal Control Level of 5 µg U/L. In 2019 all results were at or below the minimum detectable concentration. This confirms that the inhalation hazards at the Peterborough facility are negligible and that current engineered and administrative controls, where applicable, are adequately controlling the risk.

Peterborough Urinalysis	2016	2017	2018	2019
Number of urine samples analyzed	109	99	108	88
Number of samples above Internal Control Level (5 µg U/L)	0	0	0	0
Number of samples above Action Level (10 µg U/L)	0	0	0	0
Maximum result (µg U/L)	<0.1	<0.1	<0.1	0.1

Table 14: Peterborough Urinalysis Results Summary

3.7.7.2 Toronto Urinalysis Results

All Toronto employees working where exposed UO_2 material is processed submit urine samples for uranyl ion analysis weekly or monthly, depending on the work area. Samples are analyzed by an external laboratory for uranium content using Inductively Coupled Plasma - Mass Spectrometry with a minimum detectable concentration of 0.1 µg U/L. Results are compared to Internal Control Levels and Action Levels and entered and retained in an electronic database. Urinalysis results are summarized in Table 15.

In Toronto, there were no sample results above the Internal Control Level of 5 µg U/L during the reporting period. There were no Action Level exceedances. This demonstrates that current engineered and administrative controls, where applicable, are adequately controlling the inhalation hazard.

Toronto Urinalysis	2016	2017	2018	2019
Number of urine samples analyzed	1907	1621	1600	1594
Number of samples above Internal Control Level (5 µg U/L)	3	0	0	0
Number of samples above Action Level (10 µg U/L)	1	0	0	0
Maximum result (µg U/L)	13.0	4.9	3.5	3.8

Table 15: Toronto Urinalysis Results Summary

3.7.8 Radiation Doses

Radiation dose refers to the energy deposited or absorbed in materials through which it passes. Equivalent dose is used to assess how much biological damage is expected from the absorbed dose. It takes the properties of different types of radiation into account. Effective dose is used to assess the potential for long-term effects that might occur in the future. It is a calculated value, measured in milliSievert (mSv), which takes into account the absorbed dose to all organs of the body, the relative harm level of the type of radiation, and the sensitivities of each organ to radiation. All radiation exposures received by employees in the reporting period were within Internal Control Levels, Action Levels and regulatory limits. Action Levels are site specific and are accepted by the CNSC through the facility operating licence conditions handbook. Regulatory limits are specified in the Radiation Protection Regulations. Regulatory limits are listed in Table 16 and Table 17. All measured radiation doses received by individuals in the reporting period were within Internal Control Levels, Action Levels and regulatory limits.

Effective Dose Limits		
Person	**Period**	**Effective Dose (mSv)**
NEW, including a pregnant NEW	(a) One-year dosimetry period (b) Five-year dosimetry period	50 100
Pregnant NEW	Balance of the pregnancy	4
A person who is not a NEW (i.e. a member of the public)	One calendar year	1

Table 16: Regulatory Effective Dose Limits

Equivalent Dose Limits			
Organ or Tissue	**Person**	**Period**	**Equivalent Dose (mSv)**
Lens of an eye	(a) NEW (b) Any other person	One-year dosimetry period One calendar year	150 15
Skin	(a) NEW (b) Any other person	One-year dosimetry period One calendar year	500 50
Hands and feet	(a) NEW (b) Any other person	One-year dosimetry period One calendar year	500 50

Table 17: Regulatory Equivalent Dose Limits

All employees are classified as either NEWs or Non-NEWs. All contractors are classified non-NEWs. All NEWs are deemed to have a reasonable probability of receiving a dose of radiation that is greater than the prescribed limit for a member of the public (1 mSv/year) in the course of the person's work with nuclear substances or at our nuclear facilities. All fuel manufacturing NEWs at BWXT NEC are assigned personal passive dosimeters known as TLDs (thermoluminescent dosimeter). These passive dosimeters measure the whole body and skin doses received in each monitoring period. TLD rings are worn on certain employee's hands for a one-week period each quarter. The test results and the weekly hours of contact are used to estimate the extremity dose for that quarter. Both types of TLDs are exchanged

monthly (Toronto) or quarterly (Peterborough), and analyzed by a CNSC licensed external dosimetry service provider. The dosimetry service provider reports the measured doses to BWXT NEC and to the Health Canada National Dose Registry. On receipt, knowledgeable staff reviews the monitoring results, and compares them to associated Internal Control Levels, Action Levels and regulatory limits.

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, five-year and lifetime. All NEW employees who are monitored for radiation exposure receive an annual dose letter identifying their annual dose.

BWXT NEC dosimetry results are summarized in the following sub-sections. Employees are divided into workgroups based on job function for dosimetry analysis and trending. Operators are employees who manufacture product and includes the Customer Site Representative(s). Technicians are employees who support the licensed activities, (Fuel Assembly or Fuel Handling and Engineered Solutions) e.g. electrical, mechanical, quality control, laboratory, etc. Staff includes management and professional employees who support the Operators and Technicians with the licensed activities.

3.7.9 Total Effective Dose Equivalent (TEDE)

TEDE includes TLD monitored external and calculated internal dose based on workstation air monitoring at the Toronto site. As a result of operations involving sintered ceramic pellets, the Peterborough site does not have any measurable internal dose.

3.7.9.1 Peterborough TEDE

Peterborough does not have any measurable internal dose; therefore, the TEDE is the measured TLD external whole body dose. Table 18 provides a summary of TEDE dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 72% of Peterborough's TEDE are less than 1 mSv. TEDE measurement results by work group are summarized in Table 19. Note that average dose results include zero measurements. The total collective dose for 2019 was 83.3 mSv. The maximum individual five-year dose is well below the 100 mSv regulatory limit at 24.9 mSv (2015-2019).

The average annual TEDE trend for all monitored individuals is shown in Figure 6. TEDE by workgroup is listed in Table 19. Overall, average TEDE is trending down. Maximum and average doses are also trending down in each workgroup. Dose reduction is occurring as result of ongoing efforts to improve ALARA awareness (e.g. use of leaded blankets) and TLD wear and storage compliance. Reductions in the amount of rework are also contributing to this downward trend.

Calendar Year	Total # Individuals	Peterborough Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2019	71	51	15	5	0	0	0	0	0
2018	78	57	19	2	0	0	0	0	0

Table 18: Peterborough Total Effective Dose Equivalent Distribution

	Year	Peterborough			
		All Workgroups	Operators	Technicians	Staff
Maximum (mSv)	2019	5.76	5.76	1.11	0.85
	2018	6.53	6.53	0.67	1.03
	2017	5.05	5.05	0.61	0.79
	2016	5.82	5.82	1.13	0.75
	2015	5.77	5.77	1.29	1.69
Average (mSv/person)	2019	1.17	2.18	0.36	0.46
	2018	1.12	2.12	0.31	0.48
	2017	0.99	2.06	0.13	0.39
	2016	0.96	2.02	0.14	0.37
	2015	1.35	2.03	0.27	0.84

Table 19: Peterborough Total Effective Dose Equivalent Summary

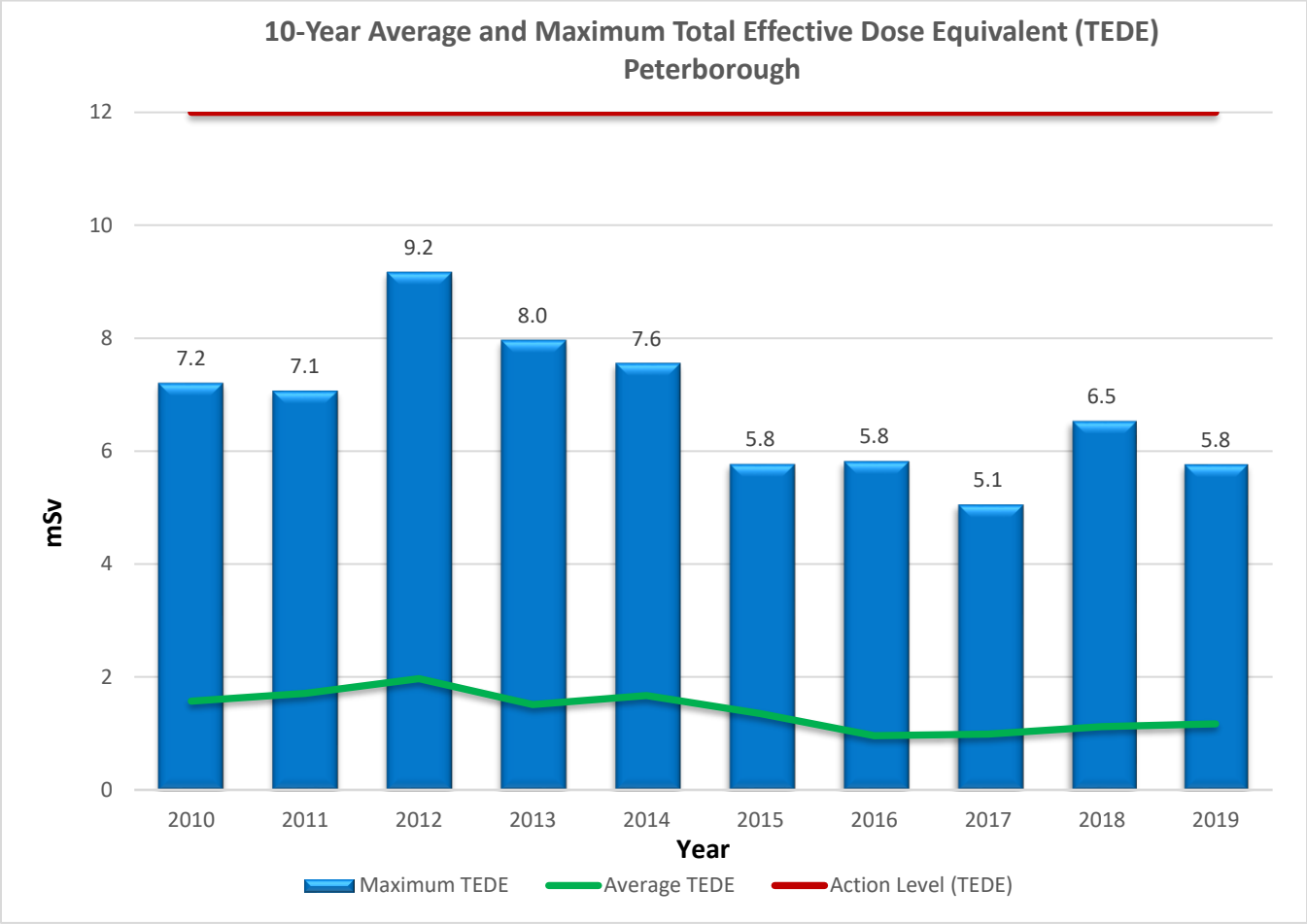

Figure 6: Peterborough 10-Year Annual Total Effective Dose Equivalent

3.7.9.2 Toronto TEDE

Table 20 provides a summary of TEDE dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 48% of Toronto's TEDE are less than 1 mSv. TEDE measurement results by work group are summarized in Table 21. Note that average dose results include zero measurements. The total collective dose for 2019 was 99.5 mSv. The maximum individual five-year dose is well below the 100 mSv regulatory limit at 38.7 mSv (2015-2019).

The average annual TEDE trend for all monitored individuals is shown in Figure 7. Average TEDE is trending down over all. Average and maximum Staff doses remain very low. Job rotation, shielding improvements made in the Sort and Stack, Grinding and Sintering areas are credited with the downward trend. Additionally, improvements in ALARA awareness and operator experience are contributors.

Calendar Year	Total # Individuals	Toronto Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2019	61	29	28	4	0	0	0	0	0
2018	58	28	26	4	0	0	0	0	0

Table 20: Toronto Total Effective Dose Equivalent Distribution

	Year	Toronto			
		All Workgroups (TEDE)	Operators External Only	Operators Internal Only	Staff (TEDE)
Maximum (mSv)	2019	7.17	6.10	1.55	0.72
	2018	9.16	8.07	1.86	2.06
	2017	8.54	8.54	2.37	0.40
	2016	11.79	11.79	2.80	0.23
	2015	8.45	7.71	2.33	3.25
Average (mSv/person)	2019	1.63	1.42	0.76	0.07
	2018	1.74	1.67	0.80	0.12
	2017	1.55	2.41	0.71	0.03
	2016	2.22	2.06	1.13	0.04
	2015	2.11	2.67	0.95	0.30

Table 21: Toronto TEDE, External and Internal Dose Summary

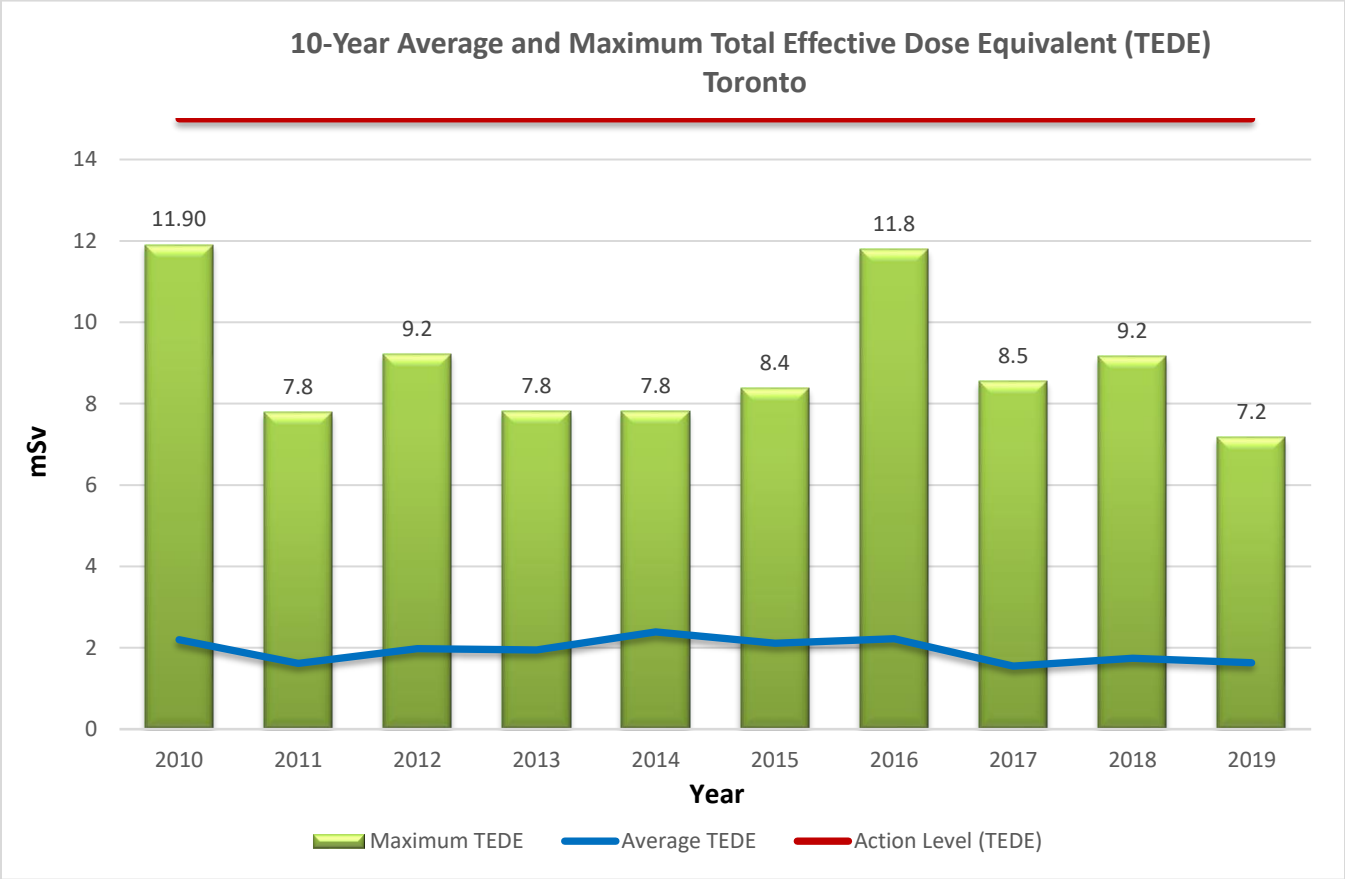

Figure 7: Toronto 10-Year Annual Total Effective Dose Equivalent

3.7.10 Equivalent Skin Dose

TLDs measure the skin doses received in each monitoring period. Skin dose is the measure of the radiation dose that is absorbed by the skin from the deposition of energy from low penetrating radiation.

3.7.10.1 Peterborough Skin Dose

Table 22 provides a summary of equivalent skin dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 66% of Peterborough's skin doses are less than 1 mSv. Equivalent skin dose by work group is summarized in Table 23. The average annual skin dose trend for all monitored individuals is shown in Figure 8. Skin doses are trending downward across all workgroups and remain a fraction of the regulatory limit and Action Level.

Calendar Year	Total # Individuals	Peterborough Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2019	71	47	9	4	11	0	0	0	0
2018	78	54	7	8	9	0	0	0	0

Table 22: Peterborough Equivalent Skin Radiation Dose Equivalent Distribution

	Year	Peterborough			
		All Workgroups	Operators	Technicians	Staff
Maximum (mSv)	2019	17.44	17.44	1.91	1.08
	2018	17.87	17.87	0.92	1.69
	2017	25.14	25.14	0.84	1.08
	2016	21.15	21.15	1.74	0.95
	2015	22.47	22.47	2.57	3.69
Average (mSv/person)	2019	3.00	6.16	0.48	0.49
	2018	2.87	6.05	0.38	0.57
	2017	2.77	6.26	0.17	0.49
	2016	2.66	6.11	0.18	0.39
	2015	4.10	7.11	0.59	0.98

Table 23: Peterborough Equivalent Skin Dose Summary

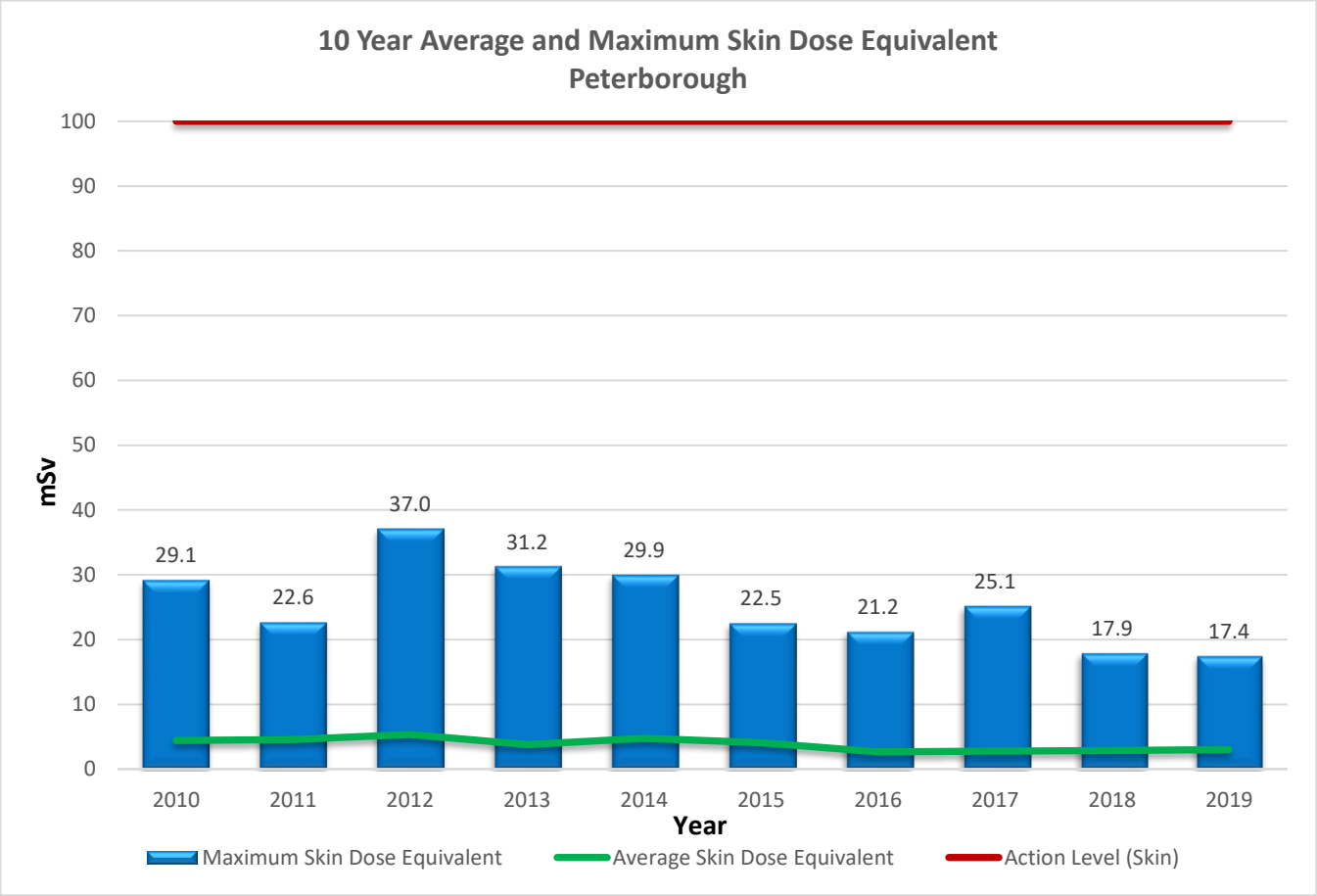

Figure 8: Peterborough 10-Year Annual Skin Dose Equivalent

3.7.10.2 Toronto Skin Dose

Table 24 provides a summary of equivalent skin dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 33% of Toronto's skin doses are less than 1 mSv. Skin dose by workgroup is listed in Table 25. The average annual skin dose trend for all monitored individuals is shown in Figure 9.

Skin doses across all workgroups remain a fraction of the applicable regulatory limit and Action Level. The overall trend is showing that average skin dose is decreasing. The maximum skin dose has decreased in the recent year due to the introduction of job rotation at Sort and Stack. The year over year decrease in overall skin dose has resulted from a combination of job rotation, shielding improvements made in the Sort and Stack, Grinding and Sintering areas and an improvement in ALARA awareness and operator experience. While the primary objective of shielding improvements is reduction in gamma exposures, there is also a reduction in overall beta fields in the work area from the shielding.

Calendar Year	Total # Individuals	Toronto Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2019	61	20	14	7	13	7	0	0	0
2018	58	19	9	11	11	6	2	0	0

Table 24: Toronto Equivalent Skin Radiation Dose Equivalent Distribution

	Year	Toronto		
		All Workgroups	Operators	Staff
Maximum (mSv)	2019	39.76	39.76	3.54
	2018	58.36	58.36	8.97
	2017	54.27	54.27	4.43
	2016	74.26	74.26	4.08
	2015	54.99	54.99	3.86
Average (mSv/person)	2019	8.07	10.85	0.27
	2018	8.92	12.68	0.54
	2017	7.85	11.80	0.34
	2016	10.23	14.82	0.49
	2015	9.89	13.16	0.47

Table 25: Toronto Equivalent Skin Dose Summary

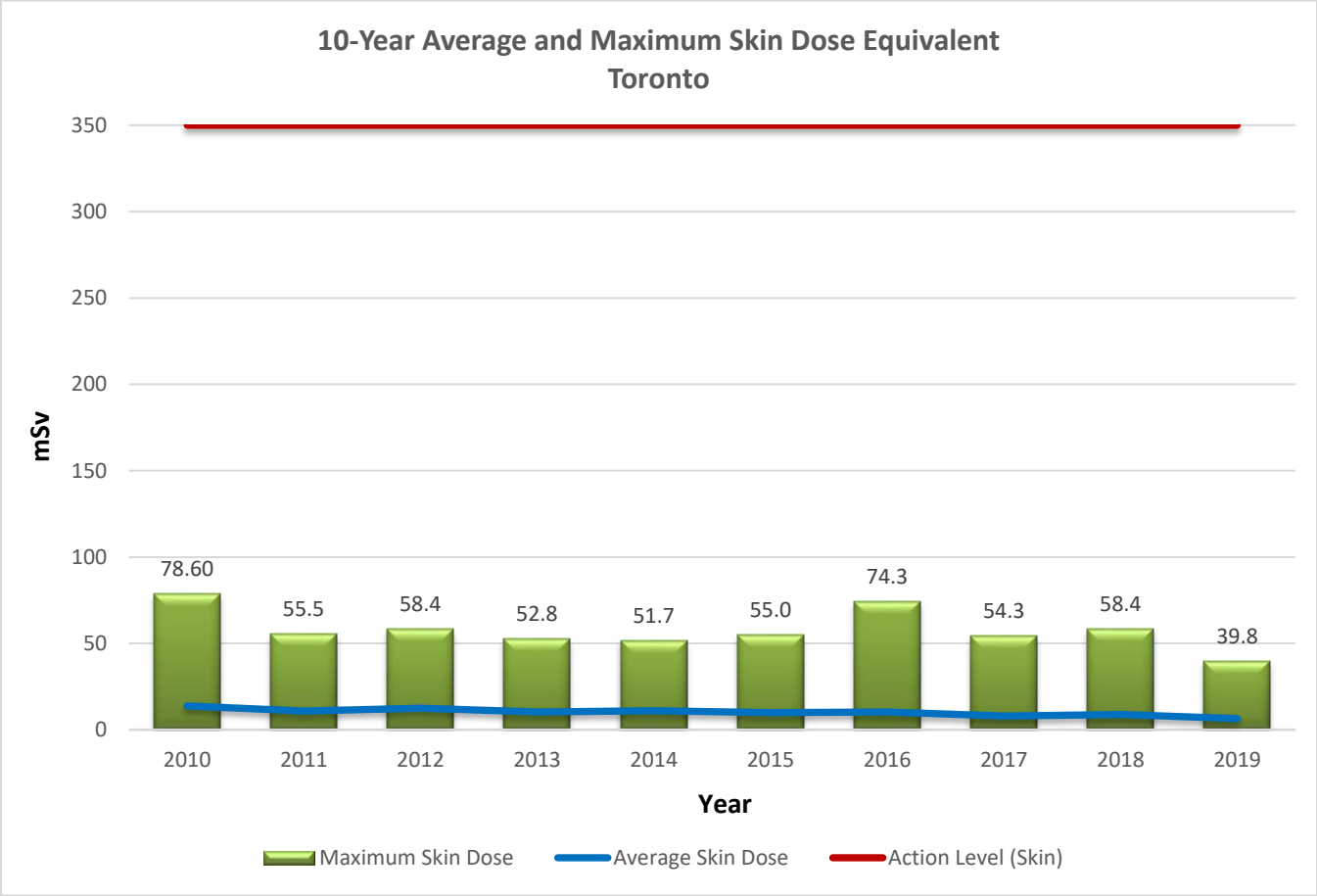

Figure 9: Toronto 10-Year Annual Skin Dose Equivalent

3.7.11 Equivalent Extremity Dose

TLD rings are worn on certain individual's hands for a one-week period each quarter to measure extremity dose. A scaling factor is calculated based on hours worked in the quarter and is provided to the dosimetry service provider each monitoring period. The dosimetry service provider applies the scaling factor to the measured dose to estimate the exposure for the quarter.

3.7.11.1 Peterborough Extremity Dose

Table 26 provides a summary of equivalent extremity dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 78% of Peterborough's extremity doses are less than 20 mSv. Equivalent extremity dose by work group is summarized in Table 27. Staff and Technicians do not routinely participate in the extremity monitoring program since there is minimal direct handling of product. The average annual extremity dose trend for all monitored individuals is shown in Figure 10. Extremity doses across all workgroups remain a fraction of the regulatory limit and Action Level and show a steady average dose trend.

Calendar Year	Total # Individuals	Peterborough Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2019	18	1	4	4	5	4	0	0	0
2018	27	6	0	6	8	7	0	0	0

Table 26: Peterborough Total Extremity Dose Equivalent Distribution

	Year	Peterborough			
		All Workgroups	Operators	Technicians	Staff
Maximum (mSv)	2019	29.41	29.41	N/A	N/A
	2018	46.06	46.06	0.68	0.88
	2017	43.18	43.18	1.20	2.17
	2016	32.84	32.84	3.6	2.25
	2015	39.34	39.34	4.98	4.82
Average (mSv/person)	2019	11.30	11.30	N/A	N/A
	2018	14.34	17.52	0.49	0.88
	2017	13.62	15.36	1.03	2.17
	2016	9.78	11.33	2.54	1.24
	2015	12.61	14.34	2.03	4.82

Table 27: Peterborough Equivalent Extremity Dose Summary

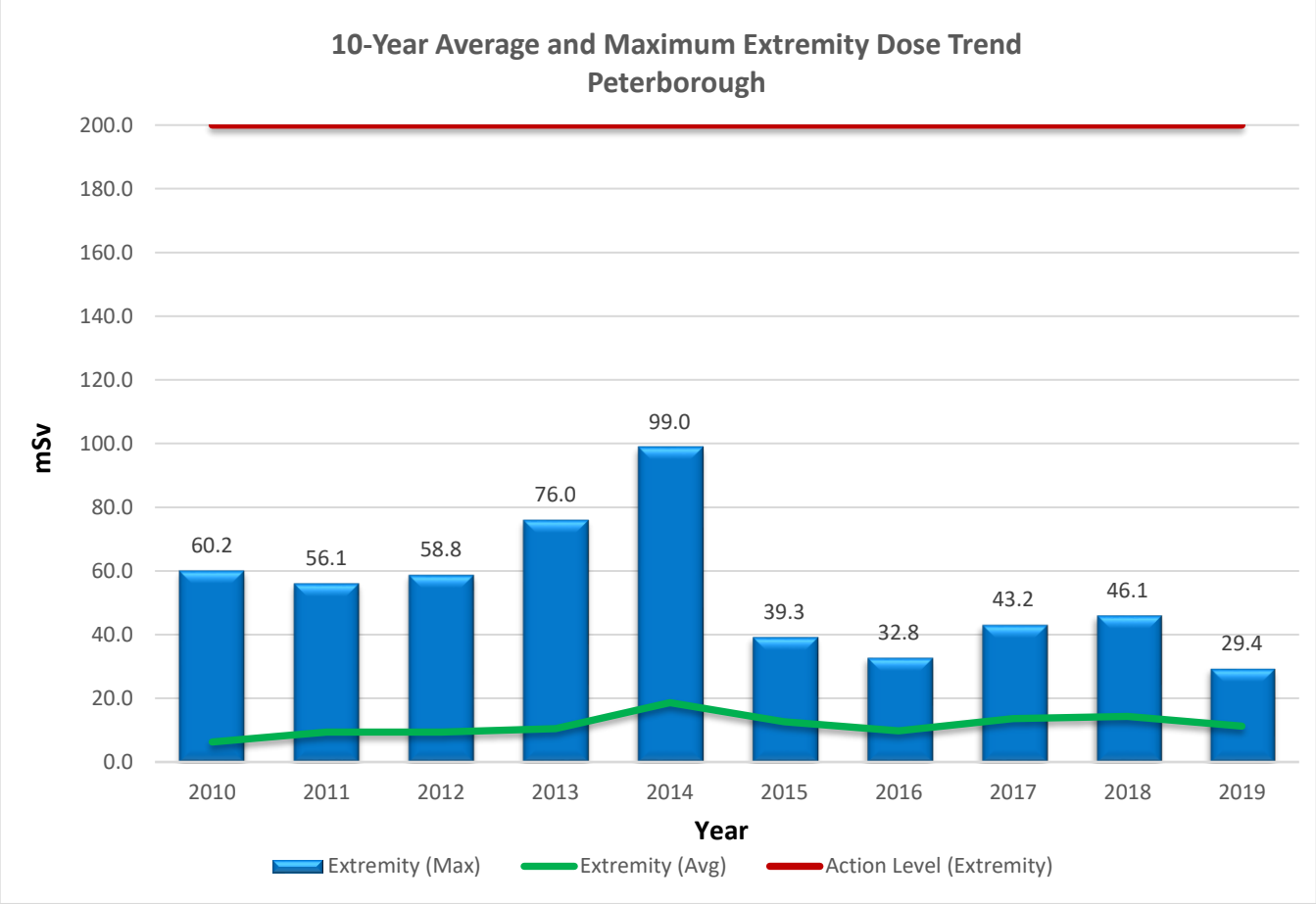

Figure 10: Peterborough 10-Year Average Annual Extremity Dose

3.7.11.2 Toronto Extremity Dose

Table 28 provides a summary of equivalent extremity dosimetry measurements with monitored workers grouped in various ranges of exposure. Approximately 64% of Toronto's extremity doses are less than 20 mSv. Equivalent extremity dose by work group is summarized in Table 29. Staff do not participate in the extremity monitoring program since there is minimal direct handling of product. The average annual extremity dose trend for all monitored individuals is shown in Figure 11. Average extremity doses continue to show a decreasing trend. The introduction of job rotation at Sort & Stack has also reduced individual dose.

Calendar Year	Total # Individuals	Toronto Total # of Individuals in Dose Range (mSv)							
		0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	50 - 100	100 - 200	200 - 500
2019	45	2	10	9	8	11	5	0	0
2018	40	0	10	7	6	8	9	0	0

Table 28: Toronto Extremity Dose Equivalent Distribution

	Year	Toronto		
		All Workgroups	Operators	Staff
Maximum (mSv)	2019	79.67	79.67	N/A
	2018	83.33	83.33	N/A
	2017	115.07	115.07	N/A
	2016	119.47	119.47	N/A
	2015	109.62	109.62	N/A
Average (mSv/person)	2019	20.67	20.67	N/A
	2018	24.56	24.56	N/A
	2017	27.36	27.36	N/A
	2016	29.58	29.58	N/A
	2015	30.30	30.30	N/A

Table 29: Toronto Equivalent Extremity Dose Summary

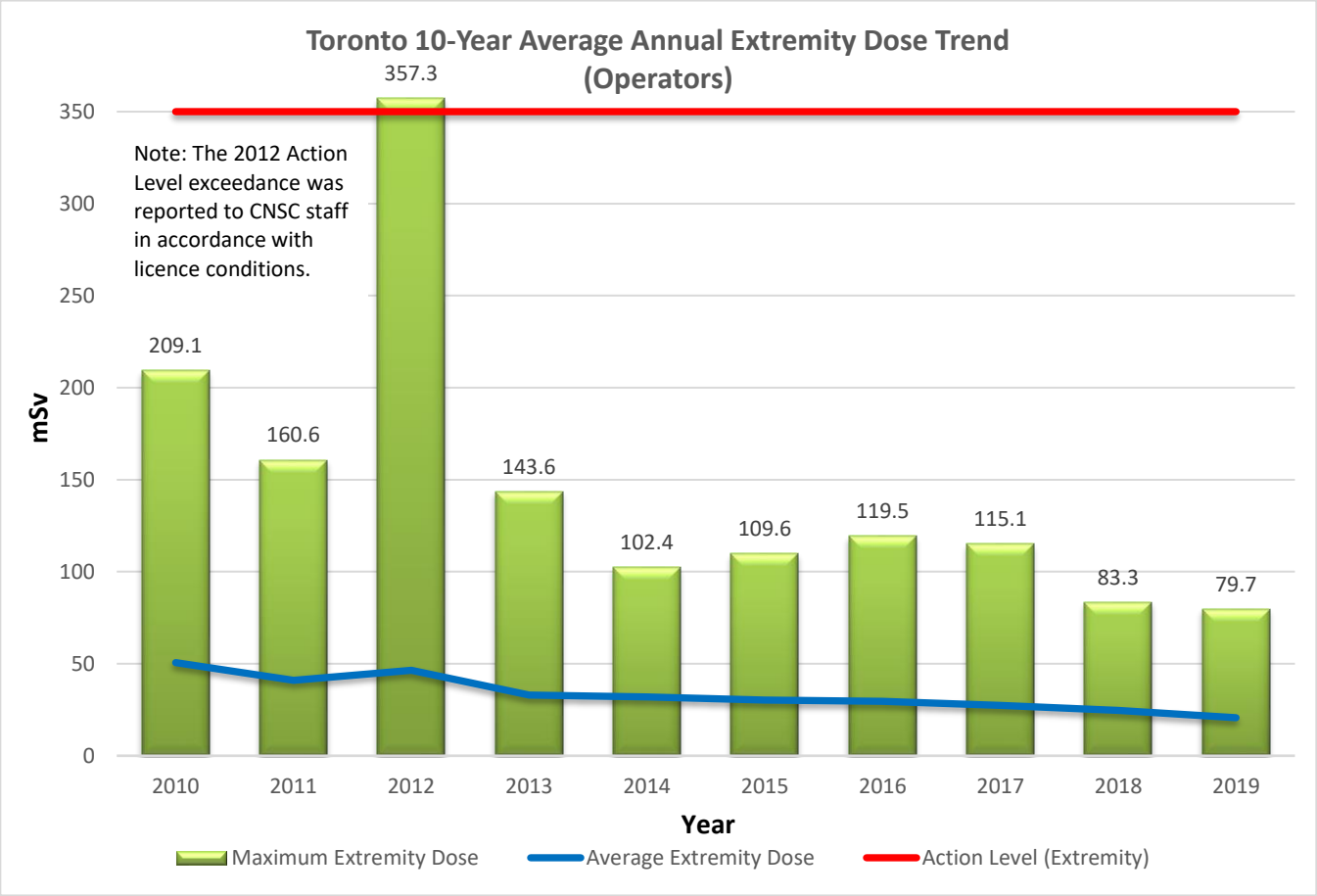

Figure 11: Toronto 10-Year Annual Extremity Dose

3.7.12 Total Estimated Doses to Members of the Public

Total effective radiation dose equivalent to members of the public are specified in the Radiation Protection Regulations and listed in Table 16. It is a calculated value, measured in mSv, which takes into account the absorbed dose to all organs of the body, the relative harm level of the radiation, and the sensitivities of each organ to radiation. To ensure compliance with this regulation, BWXT NEC has established “Derived Release Limits” (DRLs) for uranium emissions to the environment. The facility DRLs account for the realistic exposure pathways as described in the facilities radiation protection program to restrict dose to a member of the public to 1 mSv (1,000 µSv) per year, which is the regulatory dose limit. The DRLs assume that a member of the public occupies the BWXT NEC boundary continuously (24 hours per day, 365 days per year). The realistic pathways considered are summarized in Table 30. Note: Liquid effluent is not included in the calculation of public dose as the effluent from both facilities is discharged directly to city sewer systems and is not used for drinking. Through direct correlation with the facility DRLs, the estimated effective dose as a result of air releases is calculated.

In addition, the contribution from gamma radiation emission to the nearest member of the public is calculated from the net sum of the nearest environmental TLD results from all monitoring periods. The calculation conservatively assumes that a member of the public occupies the nearest residence for 66% of a year (5,7781 hours in a non-leap year). Direct gamma emissions were included in the estimates starting in 2016 for Peterborough and 2014 for Toronto.

Pathway	Description
Air immersion	Airborne UO_2 particles can expose members of the public via direct radiation This is accounted for in the Peterborough and Toronto Derived Release Limits
Air inhalation	Airborne UO_2 can expose members of the public via inhalation This is accounted for in the Peterborough and Toronto Derived Release Limits
Soil deposition gamma radiation ground shine	Gamma ground shine dose from direct radiation This is accounted for in the Toronto Derived Release Limit
Soil deposition beta radiation ground shine	Beta ground shine dose from direct radiation This is accounted for in the Toronto facility Derived Release Limit
Soil re-suspension and inhalation	Soil re-suspension and inhalation dose This is accounted for in the Toronto facility Derived Release Limit
Gamma radiation	Gamma radiation measured using strategically located environmental TLDs

Table 30: Radiological Exposure Pathways

Over the reporting period, radiation doses to members of the public surrounding BWXT NEC facilities was a small fraction of the applicable regulatory dose limit as shown in Table 31, Table 32 and Figure 12 and Figure 13.

As a result of Peterborough operations, the total estimated radiation dose to a member of the public is 11.5 µSv (0.00 µSv from air emissions + 11.5 µSv from direct gamma radiation). In comparison to the 1 mSv (1,000 µSv) per year effective dose limit to a member of the public, dose from the operations is very low at 1%.

Period	Peterborough	
	Estimated Annual Public Dose (µSv)	% of Public Dose Limit (1,000 µSv = 1 mSv)
2019	11.5	1%
2018	0.0	0%
2017	0.0	0%
2016	0.0	0%
2015	0.0	0%

Table 31: Peterborough Estimated Radiation Doses to Members of the Public

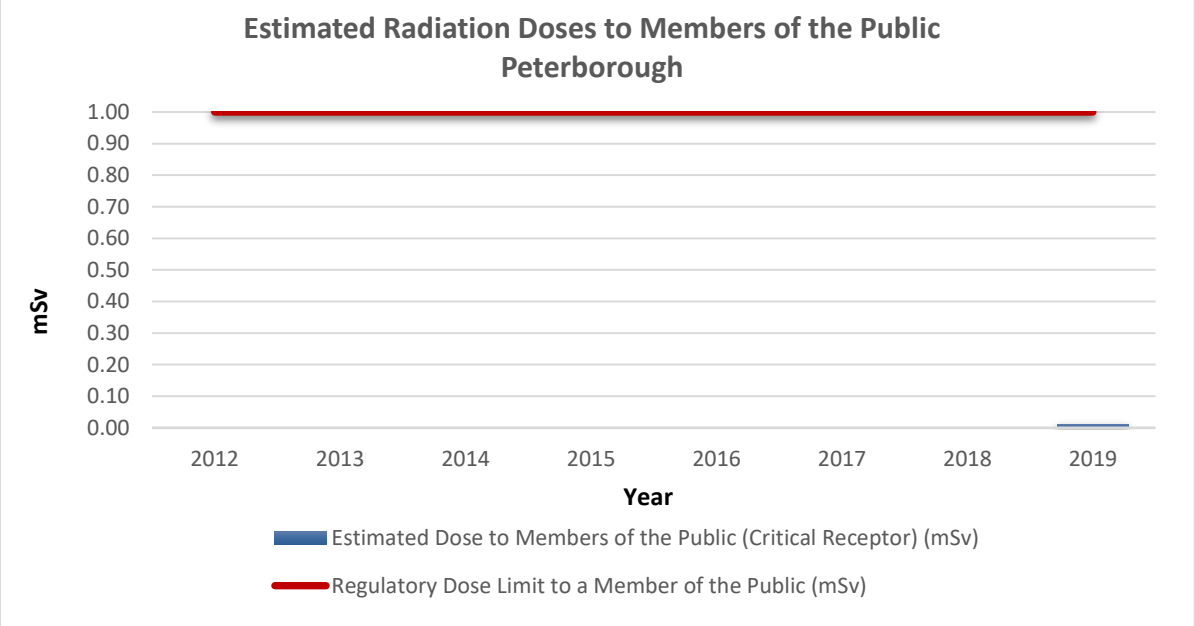

Figure 12: Peterborough Estimated Radiation Doses to Members of the Public

As a result of Toronto operations, the total estimated radiation dose to a member of the public is 23.5 µSv (0.5 µSv from air emissions + 23 µSv from direct gamma radiation). In comparison to the 1 mSv (1,000 µSv) per year effective dose limit to a member of the public, doses from the operations is very low at 2.3%.

Period	Toronto	
	Estimated Annual Public Dose (µSv)	% of Public Dose Limit (1,000 µSv = 1 mSv)
2019	23.0	2.3%
2018	0.4	0.0%
2017	17.5	1.8%
2016	0.7	0.0%
2015	10.1	1.0%

Table 32: Toronto Estimated Radiation Doses to Members of the Public

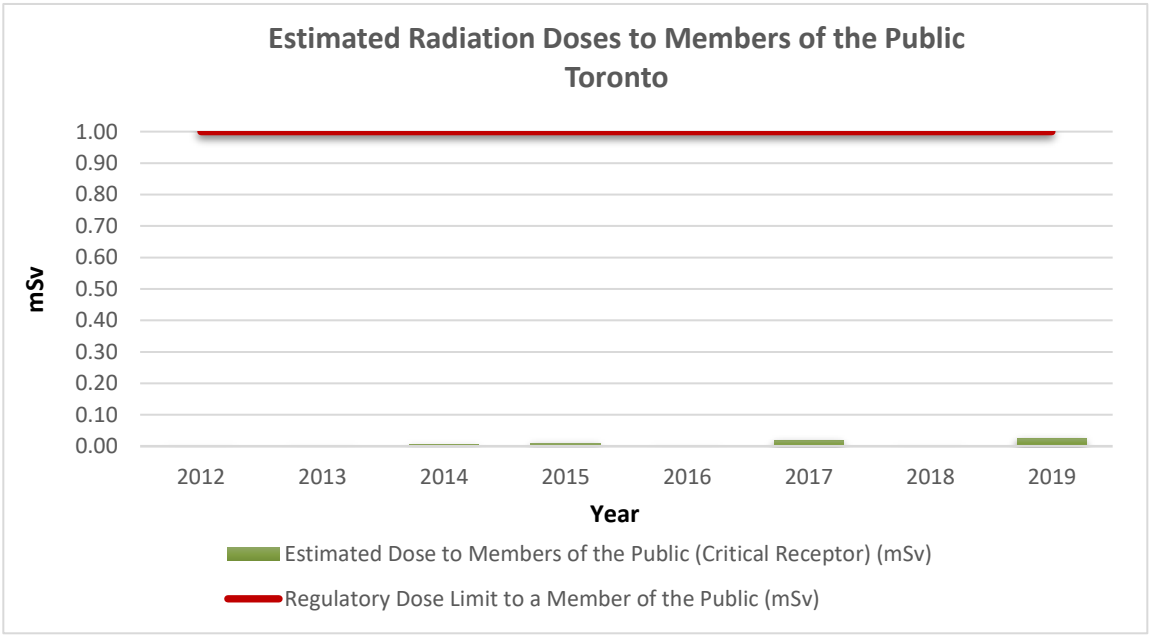

Figure 13: Toronto Estimated Radiation Doses to Members of the Public

3.8 Conventional Health and Safety

The "Conventional Health and Safety" Safety and Control Area covers the implementation of a program to manage non-radiological workplace safety hazards and to protect personnel and equipment.

BWXT NEC has a well-established integrated management system for environmental, health and safety program excellence. This is ensured through the effective implementation of program elements. BWXT NEC has an established EHS Mission Statement that is reviewed and signed annually by the President of BWXT NEC. BWXT NEC's objective is to eliminate or minimize as low as reasonably achievable both known and potential environmental, safety and health hazards which could impact our employees and the communities in which they live. EHS is a shared responsibility, top business priority and is continually improved.

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;
- 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:

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

Continuous improvement is achieved through several review processes, including site inspections, reported safety concerns, near miss and incident investigations. The effectiveness of the overall program is reviewed throughout the year and evaluated in the annual management review (section 3.2.3).

3.8.1 Workplace Safety Committees

3.8.1.1 Peterborough WSC

In Peterborough, 11 meetings were held with quorum. A total of 25 investigations and inspections were conducted in the reporting period. This includes WSC inspections, manager inspections, and near miss, incident and injury investigations. These investigations and inspections led to a total of 77 actions logged and tracked to closure. In Peterborough, the top finding categories were 'housekeeping,' 'emergency equipment inspection and egress,' and 'walking/working surfaces.' Established WSC goals for the reporting period are summarized in Table 33.

Peterborough WSC Goals	Actual	Result
Meet at least 9 times/year	11/9	Complete
Develop an in-house classroom course for WSC members	1/1	Complete
Joint meeting/discussion with other EHS teams (ALARA, Emergency Response Team, Beryllium)	4/4	Complete
Review one EHS Program (Beryllium air sampling monitoring)	1/1	Complete

Table 33: Peterborough Workplace Safety Committee Goals and Results

2020 goals for Peterborough are established as follows:

1. Meet at least nine times as required by the Canada Labour Code Part II
2. Joint meetings with other site EHS Teams (ALARA, Ergonomic, Emergency Response Team, Beryllium)
3. Inspection tour completion target of over two out of every three areas each month and each area at least once a quarter minimum.
4. Review one EHS Program for improvements by year end – updated site emergency response plan.

3.8.1.2 Toronto WSC

In Toronto, 11 meetings were held with quorum. A total of 52 investigations and inspections were conducted in the reporting period. This includes WSC inspections, manager inspections, and near-miss, incident and injury investigations. These investigations and inspections led to a total of 134 actions logged and tracked to closure. The top finding categories from WSC inspections were 'housekeeping,' 'unsafe condition,' 'concerns,' 'facilities and equipment.'

Established goals for the reporting period are summarized in Table 34.

Toronto WSC Goals	Actual	Result
Review one EHS program per quarter to promote program compliance	3/4	Not Achieved
Complete one WSC activities presentation at an all employee meeting by year end	Completed	Achieved

Toronto WSC Goals	Actual	Result
Complete one proactive safety improvement project by year end	Completed	Achieved

Table 34: Toronto Workplace Safety Committee Goals and Results

2020 goals for Toronto are established as follows:

1. Improve closure tracking/follow-up on inspection items
2. Review one EHS program per quarter to promote program compliance
3. Conduct a presentation on selected topics at all employee meeting
4. Conduct joint committee meeting with other EHS teams by year-end

3.8.2 Hazardous Occurrences

Under the Canada Occupational Health and Safety Regulations there are several different types of hazardous occurrences including:

- Minor Injury: any employment injury or an occupational disease for which medical treatment is provided and excludes a disabling injury.
- Disabling Injury: any employment injury or an occupational disease that results in either time loss, or modified duties. Disabling injuries can be either temporary (sprained wrist), or permanent (severed limb), depending on whether or not the employee is expected to make a full recovery.
- Loss of Consciousness: from an electric shock or a toxic or oxygen deficient atmosphere.
- Rescue / Revival or other Emergency Procedures: any incident that requires emergency procedures to be implemented, such as a hazardous substance spill, bomb threat or violence prevention procedure.

Annual reports are provided to the Minister Employment and Social Development Canada as required by regulation.

3.8.2.1 Injuries and Illness

As can be seen in Table 35, BWXT NEC has had five years without a Lost Time Injury (LTI). Additionally, BWXT NEC has had zero LTI's in seven out of the nine years of the current licensing period.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Peterborough	0	0	0	0	0	0	0	0	0
Toronto	0	1	0	1	0	0	0	0	0

Table 35: Lost Time Injuries

The Peterborough site experienced one recordable injury to the hand, but no lost time injuries. During the reporting period there were seven first aids. The top injury categories were 'rubbed/abraded,' 'contact by', 'falls same level,' 'lifting/lowering/carrying/pushing or pulling,' and 'struck against.' There were 15 near misses logged following defined event classification criteria. The top noted categories were 'safety,' 'other health and safety,' 'walking and working surfaces,' and 'waste management.'

In Toronto, there were 13 first aids and zero recordable injuries (no lost time). Six out of the 13 injuries involved an injury to the hand or arm. The accident type associated with the injuries varied included 'contact with a sharp object,' 'falls same level,' 'lifting, lowering, carrying, pushing, or pulling,' 'stepped on;' and 'body position/posture.' There were 18 near miss events logged following defined event classification criteria. The top three noted categories were 'other health and safety,' 'safety,' and 'radiation protection.'

3.9 Environmental Protection

The "Environmental Protection" Safety and Control Area covers programs that monitor and control all releases of nuclear and hazardous substances into the environment, as well as their effects on the environment as a 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. The facilities have well-established environmental management systems to ensure effective monitoring programs are in place to achieve environmental goals and regulatory compliance. Environmental protection programs are compliant with:

- CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*,
- CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills*, and
- CSA N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*.

3.9.1 Environmental Risk Assessment

Environmental Risk Assessments specific to the Toronto and Peterborough facilities have been completed in accordance with CSA N288.6-12. The ERAs concluded that emissions of radioactive material from the facility were very low and pose no adverse effect to human health.

The emissions of non-radioactive contaminants from the facility were below the MECP point of impingement (POI) standards; and water releases are also assessed to be minimal. Hence, it was concluded that the emissions of non-radiological substances resulting from the BWXT NEC facilities pose no adverse effect to human health.

The Environmental Risk Assessments also concluded that emissions of radioactive and non-radioactive materials from the facility pose no adverse effects to non-human biota.

3.9.2 Environmental Management System

BWXT NEC has a well-established integrated management system for environmental, health and safety program excellence. This is ensured through the effective implementation of program elements. BWXT NEC has an established EHS Mission Statement that is reviewed and signed annually by the President of BWXT NEC. BWXT NEC's objective is to eliminate or minimize as low as reasonably achievable both known and potential environmental hazards which could impact our employees and the communities in which they live. EHS is a shared responsibility, top business priority and is continually improved.

An Environmental Management System is in place to identify and control environmental aspects and drive continuous improvement to enhance performance and minimize risk to the employees and the public.

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;
- Documented environmental concerns, near misses and incidents with appropriate root-cause analysis, preventive and corrective actions.

The EHS program includes all environmental protection elements that demonstrate compliance to relevant regulations, codes and standards:

- Air
- Water
- Waste
- Dangerous goods shipping
- Boundary radiation monitoring
- Soil sampling (Toronto)

Continuous improvement is achieved through several review processes, including site inspections, reported concerns, near miss and incident investigations, self-assessments and audits. Environmental goals performance is discussed in 3.9.4. An annual internal self-assessment and audit of the environmental protection program elements are conducted at each facility (3.2.1 and 3.2.2). Following these proactive reviews, the findings are documented, corrective actions identified and tracked to completion.

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. WSC members carry out routine plant inspections. After an inspection, the findings are documented, corrective actions identified, and submitted to responsible personnel to address. Depending on the complexity of the finding immediate action may be required (i.e. equipment shutdown), or the action may be incorporated into meeting minutes, or tracked in the ATS.

There were no major program changes at the Peterborough site. In Toronto, several program improvements were instituted. Work was completed on the Furnace 5/6 ventilation in order to minimize flow variability. This work included balancing and damper installation and resulted in improved performance in this area. The facility also engaged a third party vendor to assess the exhaust in-duct sampling program, this resulted in minor procedure updates and a recommendation to consider changes to probe sizes.

In the reporting period, minor administrative updates were made to two environmental documents.

3.9.3 Effluent and Environmental Monitoring Programs

Radiological and non-radiological substances are released to the environment as the result of operations at BWXT NEC. Environmental protection is regulated municipally for water effluent through sewer-use by-laws, provincially for air effluent and federally through the CNSC. Airborne and waterborne radiological and non-radiological emissions to the environment are monitored as part of the effluent monitoring

programs. BWXT NEC's effluent and environmental monitoring program is comprised of the following components:

1. Air effluent
2. High-volume ambient air
3. Water effluent
4. Soil sampling

BWXT NEC has established facility specific CNSC approved Action Levels for various environmental parameters. An Action Level is defined in the Radiation Protection Regulations as "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 also applied to environmental protection. Action Levels are set below regulatory limits; however, they are CNSC reportable events. Accordingly, BWXT NEC has established Internal Control Levels for various environmental parameters that are set even lower than Action Levels to act as an early warning system. Internal Control Level exceedances trigger an internal investigation and corrective actions; however, they are not CNSC reportable events. No regulatory limits or Action Levels were exceeded during the reporting period.

3.9.3.1 Independent Environmental Monitoring Program

To complement existing and ongoing compliance activities and site monitoring programs, the CNSC implemented an Independent Environmental Monitoring Program to verify that the public and environment around CNSC-regulated facilities are not adversely affected by releases to the environment. This verification is achieved through independent sampling and analysis by the CNSC. This program applies to the BWXT NEC operations. Sampling was last conducted in 2019. The results are compared to relevant provincial and federal guidelines and are available on the CNSC website.

3.9.4 Peterborough Environmental Protection Program Performance

Environmental protection goals and results are summarized in Table 34.

Peterborough Environmental Protection Program Goals	Actual	Result
Develop and implement site-wide environmental awareness training	Complete	Achieved
Review and improve change control involving chemical usage	Complete	Achieved
Install coolant mixing stations in the B26 tool room	Complete	Achieved
Complete one asbestos abatement project	Complete	Achieved

Table 36: Peterborough Environmental Protection Program Goals

2020 goals for Peterborough are established as follows:

1. Implement a reduction in electricity usage (10% from highest monthly) by year end
2. Complete one asbestos abatement project by year end
3. Perform off-site soil sampling for beryllium

3.9.5 Toronto Environmental Protection Program Performance

In the reporting period, work continued related to the installation of a Maintenance Access Hole or alternate sampling device as requested by the City of Toronto. A suitable location was determined and a building permit submitted. This activity is related to a previous City of Toronto routine inspection assessing compliance with municipal environmental legislation regarding water emissions. The governing legislation includes the City of Toronto Sewer Use By-Law.

Environmental protection goals and results are summarized in Table 37.

Toronto Environmental Protection Program Goals	Actual	Result
Furnace 5/6 exhaust ventilation improvements	Complete	Achieved
Storm water management improvements	Complete	Achieved
Water analysis program/equipment review	Complete	Achieved
Noise abatement projects	Complete	Achieved

Table 37: Toronto Environmental Protection Program Goals

2020 goals for Toronto are established as follows:

1. Installation of plant sewer outlet sampling device
2. 6h68 ventilation system assessment and balancing
3. Optimize waste water treatment process and capacity

3.9.6 Air Effluent Monitoring

BWXT NEC facilities have valid Environmental Compliance Approvals issued by the Ministry of Environment, Conservation and Parks (MECP) for air emissions. In accordance with permit conditions, each site maintains emission summary and dispersion modelling reports and acoustic assessment reports that demonstrate compliance to relevant legislation. Annual summary reports are submitted to the MECP.

Measured uranium air emissions are included in the estimated dose to members of the public through direct correlation with facility DRLs. Details are provided in section 3.7.12.

3.9.6.1 Peterborough Air Monitoring

A single process uranium air emission point exists in the Peterborough facility. The R2 Area Decan Station exhausts through a High Efficiency Particulate Air filter. The facility performs continuous in-stack monitoring 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 for testing by delayed neutron activation analysis. The minimum detection limit is 0.01 µg uranium. Results are compared to the previous results and to relevant Internal Control Levels and Action Levels.

The Peterborough facility uses beryllium as part of the fuel bundle manufacturing process. The Environmental Protection Act of Ontario (R.S.O. 1990, c. E. 19) and Ontario Regulation 419/05 Air Pollution – Local Air Quality determine the permitted concentration of contaminant release. The limit at the POI for Beryllium is 0.01 µg per cubic meter of air (µg/m^3). The POI is the plant/public boundary. In accordance with the relevant provincial regulations, an Environmental Compliance Approval is valid for the site's operations with modelling in place to confirm compliance.

Three beryllium air emission points exist in the Peterborough facility. Monitoring of this emission is not required by the MECP as the emissions are deemed to be insignificant in accordance with MECP methodology. Due to the additional regulation by the CNSC, BWXT NEC monitors the contaminant concentration in each stack and has an established Action Level of 0.03 µg/m^3 and an Internal Control Level of 0.01 µg/m^3 at the stack exit, which are both very conservative. 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 using the Atomic Absorption method or the Inductively Coupled Plasma - Atomic Emission Spectrometer method at an accredited external independent laboratory. The result is related to the air volume passed through the filter. The minimum detection limit is 0.002 µg beryllium. A calculation of the concentration is then made based on the volume of air drawn across the filter. These values are compared to the previous results, and to relevant Internal Control Levels and Action Levels.

A summary of air effluent sampling results is in Table 38. Uranium air release results continue to remain low and well below the Action Level of 1 µg/m^3. The ten-year trend graph of annual uranium air releases, presented in Figure 14, shows a stable performance consisting of very low measurements. The total release of 0.004 g in the reporting period is well below the regulatory established discharge limit of 550 g per year. The ten-year trend graph of annual beryllium air concentrations presented in Figure 15 shows a stable performance consisting of very low measurements.

Peterborough Air Emissions						
Stack Description	**Emission Contaminant**	**Total Number of Samples**	**Action Level (µg/m^3) (# Samples Exceeding Level)**	**Highest Value Recorded (µg/m^3)**	**Average Value Recorded (µg/m^3)**	**Total Discharge (g)**
R2 Decan	Uranium	47	1.0 (0)	0.014	0.001	0.004
North	Beryllium	47	0.03 (0)	0.001	0.000	N/A
Acid	Beryllium	47	0.03 (0)	0.001	0.000	N/A
South	Beryllium	47	0.03 (0)	0.000	0.000	N/A

Table 38: Summary of Peterborough Monitored Air Emissions

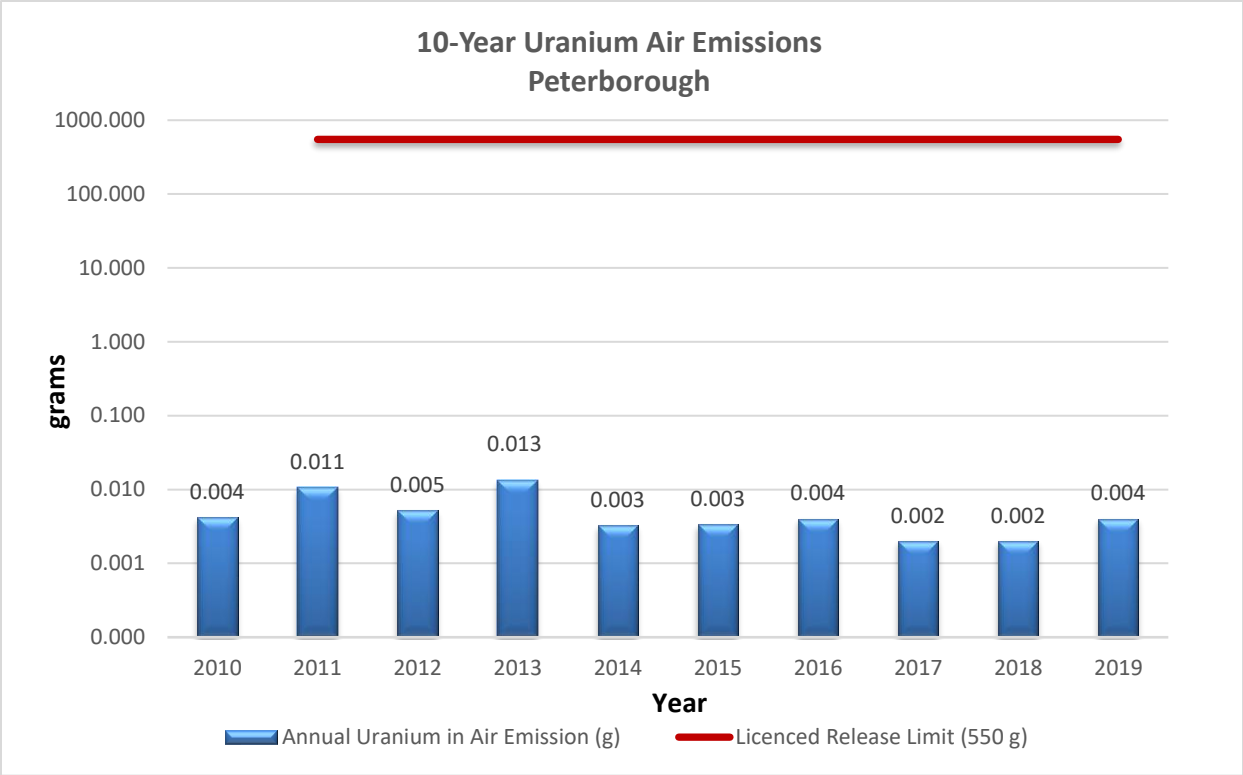

Figure 14: Peterborough 10-Year Annual Uranium Air Emissions

Note: the above graph has a logarithmic scale

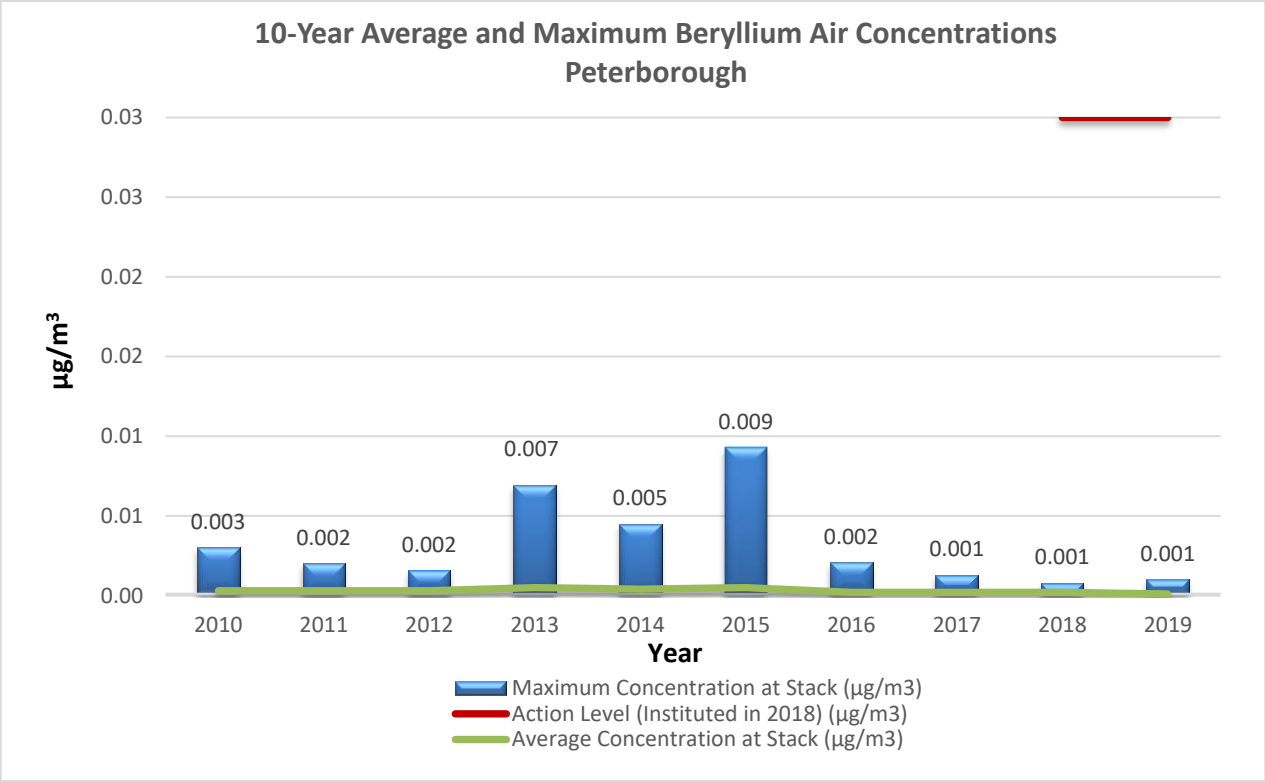

Figure 15: Peterborough 10-Year Annual Beryllium Air Concentrations

3.9.6.2 Toronto Air Monitoring

The Toronto facility performs continuous in-stack sampling and boundary air monitoring for uranium. The facility performs continuous in-stack monitoring 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. Boundary samples are analyzed externally by an independent laboratory. In both cases the external independent laboratory tests the filter papers by delayed neutron activation analysis. The minimum detection limit is 0.01 µg uranium. Results are compared to the previous results, and to relevant Internal Control Levels and Action Levels.

A summary of air effluent sampling results is in Table 39 and Table 40. Air monitoring results are trended over ten years as shown in the Figure 14 and Figure 16. Toronto's average boundary monitor results are trended over five years as shown in Figure 17. The Toronto stack air emission is trending down, with a steady trend in recent years. The total release of 7 g during the reporting period is well below the discharge limit of 760 g. The total release includes all monitored locations (Rotoclone, 6H-68, 4H-48, Furnace #1, Furnace #2/4 and Furnace #5/6). The downward trend is primarily the result of measured furnace stack emissions in 2017 and 2018, rather than the conservative estimates applied prior. In addition, the furnace filter housings were replaced in late 2016 to improve performance and ease of maintenance tasks including filter changes. Note also that air emission concentrations are now reported using third party measurements as opposed to in-house values.

Toronto's average boundary monitor results are trended over ten years in Figure 17 and consist of very low uranium in air concentrations. The boundary air monitor maximum concentration measurements also continue to remain low and well below the Action Level of 0.08 µg/m^3.

Toronto Uranium in Air Emissions						
Stack Description	**Emission Contaminant**	**Total Number of Samples**	**Action Level (µg/m³) (# Samples Exceeding Level)**	**Highest Value Recorded (µg/m³)**	**Average Value Recorded (µg/m³)**	**Total Discharge (g)**
Rotoclone	Uranium	251	1.0 (0)	0.077	0.016	1.16
6H-68	Uranium	251	1.0 (0)	0.111	0.024	3.99
4H-48	Uranium	251	1.0 (0)	0.037	0.012	0.32
Furnace #1	Uranium	251	1.0 (0)	0.081	0.031	0.62
Furnace #2/4	Uranium	251	1.0 (0)	0.103	0.020	0.32
Furnace #5/6	Uranium	251	1.0 (0)	0.245	0.057	0.64

Table 39: Summary of Toronto Uranium in Air Emissions

	Toronto			
	2016	**2017**	**2018**	**2019**
Number of Boundary Air Samples Taken	260	260	260	260
Number of Samples > Action Level (0.08 µg/m³)	0	0	0	0
Average Concentration (µg U/m³)	0.001	0.000	0.000	0.000
Highest Value Recorded (µg U/m³)	0.039	0.008	0.003	0.001

Table 40: Summary of Toronto Boundary Air Quality Monitoring

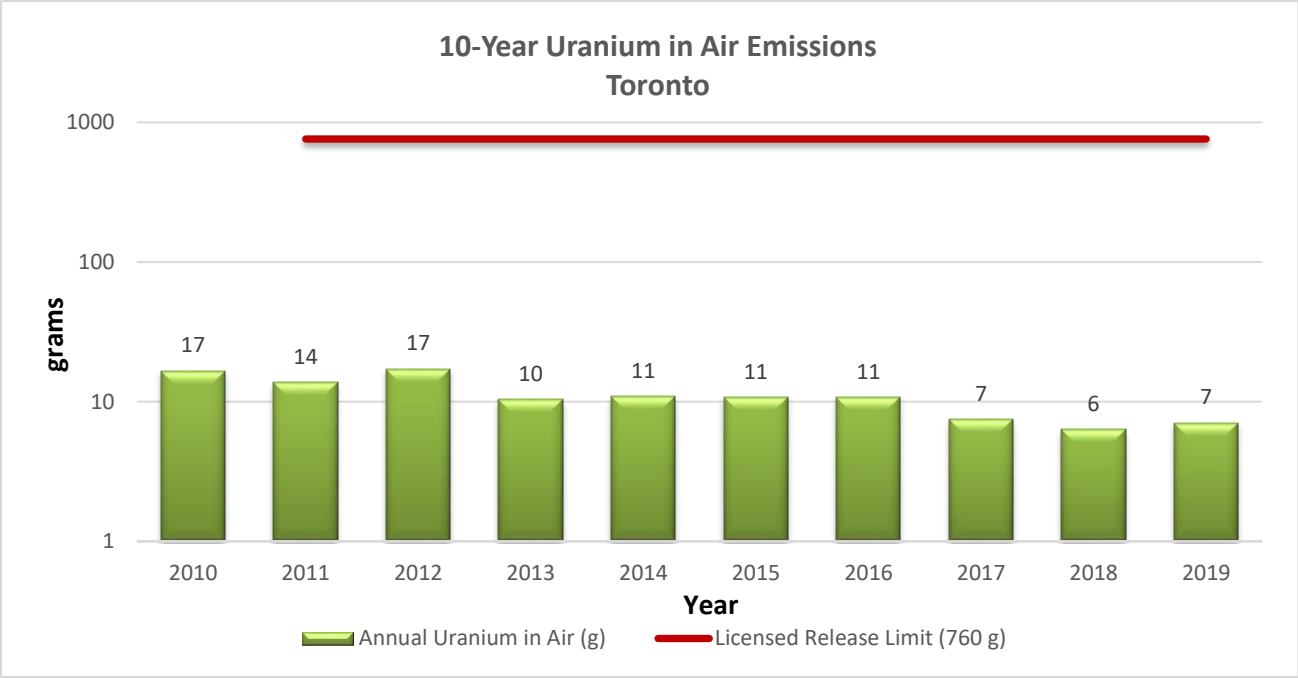

Figure 16: Toronto 10-Year Annual Uranium Air Emissions

Note: the above graph has a logarithmic scale

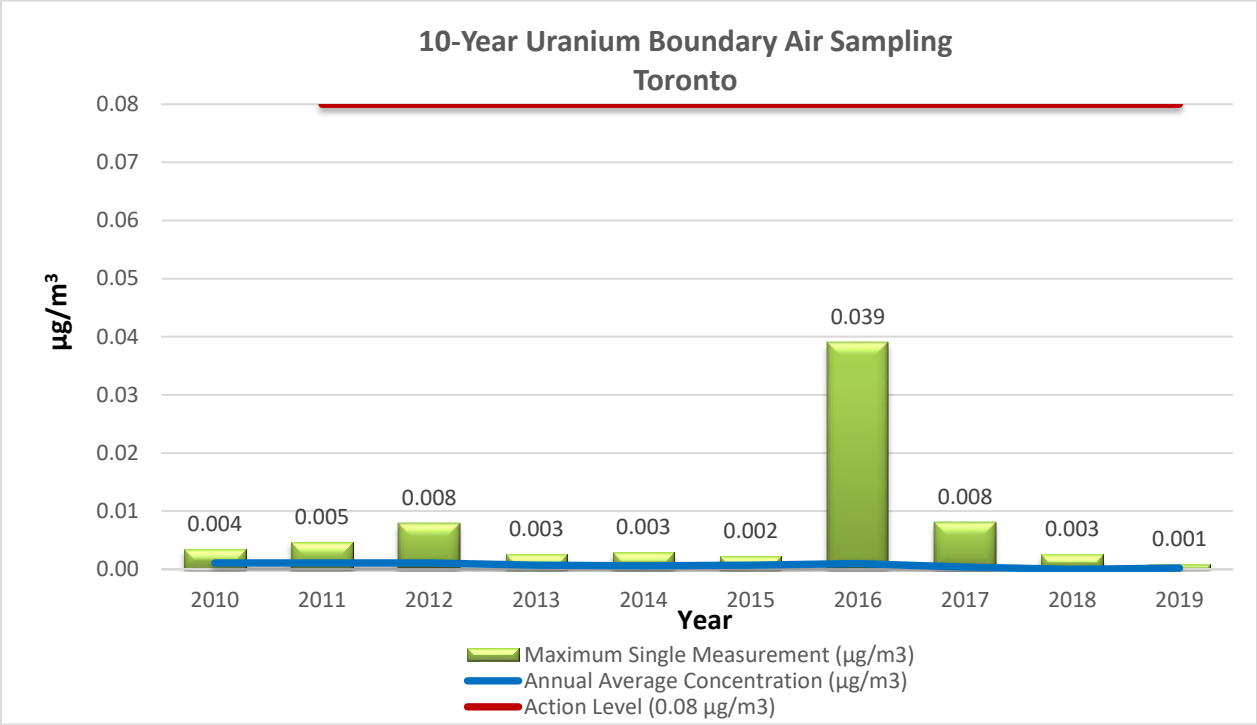

Figure 17: Toronto Annual Boundary Air Monitor Concentration

3.9.7 Water Effluent Monitoring

3.9.7.1 Peterborough Water Monitoring

All potentially uranium-contaminated wastewater is held for determination of the quantity and concentration of uranium prior to discharge. 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 independent analysis at an accredited external laboratory. The minimum detectable concentration is 0.000002 mg U/L (parts per million (ppm)).

After the waste 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 discharged to the sanitary sewer.

The ten-year trend graph of uranium water releases, presented in Figure 18, shows a stable performance consisting of very low uranium in water concentrations. The sample batch number size is limited and trending is difficult due to small random fluctuations in low concentrations. Water release results continue to remain low and below the Action Levels of 6 ppm (per batch) and 3 ppm (annual average). The total release of 0.02 g is a very small fraction of the derived release limit and of the regulatory discharge limit of 760 kg/year.

A second liquid effluent from the Peterborough facility is beryllium in water that is generated from equipment use and cleaning activities. BWXT NEC has established an Internal Control Level of 4 µg/L and the Action Level is 40 µg/L. The Internal Control Level is conservatively consistent with international drinking water guidelines for beryllium, noting that the discharge point is to the sanitary sewer (i.e. not to drinking water). 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. It is sent for analysis at an external accredited independent laboratory. The minimum detectable concentration is 0.007 µg Be/L (0.000007 mg Be/L or parts per million (ppm)).

Beryllium average and maximum concentrations and Internal Control Level exceedances are trending down overall following the replacement of the weir settling system in December 2015, as presented in Figure 19. Where Internal Control Levels are exceeded, internal investigation is conducted to determine the cause and corrective/preventive actions are tracked to closure.

	Peterborough			
	2016	**2017**	**2018**	**2019**
Total Amount of Liquid Discharged (L) from Uranium Processing Areas	820	820	820	615
Maximum Uranium Concentration (at the point of release) (ppm)	0.48	0.09	0.03	0.07
Average Uranium Concentration (at the point of release) (ppm)	0.15	0.04	0.02	0.04
Number of Samples Exceeding Action Level (6 ppm per batch)	0	0	0	0
Total Uranium Discharge to Sewer (g)	0.13	0.03*	0.01	0.02
Total Number of Samples Analyzed for Beryllium Concentration in Water	18	17	19	19
Maximum Beryllium Concentration (at the point of release) (µg/L)	2.5	5.4	2.5	1.8
Average Beryllium Concentration (at the point of release) (µg/L)	0.4	1.0	0.6	0.6
Number of Samples Exceeding Internal Control Level (4 µg/L)	0	2	0	0
Number of Samples Exceeding Action Level (40 µg/L)	N/A	N/A	0	0

Table 41: Peterborough Water Effluent Monitoring Results

*Total uranium discharge to sewer (g) for Peterborough was revised from 2017's annual compliance report to reflect actual discharge.

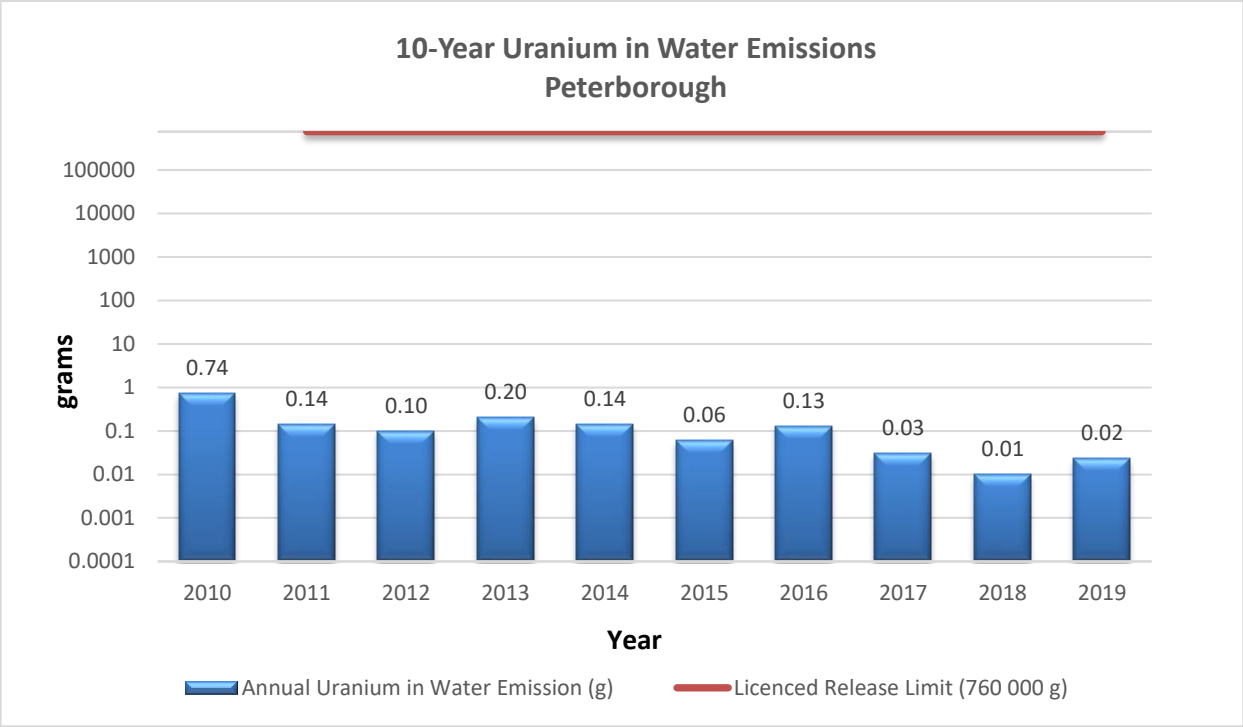

Figure 18: Peterborough 10-Year Uranium in Water Emissions

Note: the above graph has a logarithmic scale

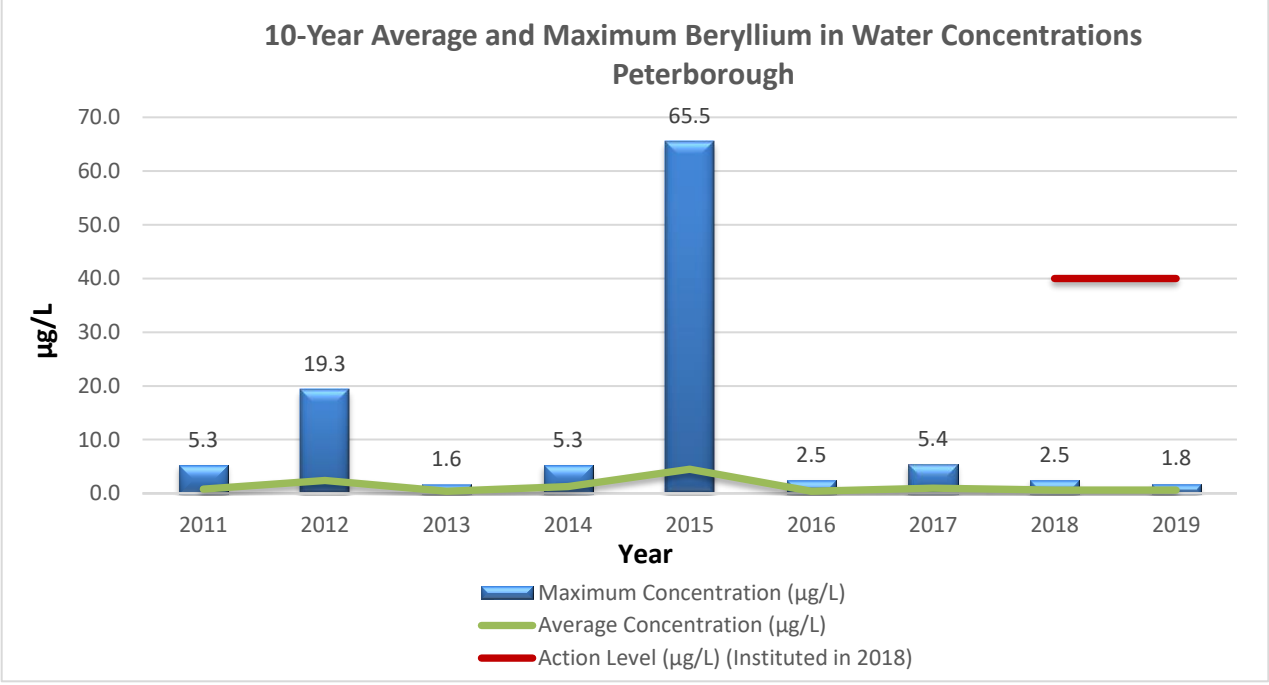

Figure 19: Peterborough 10-Year Beryllium in Water Concentrations

3.9.7.2 Toronto Water Monitoring

In Toronto, water is used to clean protective clothing, walls, floors, equipment and in various other janitorial functions. The water is treated to remove UO_2 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). Maximum values reported are calculated from the analyzed in-house samples. In addition, a weekly composite sample is prepared and sent for independent analysis at an accredited external laboratory. The minimum detectable concentration is 0.000001 mg U/L or parts per million (ppm). Averages and annual releases are calculated from the weekly composite samples.

The water effluent treatment system at the Toronto facility operates as follows:

1. Waste water is held in batches
2. Each batch is treated, then sampled
3. Each batch is only released when in-house sample results confirm the concentration is less than 3 ppm (note: The Action Level for a batch is 6 ppm)

Results from water effluent monitoring are summarized in Table 42. Sample measurements are taken at the point of release, prior to mixing with non-process water. Annual discharges for uranium in Toronto are trended in Figure 20. Toronto total liquid effluent releases are showing a downward trend. Decreased average uranium concentration at the point of release is attributed to changes in chemical usage for water treatment. Results continue to remain low and below the Action Levels of 6 ppm (per batch) and 3 ppm (annual average). The total release of 0.57 kg during the reporting period is well below the licensed release limit of 9000 kg/year.

	Toronto			
	2016	**2017**	**2018**	**2019**
Total Amount of Liquid Discharged (L) (from Uranium Processing Areas)	1,239,375	1,140,225	1,295,560	1,232,765
Maximum Uranium Concentration (at the point of release) (ppm)	2.80**	2.56	2.95	2.58
Average Uranium Concentration (at the point of release) (ppm)	0.81**	1.12	0.72***	0.46
Number of Samples Exceeding Action Level (6 ppm per batch)	0	0	0	0
Total Uranium Discharge to Sewer (g)	650	941	935	572
Minimum pH	6.7	6.1	7.1	6.5
Average pH	7.1	7.2	7.6	7.6
Maximum pH	7.7	7.8	8.7	8.5

Table 42: Toronto Liquid Effluent Monitoring Results

**Values were revised from 2016's annual compliance report to reflect undiluted concentrations; diluted concentrations included dilution of effluent within the plant sewer prior to entry to the municipal sewers and were previously reported in error.

***Values reported 2018 going forward are from external laboratory composite samples.

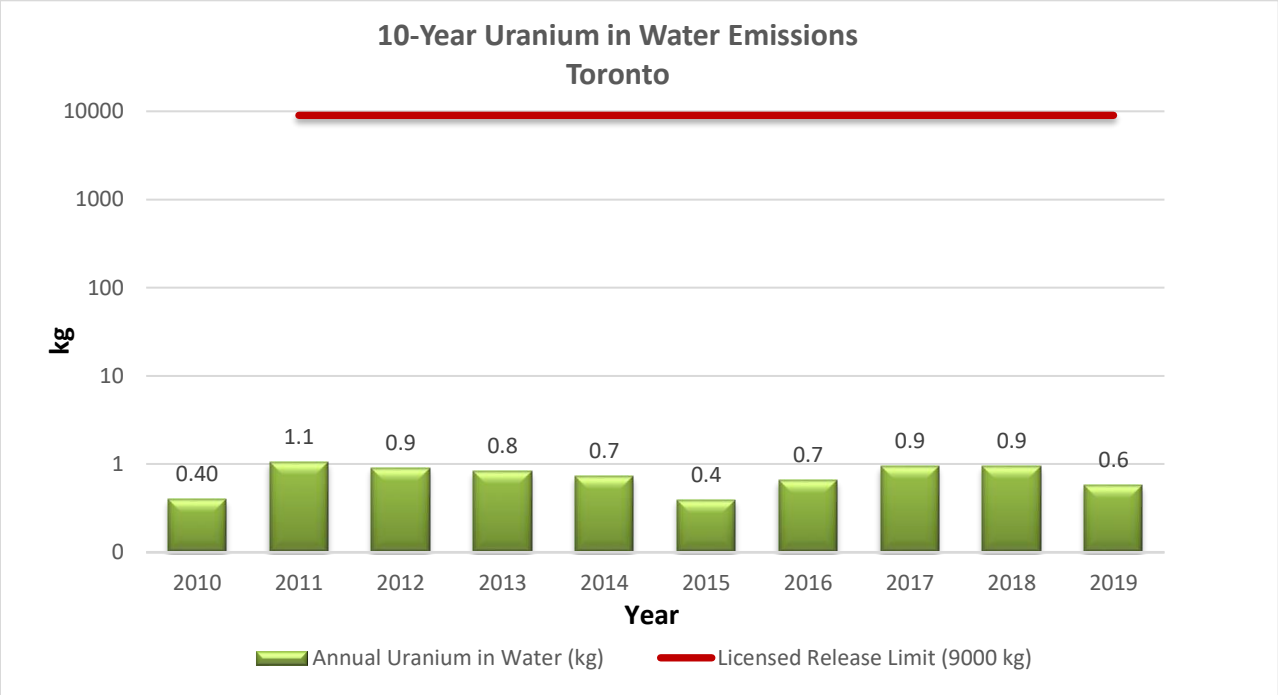

Figure 20: Toronto 10-Year Uranium in Water Emissions

Note: the above graph has a logarithmic scale

3.9.8 Soil Sampling Measurements/Monitoring

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 ((parts per million (ppm)). The Canadian Council of Ministers of the Environment (CCME) have 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. For residential and parkland land use, the guideline is 23 µg/g; for commercial use, the guideline is 33 µg/g; for industrial land use the guideline is 300 µg/g. These guidelines have been adopted by the MECP and are listed in Ontario regulation 153/04. Uranium content in soil at concentrations higher than the MECP standards suggest a need for further assessment, and mitigation of the source of the uranium to eliminate potential exposure and environmental impairment.

Depositions of uranium are measured by taking small samples of surface soil and analyzing for natural uranium. Soil sampling is not conducted at the Peterborough facility due to the negligible air release measurements. Soil sampling is conducted annually at the Toronto facility by a third-party consultant. If soil analysis indicates rising natural uranium levels, emissions may have increased and investigation is made into the cause.

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. Surface uranium levels will indicate deposited emissions. Continuous ambient air monitoring units are installed at the perimeter of the facility (boundary air monitors) to verify the effectiveness of the emission control systems. No concerns have been detected regarding release of uranium as sampled at the perimeter air monitoring units which is consistent with very low emissions as measured at the emission stacks.

At the Toronto facility, samples of surface soil are retrieved from 49 locations in accordance with a documented plan. The sampling methodology used is based on the MECP "Guidelines on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario," December 1996, ISBN-0-7778-4056-1. Annually, the five-year average wind data obtained from Toronto Pearson Airport climate data centre (located approximately 12 kilometers west of the facility), is reviewed and used to confirm the appropriateness of the selected soil sampling locations. The data shows prevalent winds from north to south-west blowing across the BWXT NEC location. Three quality control soil samples at a background location more than 20 km north and east of the facility are also taken, along with two replicate soils samples for field quality control purposes. The soil samples are stored in a cooler with ice and transported the next day for analysis at an independent accredited laboratory by Inductively Coupled Plasma Mass Spectrometry for uranium content. The minimum detectable concentration is 1.0 part per million (1.0 µg U/g). Results are compared to previous years and the CCME guidelines. A summary of results taken in the reporting period is listed in Table 43. Each individual soil sampling result is listed in Table 44. Locations are colour coded per their area classification: BWXT NEC property is blue, industrial/commercial lands are purple, and all other locations are green. Note: location ID 39 and 40 were removed from the plan in 2013 because of inaccessibility due to construction.

	Location Description		
	On BWXT NEC property	**On industrial/commercial lands, i.e. south rail lands**	**All other locations, i.e. residential**
Relevant CCME Guideline (µg U/g)	**300 µg U/g**	**33 µg U/g**	**23 µg U/g**
Number of Samples Taken	1	34	14
Average concentration (µg U/g)	1.2	1.5	1.1
Maximum concentration (µg U/g)	1.2	2.8	1.7

Table 43: Toronto Soil Sampling Result Summary

Sample Location ID	Surrounding Land Use	Uranium Content (µg U/g)	% of guideline
1	Residential	<1.0	<4.3
2	Residential	<1.0	<4.3
3	Industrial	1.2	0.4
4	Commercial	<1.0	<3.0
5	Commercial	<1.0	<3.0
6	Commercial	1.5	4.5
7	Commercial	1.5	4.5
8	Commercial	1.1	3.3
9	Commercial	2.3	7.0
10	Commercial	2.8	8.5
11	Commercial	1.2	3.6
12	Commercial	1.6	4.8
13	Commercial	1.4	4.2
14	Commercial	<1.0	<3.0
15	Commercial	1.8	5.5
16	Commercial	1.4	4.2
17	Commercial	1.6	4.8
18	Commercial	1.0	3.0
19	Commercial	1.0	3.0
20	Commercial	1.5	4.5
21	Commercial	1.2	3.6
22	Commercial	1.8	5.5
23	Commercial	2.0	6.1
24	Commercial	1.3	3.9
25	Commercial	1.5	4.5
26	Commercial	1.7	5.2
27	Commercial	<1.0	<3.0
28	Commercial	1.2	3.6
29	Commercial	<1.0	<3.0
30	Commercial	2.1	6.4
31	Commercial	1.6	4.8
32	Commercial	1.5	4.5

Sample Location ID	Surrounding Land Use	Uranium Content (µg U/g)	% of guideline
33	Commercial	2.3	7.0
34	Commercial	1.7	5.2
35	Commercial	<1.0	<3.0
36	Residential	<1.0	<4.3
37	Commercial	<1.0	<3.0
38	Residential	<1.0	<4.3
41	Commercial	<1.0	<3.0
42	Residential	1.7	7.4
43	Residential	<1.0	<4.3
44	Residential	<1.0	<4.3
45	Residential	<1.0	<4.3
46	Residential	<1.0	<4.3
47	Residential	<1.0	<4.3
48	Residential	<1.0	<4.3
49	Residential	<1.0	<4.3
50	Residential	<1.0	<4.3
51	Residential	<1.0	<4.3

Table 44: Toronto Individual Soil Sampling Results

The analytical results for uranium concentrations for all soil samples analyzed are, without exception well below the acceptable standard published by the MECP under Ontario regulation 153/04 and CCME soil quality guideline. The results show a range of concentrations from <1.0 µg/g to 2.8 µg/g with 48 sample locations having reported uranium concentrations below the Ontario background concentration of 2.5 ppm.

It is noted that uranium content in 2019 decreased compared to the 2018 results at 41 of the 49 sample locations. The reported analytical results for uranium content show a marginal increase for the remaining 8 sample locations. The 2019 analytical results confirm an overall downward trend year over year in uranium content at most sample locations.

3.10 Emergency Management and Fire Protection

The emergency preparedness and fire protection programs are well-established and effective. 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. The plans are intended to reduce the risk of fires within the facility and assist emergency staff and plant personnel in understanding key emergency response issues, and assist the facility in protecting employees, the local community and the environment through sound emergency management practices. The emergency response plans are developed in accordance with standards and meets the CNSC operating licence requirements.

Continuous improvement is achieved through several review processes, including site inspections, reported safety concerns, near miss and incident investigations, drills and self-assessments. Non-conformances are tracked to closure.

At the Toronto site, there were no events that activated the emergency organization during the reporting period. There were two events that required portions of the emergency plan to be implemented. In the first, in-house emergency responders followed decontamination and injury protocols while responding to a medical incident. In the second, a power failure required personnel to respond during the weekend to restart emergency response and safety-related equipment.

3.10.1 Emergency Preparedness Program Activities

During the reporting period, the Peterborough site improved its chemical spill response plan. This was achieved through a review and update of spill kit contents, revised response plans for minor and major spills and implementing donning and doffing training for on-site emergency responders.

The Toronto site continued with program improvements which focused on detailed work instruction reviews and drill management. There were a number of improvements recommended as a result of drills in the areas of emergency equipment and emergency procedures.

Emergency preparedness training is achieved through response drills where actual responses are regularly critiqued to continually improve the effectiveness of the process. These are conducted at least annually. 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. On-site emergency responders are provided with the level of training necessary to allow them to effectively perform their designated functions as defined in each facilities training matrix. Training course completion is summarized in Table 4.

Tests of the emergency response plans were performed in the following areas:

At the Peterborough site:

1. Fire safety/Evacuation (two)
2. Business Continuity Drill – electrical fire (one)
3. Graphite Coater alarm (one)

At the Toronto site:

1. Fire safety/evacuation (two)
2. Emergency plan (two)
3. Medical emergency (two)

3.10.2 Fire Protection Program Activities

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.

The documented fire hazards analysis (FHA) identifies the facility fire hazards and their potential impact on the worker and public safety and asset protection. In Peterborough, FHA's for building 21, building 24, and buildings 26/28 were updated and submitted to the CNSC and meet the required standards.

The facilities maintain documented fire safety plans that are developed in accordance with the National Fire Code of Canada, the National Building Code of Canada and CSA N393-13, *Fire protection for facilities that process, handle, or store nuclear substances*. The fire safety plans are based on the documented FHA and ensures that measures are appropriate to the facility. They provide information on resources in the buildings, emergency procedures and actions to be taken in the event of a fire. They include training, duties of designated personnel, details of maintenance procedures and fire protection measures. The information assists the occupants in utilizing life safety features in the buildings, ensure an orderly evacuation at the time of an emergency and provide a maximum degree of flexibility to achieve the necessary fire safety for the buildings.

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

During the reporting period, BWXT NEC worked with Toronto Fire Services to establish a clear basis for contingency response planning between the organizations to deal with fire and rescue emergency situations at BWXT NEC. This facilitates effective communication and exchange of relevant information, and assures timely, reliable, and effective decision making and response actions. Site hazard reviews and site familiarization tours are scheduled annually with Peterborough Fire Service and Toronto Fire Services.

In Toronto, a review of Fire and Life Safety System Impairment procedures was completed. The National Fire Code and *CSA N393-13, Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances* were reviewed for impairment procedure requirements against existing documentation and a stand alone document was created.

Physical plant changes are periodically made to improve fire protection programs. In Toronto, minor changes to improve the fire protection program were implemented including the addition of new sprinkler heads at overhead doors, and the installation of glycol and backflow preventers in the shipping area. In Peterborough, some improvements were made to emergency lighting, including updating some emergency lighting units in building 28 to LED lights, and adding two emergency lighting units in the north end of building 26. Penetrations in fire separations in building 21 were fire-stopped with an approved fire stop product. Additionally, building 24 steel columns had fire protection extended to the top of the columns.

3.11 Waste Management

The "Waste Management" Safety and Control Area covers internal waste and by-product related programs which form part of the facility's operations, up to the point where the waste is removed from the facility to a separate waste and by-product management facility. This Safety and Control Area also covers the ongoing decontamination and planning for decommissioning activities.

Radioactive wastes are any materials that contain a radioactive nuclear substance, and which have been declared to be waste. BWXT NEC has an effective and well-established radioactive waste disposal program that ensures all radioactive waste disposals are compliant with the Nuclear Safety and Control Act and regulations and the facility operating licence conditions. Radioactive solid waste 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 0.1% 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.

Waste management and generation details are further described in Appendix B, submitted to the CNSC separately.

BWXT NEC maintains preliminary decommissioning plans (PDPs) and financial guarantees for both the Toronto and Peterborough facilities in accordance with CNSC Regulatory Guide G-219 Decommissioning Planning for Licensed Activities, CNSC Regulatory Guide G-206 Financial Guarantees for the Decommissioning of Licensed Activities, and CSA N294-09 Decommissioning of Facilities Containing Nuclear Substances. (PDPs). The PDP strategy and end-state objective of decommissioning is to release the site from regulatory control for industrial use or demolition of the structures. These are reviewed at least once every five years. During the reporting period, BWXT NEC provided updated PDPs to the CNSC, which were reviewed and subsequently accepted.

The Peterborough site conducts an annual Waste Audit and Waste Reduction Work Plan in accordance with Ontario regulation 102/94 under the Environmental Protection Act. This audit is not required at the Toronto facility. The audit serves to assess and advance the non-nuclear waste diversion initiatives and consists of the physical collection and sorting of generated waste and includes a waste composition study. It provides a prepared Waste Reduction Work Plan where areas of success are highlighted and opportunities for improvement are identified through waste reduction, reuse and recycling. The results of the audit are communicated to employees and waste reduction and diversion initiatives are undertaken.

3.12 Security

The "Security" Safety and Control Area covers the programs required to implement and support the security requirements stipulated in the regulations and in the operating licence.

The Toronto and Peterborough facilities each maintain a security program in accordance with the General Nuclear Safety and Control Regulations, Class I Nuclear Facilities Regulations, and the Nuclear Security Regulations. The security programs outline the systems, processes and responsibilities for performing security operations with the objective of maintaining safe and secure facilities. The program manuals identify the individual responsibilities for implementation and maintenance of the program. The manuals include instructions for administering the security program, provides the basis for security protocols and identifies the controls in place to meet regulatory requirements. Program details are prescribed information and confidential. 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.

3.13 Safeguards and Non-Proliferation

The "Safeguards and Non-proliferation" Safety and Control Area covers the programs required for the successful implementation of the obligations arising from the Canada/IAEA Safeguards and Non-proliferation Agreement. BWXT NEC has implemented and maintains a safeguards program and undertakes all required measures to ensure safeguards implementation in accordance with IAEA commitments and CNSC regulatory document 2.13.1 *Safeguards and Nuclear Material Accountancy (which superseded RD-336 Accounting and Reporting of Nuclear Material)*. Movement of safeguarded nuclear material (inventory changes) are documented and reported to the CNSC as required.

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. At the start of 2019 BWXT NEC transitioned to reporting all Inventory Change Documents for both facilities through the Nuclear Materials Accountancy Reporting system.

In Peterborough, the Physical Inventory Taking was conducted on June 25, 2019. A Physical Inventory Verification and Design Information Verification involving the CNSC and the IAEA followed on June 26 2019. The scope of the Physical Inventory Verification concerned book examination, physical verification of nuclear material and evaluation of the quality and performance of BWXT NEC Inc.'s measurement system. The scope of the Design Information Verification concerned verification of the facility, general building design, essential equipment, accounting procedures, operator's measurement system, nuclear material characteristics, nuclear material location & flow and operational status of the facility. Short Notice Random Inspections were conducted by the IAEA on January 23rd 2019 and October 30th 2019. The inspection involved physical examination of bundle boxes, sampling and scanning of pellet skids and verification of records. No non-conformances were noted.

In Toronto, the Physical Inventory Taking was conducted on July 2nd 2019. A Physical Inventory Verification and Design Information Verification involving the CNSC and IAEA followed on July 3rd and 4th 2019. The scope of the Physical Inventory Verification concerned book examination, physical verification of nuclear material and evaluation of the quality and performance of BWXT NEC Inc.'s measurement system. The scope of the Design Information Verification concerned verification of the facility, general building design, essential equipment, accounting procedures, operator's measurement system, nuclear material characteristics, nuclear material location & flow and operational status of the facility. Short Notice Random Inspections were conducted by the IAEA on January 16th and November 29th 2019. The inspection involved sampling, measurements and verification of records. No non-conformances were noted.

3.14 Packaging and Transport of Nuclear Substances

The "Packaging and Transport of Nuclear Substances" Safety and Control Area covers the packaging and transport of nuclear substances and other nuclear materials to and from the licensed facilities. In the reporting period, all packaging and shipments to and from both facilities were conducted safely according to relevant regulations. Shipments of dangerous goods are not routinely made from BWXT NEC by air, rail or water. Routine road shipments of both dangerous goods and non dangerous goods are made between suppliers, the Toronto plant, and the Peterborough plant and customer nuclear generating stations. 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.

The transportation of dangerous goods in Canada is regulated by Transport Canada through the Transportation of Dangerous Goods Regulations. Additional requirements for the transport of Class 7 radioactive materials is regulated by the CNSC through the Packaging and Transportation of Nuclear Substances Regulations. In addition, the IAEA has established uniform regulations for all modes of transportation throughout the world. The IAEA has published the Regulations for the Safe Transport of Radioactive Material and the CNSC has endorsed these through the Packaging and Transport of Nuclear Substances Regulations.

BWXT NEC has an established Emergency Response Assistance Plan compliant to Part 7 of the TDG. 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 UO_2. Transportation of uranium materials to and from BWXT NEC are included in the plan.

4 OTHER MATTERS OF REGULATORY INTEREST

4.1 Public Information Program

Employee/Internal Communications

BWXT NEC uses a variety of means to engage its ~400 employees in Peterborough, Toronto and Arnprior. The company uses the employee portal (intranet), electronic bulletin boards, email alerts and printed communications to issue company news, executive blogs and general business updates.

The president of BWXT NEC held all-employee meetings at all sites in the fourth quarter of 2019 and during the summer attends staff appreciation barbeques at all sites to provide updates and address employee questions.

Government Stakeholders

BWXT NEC places great importance on its relationships with all levels of government in the communities in which it operates and works to ensure there is open communication and awareness of BWXT NEC's operating activities.

In 2019, BWXT NEC mailed letters and emailed electronic updates to the MP for Peterborough-Kawartha, MPP for Peterborough, MP and MPP for Davenport, Mayor and Councillors for Peterborough and Councillor for Davenport. These communications provided elected officials in Toronto and Peterborough with information about the licence renewal, invitations for tours, meetings and community events, relevant information and links, and copies of newsletters and other documentation. In 2019, facility tours and meetings were conducted with the Mayor of Peterborough, MPP for Peterborough, Peterborough Councillors in Wards 1, 2, 3 and 5, and representatives from Peterborough & the Kawarthas Economic Development. BWXT NEC discussed the licence renewal on separate occasions with the MP for Davenport and a representative for the MPP for Davenport by way of phone. A representative from BWXT NEC met with the MPP for Davenport as part of the Canadian Nuclear Association's Queen's Park Day in early December.

In December, BWXT NEC officials hosted Peterborough Public Health to discuss the licence renewal and Public Attitude Survey from 2018.

Indigenous Relations

BWXT NEC has been a member of the Canadian Council of Aboriginal Business (CCAB) since September of 2017 and is currently Progressive Aboriginal Certified (PAR) at the committed level. This signifies BWXT's commitment to continual improvement in Indigenous relations and intention to undergo external verification of performance in the future.

The BWXT PAR Committee meets regularly to review objectives outlined in the PAR criteria as the company works to find ways to strengthen its ties with Indigenous communities.

BWXT NEC's local Indigenous communities were contacted via letter and email in 2019. These communications provided information about the licence renewal, invitations for tours, meetings and community events, relevant information and links, and copies of newsletters and other documentation.

In 2019, a facility tour and meeting was conducted with the Métis Nation of Ontario Peterborough & District Wapiti Metis Council in Peterborough. BWXT NEC representatives attended the Métis Nation of Ontario Peterborough & District Wapiti Metis Council Harvest Lunch at the Canadian Canoe Museum. In July, BWXT NEC had a call with representatives from Curve Lake First Nation to discuss the licence renewal. A follow-up meeting was discussed and occurred early in January of 2020.

The company is also an active member within the Indigenous Relations Suppliers Network established by Bruce Power and Indigenous Opportunities in Nuclear program established by Ontario Power Generation.

The company sponsored and attended the Saugeen Ojibway Nation's Youth Leaders in Training Dinner in May of 2019. In August, BWXT NEC sponsored the Métis Nation of Ontario's National General Assembly and provided funding for the Harvest Lunch for Region 6. In October, BWXT NEC attended the CCAB's Indigenous Relations Supplier event.

Overall, the CCAB PAR program supports BWXT NEC's commitment to engaging Indigenous communities and building and sustaining meaningful long-term relationships with them. More information on BWXT NEC's commitment to Indigenous relations, including our policy, can be found at www.nec.bwxt.com under the Community tab.

Community Volunteerism

BWXT NEC remains active in the community through its BWXT Volunteer Strong program. In 2019, BWXT NEC employees volunteered at 17 community events in Peterborough and 1 event in Toronto. These events included: Peterborough Regional Science Fair, Greenwing Fishing Derby, Daffodil and Pink Ribbon fundraisers, Junior Achievement programs, Habitat for Humanity build in Curve Lake, Prince of Wales P.S. Fun Fair, Community Park Clean-Up, Kawartha Food Share Food Drive and Sorting, Five Counties Winterfest, Blood Drive, Canadian Cancer Societies Dragon Boat Festival, Canadian Canoe Museum Painting, Angel Tree and WTCS FIRST LEGO League Judging.

BWXT NEC volunteers helped make these events a success in the Peterborough and Toronto communities and support our key pillars of focus for the community, which include education, health & well-being, arts & culture, environment and Indigenous relations.

Community Investment

In Peterborough, BWXT NEC made charitable contributions to Big Brothers Big Sisters, Kinark Child & Family Services, Métis Nation of Ontario, The Canadian Cancer Society, Fleming College, Kenner Collegiate, Adam Scott Collegiate and Vocational Institute, Crestwood Secondary School,

Greenwing/Ontario Federation of Anglers and Hunters, Five Counties Children's Centre, Kawartha Food Share, Habitat for Humanity, Peterborough Regional Science Fair, and Canadian Canoe Museum.

In Toronto, BWXT NEC made charitable contributions to the Toronto District School Board's Western Technical Commercial School for both their FIRST Robotics Program as well as a bursary award. BWXT NEC also made charitable contributions to the Davenport-Perth Neighbourhood & Community Health Centre, Ontario Tech University, and Pauline Junior Public School.

Tours

BWXT NEC provides facility tours to help engage members of the industry and the public in an effort to help them better understand our business. In 2019, BWXT NEC provided facility tours in Peterborough to the following groups: Canadian Canoe Museum, Crestwood Secondary School students and faculty, Prince of Wales Public School parents via the parent council, Ontario Power Generation, MPP for Peterborough, City of Peterborough Mayor and Councillors, Peterborough & the Kawarthas Economic Development, Citizens Against Radioactive Neighbourhoods, Ontario Tech University, and Métis Nation of Ontario Peterborough & District Wapiti Métis Council. In addition, BWXT NEC provided facility tours in Toronto to the following groups: New Community Liaison Committee (CLC) members, Citizens Against Radioactive Neighbourhoods, Sussex Strategy Group, and a Peterborough Councillor.

BWXT NEC offered tours to our local elected officials in Peterborough and Toronto in April, July, October and November, however, no tours occurred with the MP Peterborough-Kawartha or the MP and MPP for Davenport. BWXT NEC will continue outreach to elected officials.

Community Events

Community barbeques were held in Peterborough on June 5, 2019 and in Toronto on June 11, 2019 and Community Information Night events were held in Peterborough on October 8, 2019 and in Toronto on October 22, 2019.

These events provide a means to engage neighbours, community members and other stakeholders, and to educate them about our business. Over 300 members from each community attended the barbeques. Approximately 50 community members attended the Peterborough Information Night and 10 attended the Toronto event.

Both events were staffed by BWXT NEC leaders and managers. Posters were displayed to share visuals and information about BWXT NEC's capabilities, safety and compliance, public information program, licence renewal and facts about natural uranium. Representatives from the CNSC were in attendance at both events. At the Information Night, guests were encouraged to take home a copy of the Licence Renewal Briefing Guide, a document prepared by BWXT NEC to provide an overview of the licence renewal in Toronto and Peterborough.

BWXT NEC mailed postcard invitations, included invitations in newsletters, hung fence banners, posted to social media and the public information website to advertise the barbeque in June in both Peterborough and Toronto and Information Nights held in October in both Peterborough and Toronto. Additionally, four outdoor media screens were used in Peterborough to invite community members to the Information Night.

Community Newsletters

BWXT NEC distributes, and posts to its website, community newsletters as a tool to share information with the local communities about the company's operational performance, health and safety, licence renewal, activities in the community and general information.

Three newsletters were issued to both the Toronto and Peterborough surrounding communities in May, September and December of 2019 and were also posted to our public information website. In both

communities, distribution increased to ~4000 residents around our facilities compared to approximately 2,500 in Toronto and Peterborough in 2018.

In addition to mailing paper copies of the newsletters, BWXT NEC utilized outdoor and indoor screen signage to advertise the Fall newsletter in Peterborough. Four outdoor signs and nine indoor signs in key locations across Peterborough advertised the Fall newsletter for one week. This change was part of an effort to explore new communication methods to advertise BWXT NEC newsletters or company news to a broader range of community members.

Community Liaison Committee

The Toronto CLC was established in 2013 and meets three or four times per year at the Toronto BWXT NEC facility in the evenings. The CLC is a forum for the exchange of information between the community and BWXT NEC and allows members to bring forward questions, discuss concerns and identify opportunities to improve community relations.

BWXT NEC held a new member orientation on March 5th and met with the CLC on April 2nd, July 25th, October 29th and November 26th of 2019. Meeting records are posted to the company's website.

In 2019, members met with BWXT NEC staff to discuss the facility's operations and received updates on topics such as the annual compliance report, CNSC Independent Environmental Monitoring Program (IEMP), Regulatory Oversight Report, Public Attitude Survey, community initiatives and events, and BWXT NEC's application for relicensing.

Guest speakers to the CLC in 2019 included an official from the CNSC in April and an official from Sussex Strategy Group in July.

In 2019, the CLC had a membership of five external members and the company launched a recruitment campaign in the fall of 2019 to attract new members for which five applications were received. Three of the five applications were accepted upon review and will join the committee in 2020.

BWXT NEC is recruiting for a Peterborough CLC to begin in 2020.

Website

BWXT NEC has a dedicated public information website, located at 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 2019, there were 13,519 sessions from 9,888 users. Top pages visited were: Home page (27%), About Peterborough (9.5%), About (7%), Contact Us (6%), About Toronto (4.5%).

2019 saw an increase by 65% in visitors compared to 2017.

Over the course of 2019, new information was regularly updated on the website. The following represents some of the updates that were posted:

- Licence renewal updates
- Frequently asked questions
- Peterborough CLC
- Copies of the Toronto (three) and Peterborough (three) newsletters
- Community barbeque and information night information
- Annual compliance report information
- Notice of annual public meeting

Information Brochures

BWXT NEC maintains public information brochures for the Peterborough and Toronto sites. These brochures are available at both sites for use during tours and meetings and are also posted on our public

website. Brochures are used as information tools at community events like job fairs and community barbeques.

Public Inquiries

Members of the public can contact the company by dialing a toll-free number, 1-855-696-9588 and/or emailing questions@bwxt.com. These contact details appear on BWXT NEC's website and in community newsletters and public information brochures.

In 2019, 621 emails were received by questions@bwxt.com, the majority of which were spam, solicitations, job seekers or agencies seeking employment verifications. BWXT NEC did notice an increase in questions from the public through the email and encourages community members to use this outlet to contact the company. There were 37 calls to the toll free number and most were primarily related to employment verification, community giving or public/media relations.

All emails and calls to the information line were appropriately handled and addressed.

Earned Media

BWXT NEC was also mentioned in over 20 Peterborough news articles and a few Toronto news articles regarding the licence renewal. Overall, media coverage in 2019 was neutral or negative regarding opposition from community members on our licence renewal.

Social Media

BWXT NEC leverages BWX Technologies' social media channels, which include Twitter, Linked-In and Facebook, to share information about BWXT NEC activities. In 2019, BWXT NEC issued 20 social media posts including four invitations to community events, three job postings, six posts about volunteerism and community involvement, one post about the Toronto CLC, and six posts about the industry.

Public Disclosure Protocol

BWXT NEC has a Public Disclosure Protocol in place that sets guidelines to providing timely information to interested members of the public and other stakeholders. This Protocol and any Public Disclosures issued by BWXT NEC can be found at www.nec.bwxt.com under the Community tab.

There were no public disclosures required in 2019.

4.2 Cost Recovery

BWXT NEC is current on its cost recovery payments to the CNSC.

4.3 Financial Guarantees

Preliminary Decommissioning Plans and associated decommissioning costs estimates for both facilities were updated in 2019 in accordance with CNSC Regulatory Guide G-206 Financial Guarantees for the Decommissioning of Licensed Activities, CNSC Regulatory Guide G-219 Decommissioning Planning for Licensed Activities, and CSA N294-09 Decommissioning of Facilities Containing Nuclear Substances. The PDP strategy and end-state objective of decommissioning is to release the site from regulatory control for industrial use or demolition of the structures.

Updated PDPs were submitted to the CNSC for both facilities on March 27, 2019 and were accepted by CNSC Staff on July 30, 2019. Subsequently, a minor revision of the Toronto PDP was submitted on October 16, 2019. BWXT NEC currently maintains a letter of credit for the full preliminary decommissioning plan amount.

4.4 Improvement Plans and Future Outlook

BWXT NEC remains committed to continuously improve our EHS programs to improve efficiency and minimize risk to employees, the public and the environment. Facility operations are projected to remain constant in 2020. Fuel production levels are projected to be similar to the amount processed in 2019.

The facility operating licence remains valid until the end of 2020. In November of 2018 BWXT NEC submitted an application to the CNSC to renew its Class 1B operating licence for a period of 10 years. BWXT NEC is seeking one change to its licence with regard to pellet manufacturing operations. BWXT NEC is seeking authorization during the proposed next 10-year licence period to produce natural uranium pellets at both the Peterborough and Toronto facilities. While there is currently no plan to change the existing state of operations, including the flexibility to allow BWXT NEC's Peterborough facility to conduct pelleting will help to ensure that BWXT NEC has the ability to adapt as needed to changing business needs over the next licence period.

The following additional improvements are planned for the next year:

- Hazard management for use of simple asphyxiants across all BWXT NEC sites.
- Implement Peterborough-wide use of Cority Industrial Hygiene software
- Evaluate pre-job and other task preview human performance tools so that one or two can be implemented and trained to at the shop floor worker level (Fuel Handling & Engineered Solutions - Peterborough)
- Update the Peterborough Emergency Plan
- Perform offsite soil sampling for Beryllium.

5 CONCLUDING REMARKS

BWXT NEC is committed to the establishment and continuous improvement of a healthy Safety Culture. Safety Culture refers to the core values and behaviours resulting from a collective commitment by our company's leaders and individuals to emphasize safety, quality, ethics, and security over competing goals to ensure protection of employees, the public and the environment. It is a top business priority to continuously improve our EHS systems to protect fellow employees, the environment, and our communities against environmental, health and safety hazards. BWXT NEC management recognizes, reviews, prioritizes and controls workplace hazards and ensures compliance with applicable regulatory requirements, applicable codes and company policies.

Governed by an integrated management system, conventional health and safety, radiation protection and environmental protection programs are well implemented. All radiation dose measurement results were below Internal Control Levels, Action Levels and regulatory limits. Environmental protection programs are well implemented. There were no significant environmental issues or incidents encountered during the reporting period. Facility emission results were very low and below Action Levels and regulatory limits. Annual releases to the air and water were both a very small fraction of regulatory limits. Public dose for each facility was a small fraction of the public dose limit.

All production and possession limits were respected. Transportation of dangerous goods was conducted safely between suppliers, customers and waste vendors without risk to workers, the public or the environment.

This annual compliance monitoring and operational performance report demonstrates that BWXT NEC has successfully met the requirements of the Nuclear Safety and Control Act, regulations and CNSC Class IB Nuclear Fuel Facility Operating Licence requirements.