

CONFIDENTIAL



**NORDION (CANADA) Inc.**  
**CLASS 1B FACILITY**

License Number: NSPFOL-11A.01/2025

**2020 ANNUAL COMPLIANCE AND  
OPERATIONAL PERFORMANCE**

**REPORT** to the Canadian Nuclear Safety  
Commission for the period JANUARY to  
DECEMBER 2020

**Signatures**

Prepared by: \_\_\_\_\_

Approved by: \_\_\_\_\_

447 March Road

Ottawa, ON Canada K2K 1X8

613-592-3400 | [nordion.com](http://nordion.com)

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**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility**

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**ABSTRACT**

This Annual Compliance and Operational Performance Report (ACOPR) provides performance and operational information for Nordion's Class 1B Facility. It reports annual performance against the Nuclear Safety and Control (NSC) Act, applicable regulations, relevant safety and operational programs and the license conditions of the Nuclear Processing Facility Operating License issued by the Canadian Nuclear Safety Commission (CNSC) (License NSFPOL-11A.01/2025) and demonstrates that Nordion is operating in a safe and responsible manner.

As per Nordion's license condition on annual reporting, this report contains information on the following:

- The operation and maintenance of the facility
- A summary of facility and equipment performance and changes
- Changes to operating policies and organization
- Occurrences and personnel radiation exposures
- Releases of nuclear substances and hazardous substances from the facility
- Changes to the emergency procedures, changes that affect or may affect the facility's emergency response arrangements, training activities, drill and exercise activities and unplanned events in which the facility's emergency response organization was tested
- The results of the effluent monitoring and personnel radiation exposures of the facility
- The results of environmental monitoring
- A summary of non-radiological health and safety activities, information on minor incidents and lost-time incidents
- A summary of the Public Information Program activities
- The 2021 Environmental, Health and Safety Objectives

The key points of this report are as follows:

- The implementation of the key measures were taken to ensure compliance with Nordion's Licence Conditions Handbook (LCH).
- All measurable radiation doses received by personnel and the public were within the regulatory limits of 50 mSv/yr for (Nuclear Energy Worker) NEW personnel and 1 mSv/yr for non-NEW personnel and public, and no internal dose levels or limits were exceeded.
- There were no instances in which there was potential to exceed a regulatory limit or to reach or exceed an action level.
- Nordion had no lost time injuries and one medical treatment injury.
- There were no lost time injuries and two medical treatment injuries for BWXT ITG employees who were contracted to work in the Medical Isotopes Facility.
- There was one reportable exceedance of an environmental regulatory limit or action level in 2020 involving a non-radiological release to the sanitary sewer which resulted in by-law limit exceedance of suspended solids. This was identified by Nordion during routine sampling and self-reported to the City of Ottawa.

In 2020, Nordion's Class 1B Facility operated within the requirements of the Nuclear Safety and Control (NSC) Act, the applicable regulations and the conditions of the operating license issued by the CNSC with the exception of eight (8) non-compliances with the NSC Act, the regulations or with Nordion's site license NSFPOL-11A.01/2025. Nordion had ten (10) occurrences that were reportable to the CNSC in 2020 (see Appendix A).

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**GLOSSARY**

|          |  |
|----------|--|
| ACOPR    | Annual Compliance and Operational Performance Report         |
| ALARA    | As Low As Reasonably Achievable                              |
| AMMS     | Advanced Maintenance Monitoring System                       |
| AMP      | Administrative Monetary Penalty                              |
| BH       | Borehole   |
| BOD      | Biochemical Oxygen Demand                                    |
| BWXT ITG | BWX Technologies Inc. Isotope Technologies Group Canada Inc. |
| CAD      | Charcoal Adsorber  |
| CAM      | Continuous Air Monitor                                       |
| CAPA     | Corrective Action Preventative Action                        |
| COF      | Cobalt Operations Facility                                   |
|          |  |
| CSA      | Canadian Standards Association                               |
| DRD      | Direct Reading Dosimeter                                     |
| DRL      | Derived Release Limit  |
| EHS      | Environment, Health and Safety                               |
| EMS      | Environmental Management System                              |
| eQMS     | Electronic Quality Management System                         |
| ER       | Emergency Response   |
| ERP      | Emergency Response Plan                                      |
| FMEA     | Failure Modes Effects Analysis                               |
| FSAR     | Final Safety Analysis Reports                                |
| HEPA     | High Efficiency Particulate Air                              |
| HPGe     | High Purity Germanium  |
| HSA      | High Specific Activity                                       |
| IAEA     | International Atomic Energy Association                      |
| ICP      | Incident Command Post  |
| IMS      | Incident Management System                                   |
| KRMF     | Kanata Radiopharmaceutical Manufacturing Facility            |
| KOB      | Kanata Operations Building                                   |
| LCH      | Licence Conditions Handbook                                  |
| MDA      | Minimum Detectable Activity                                  |
| NEW      | Nuclear Energy Worker  |
| NMPF     | Nuclear Medicine Production Facility                         |
| NPRMI    | Non-production Radioactive Material Inventory                |
| NSC      | Nuclear Safety and Control                                   |
| NVS      | Nuclear Ventilation System                                   |
| PIP      | Public Information Program                                   |
| PIT      | Physical Inventory Taking                                    |
| PPE      | Personal Protective Equipment                                |
| PTNSR    | Packaging and Transport of Nuclear Substances Regulations    |
| QA       | Quality Assurance  |
| RE       | Roy Errington  |
| SAHE     | Systematic Approach to Hazards Evaluation                    |
| SCA      | Safety and Control Area                                      |
| SCBA     | Self Contained Breathing Apparatus                           |
| SOP      | Standard Operating Procedures                                |
| SSTS     | Sealed Source Tracking System                                |
| SSC      | Structures, Systems, and Components                          |
| TDG      | Transportation of Dangerous Goods                            |
| TLD      | Thermo-luminescent Dosimeter                                 |
| US DOT   | United States Department of Transportation                   |
| US NRC   | US Nuclear Regulatory Commission                             |
| WSIB     | Workplace Safety Insurance Board                             |

## 1. INTRODUCTION

Nordion is a business unit of Sotera Health Company (Sotera Health), a recognized global leader in contract sterilization and testing services for the medical device and pharmaceutical industries. Nordion's Class 1B Facility is comprised of two major production operations, one involving the processing of radioisotopes used in nuclear medicine (Medical Isotopes) and the other involving sealed sources used in cancer therapy and irradiation technologies (Gamma Technologies).

The production operations for Medical Isotopes are housed in the Nuclear Medicine Production Facility (NMPF) portion of the Kanata Operations Building (KOB) and in the Kanata Radiopharmaceutical Manufacturing Facility (KRMF). Production operations for Gamma Technologies are housed in the Cobalt Operations Facility (COF) portion of the KOB.

On July 30, 2018, Sotera Health sold the Medical Isotopes segment of Nordion's business to BWXT Technologies, Inc. (BWXT ITG). With the sale, BWXT ITG became the owner of Nordion's former medical isotope business, including the radiochemical manufacturing operations in Ottawa, Ontario and the isotope production facility in Vancouver, British Columbia. Nordion has retained ownership of the Gamma Technologies operations and of the Class 1B Facility. Nordion and BWXT ITG also signed a long-term lease agreement that will allow BWXT ITG to operate from the Kanata, Ontario site once they obtain their own Class 1B licence.

Notwithstanding the sale of the Medical Isotopes segment July 2018, Nordion remains operator of the Class 1B Facility in Ottawa. Until such time as BWXT ITG obtains an operating license from the CNSC, BWXT ITG acts as a sub-contractor to Nordion for all Medical Isotopes related Class 1B activities under Nordion's Nuclear Facility Processing License (License NSFPOL-11A.01/2025). As such, the sale of the Medical Isotopes segment has no impacts on the 2020 ACOPR for the Class 1B Facility.

A summary of the organizational structure and key environmental, health and safety (EHS) personnel is provided in Section 2.1.5.

Throughout this report, the following EHS risk significance definitions are applied to incidents:

**Low Risk** – A finding or failure that will not result in negative impact to security, employee health and safety, the environment, registrations, or licenses.

**Medium Risk** – A finding or failure that resulted or could potentially result in a negative impact to security, employee health and safety, the environment, registrations, or licenses.

**High Risk** – An event or occurrence which has a major negative impact, or potential major negative impact on security, employee health and safety, the environment, registrations, or licenses.

### 1.1 Impacts and Response to COVID-19 Pandemic in 2020

On March 3<sup>rd</sup>, Nordion initiated its emergency operations centre (EOC) to respond to the COVID-19 pandemic. Nordion has a Communicable Disease Response Plan that formed the basis for the Nordion COVID-19 response plan. The EOC provided guidance, based on municipal, federal, and provincial health authorities, to the Nordion leadership to ensure the safety of personnel. As part of the response plan, Nordion took the following steps:

- 1) All office employees were designated as work from home until further notice. A limited number of office employees required to perform emergency response duties, or required to be on-site to perform their duties, were allowed on-site.
- 2) Visitor protocols were implemented, including restricting all but essential visits.
- 3) Protocols were put into place for mask usage, physical distancing, and increased cleaning of high-touch points.
- 4) Employees were required to self-assess themselves for COVID-19 symptoms or conditions, prior to coming on-site, for assessment by the COVID-19 response team.
- 5) BWXT and Nordion employee populations were separated to reduce risks, which involved modifying building entrance practices while maintaining security.
- 6) Modifying work routines and locations to maximize physical distancing, etc.

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- 7) Shift of on-site meeting to virtual meetings, even for employees on site where possible.
- 8) Travel was restricted to essential only and required approval by the president.
- 9) Travel protocols were put into place to ensure the safety of the travelers.
- 10) A deviation was opened to defer non-critical, in-class training.

Nordion's COVID-19 EOC continues to operate and the protocols described above continue to remain in place. Nordion has successfully managed the COVID-19 pandemic within the facility. In 2020, 1 Nordion employee and 2 BWXT employees tested positive for COVID-19. The positive cases were not related to each other.

The policies and protocols implemented by Nordion have ensured that Nordion has maintained the safety and security of personnel, the public, and the environment.

## **1.2 Compliance with Other Regulations**

During 2020, Nordion self-reported one exceedance of the City of Ottawa Sewer Use by-laws (2003-514) for total suspended solids. The cause for the total suspended solids exceedance appears to be the result of outdoor construction activities. There had been a filter placed over the manhole cover to prevent solids (soil) from entering the manhole as part of the work permit requirements, however the filter paper was either inadvertently removed or came loose, allowing solids (soil) to enter the manhole that is used for sampling.

Nordion reports to the Workplace Safety Insurance Board (WSIB) whenever a reportable occupational injury or illness occurs. In 2020, Nordion reported two incidents to WSIB, with one being a medical treatment claim. WSIB may inspect Nordion's Occupational Health and Safety programs at any time; however, no inspections were held in 2020.

As part of the transportation program, Nordion must remain compliant with not only CNSC regulations and requirements but also those of other regulators, most prominently Transport Canada (Transportation of Dangerous Goods (TDG) regulations), US Department of Transport (US DOT) and US Nuclear Regulatory Commission (US NRC). There were two issues regarding missing transport packages that were reported to both the CNSC and CANUTEC in 2020.

There were no non-compliances related to the sealed and unsealed source reporting performed by Nordion to the Competent Authorities in France, Belgium or Switzerland.

## **1.3 New Licensed Activities**

There were no new licensed activities in 2020.

## **1.4 Significant Modifications or Changes to Site or Facility**

Significant modifications and repairs that were carried out in 2020 include:

- Facility modifications and additions in the leased Medical Isotopes Facilities
- Initial construction work for a new hot cell in the Cobalt Operations Facility was started in 2020 (expected to be completed in 2021).

### **1.4.1 Changes to Procedures Related to Operations Safety and Control**

In 2020, the following changes were made to procedures related to operational safety and control:

- SE-EHS-007 "Fire Protection Program"  
Update document to reflect areas of improvement

## **1.5 Operational Challenges**

In 2020, the following operational challenges were experienced by Nordion;

- Managing the response to the COVID-19 pandemic in 2020, see Section 1.1.

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- Managing the on-going demolition/construction activities conducted throughout 2020 in the BWXT ITG Medical Isotopes facility,
- Meeting the internal target for timely closure of CAPAs. The annual average closure rate of 67% was below the target of 80%. A new metric of 100% of CAPAs through Investigation phase was implemented in 2020. At year end this metric stood at 83%. It will take some time to collect sufficient data and see progress on this metric. As well, Nordion has implemented a "CAPA Review Board" comprised of representatives of EHS and Quality Assurance. This group reviews aging CAPAs, the relative importance of the initiating issue(s), the planned corrective actions and the associated timelines and provides additional support and resources where required.
- On April 20, 2020 Nordion exported a shipment of Co-60 sealed sources to a customer located in the US. On April 24, 2020 during installation of the sources at the customer site, it was determined that an incorrect source had inadvertently been loaded into the container and exported. The source that was shipped had a slightly higher activity, which resulted in the activity for the shipment marginally exceeding that allowed by the CNSC export license and the package certificate but did not result in any increased dose to the public. Additionally, the incorrect source was reported to the CNSC Sealed Source Tracking System as a result of the inadvertent loading error. Nordion provided an initial notice of the occurrence to the CNSC on April 24, 2020 and submitted a formal voluntary disclosure on April 30, 2020. Nordion received a written notice of non-compliance with respect to the occurrence on December 7, 2020. Appendix B provides a summary of the internal investigations and related findings and corrective actions for this occurrence.

## **2. SAFETY AND CONTROL AREA (SCA)**

### **2.1 Management System**

#### **2.1.1 Applicable Activities**

The Management System for Safety is applicable to all CNSC licensed activities conducted under the Class 1B nuclear substance and processing facility operating license. Licensed activities include those activities undertaken to operate a nuclear substance processing facility and to service prescribed equipment.

Nordion operates the facility to process nuclear substances for medical purposes and manufactures sealed sources for medical and industrial applications. Nordion manufactures sealed sources that are installed in prescribed equipment that are either transported to another licensee or packaged and transported to be installed in prescribed equipment at another location or licensee. In addition, Nordion services its own self-shielded irradiator that is used to support the operations of the facility.

Nordion also services, at the Class 1B nuclear substance and processing facility, prescribed equipment from other licensees and clients for which they have provided procedures to the CNSC.

#### **2.1.2 Management System for Safety Program Effectiveness**

The annual management review of the Environmental Management System (EMS) and the Management System for Safety was conducted July 7, 2020 by the EHS Committee. At this meeting the status of actions from the previous meeting, the Environment, Health & Safety Policy, Suitability and Effectiveness, Program Effectiveness, changing circumstances and EHS objectives and targets, are reviewed and recommendations for improvement are made.

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Results of the 2020 annual management review are as follows:

1. 5 of 10 outstanding actions from the previous meetings were closed.
2. The Environment, Health and Safety Policy was reviewed and minor changes to the policy were proposed.
3. The 2019 EHS Performance Report was reviewed and discussed. This report assesses the performance related to the 14 Safety and Control Areas over the past three years where this information was available. Any trends identified are addressed and tracked via a Nordion non-conformance system (ex. CAPA, Velocity EHS Action Items). It was noted that collection of some data for the 2020 Report was impacted by the COVID-19 pandemic.
4. The 2020 Environmental Objectives and Targets were reviewed by the Committee. At the time, the environmental objectives and targets were on track.
5. Resource requirements for the EMS and Management System for Safety were discussed. The EHS Committee agreed that the programs are resourced adequately to ensure that critical issues are being addressed. Financial and specialized skills resources were felt to be adequate.
6. Twenty actions resulted from the meeting:
  - a. Two actions were related to conducting an internal review to ensure consistency in the data and trending codes used for the Annual Performance Report
  - b. Two actions were related to ensuring there was an addendum added to the 2019 Annual Performance Report for data that could not be fully obtained due to the COVID-19 pandemic and the related remote working conditions.
  - c. Twelve actions were related to revisions of the 2019 Annual Performance Report that were completed before the report was finalized.
  - d. One action was related revising internal Change Control procedure to ensure EHS approval is obtained for the closure of all change forms including those related to administrative changes.
  - e. One action was related to how reportable events are presented in the Annual Performance and Annual Compliance Reports.
  - f. One action was related to including COVID-19 as a “changing circumstance” in the annual performance review.
  - g. One action was related to circulating the Interested Parties Database to the EHS Committee for review and comment.

The Committee concluded that they were satisfied with the effectiveness of the EMS and the Management System for Safety.

#### 2.1.3 Internal and External Audits

Nordion uses both internal and external audits as a key part of the Management System for Safety and the EMS.

In 2020, there were 3 audits/inspections of Nordion by external parties, and Nordion conducted 1 audit of a supplier. There were 13 internal audits completed by Nordion EHS in 2020. These audits included an audit of production areas and supporting functions as well as policy and program audits.

In 2020 there were also 6 internal audits that were deferred because of the Covid-19 pandemic and the resulting remote working conditions. These internal audits, deferred under an internal deviation, are shown in the audit summary table in Appendix B.

In addition, as part of its inspection program, Nordion conducted a total of 12 health and safety inspections, and 13 environmental and fire inspections.

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Out of a total of 51 EHS related Corrective Actions/Preventative Actions (CAPAs) initiated in 2020, 4 CAPAs were a result of minor findings from internal audits. There were three CAPAs, initiated in early 2021, resulting from external audits/inspections of Nordion conducted in 2020. Also, at the end of 2020 there was one internal audit report, including findings, that was being finalized as the audit was conducted late in 2020. The remaining CAPAs resulted from investigations or were issued to address observed deficiencies. A list of the internal audits and associated EHS CAPAs and other corrective actions are provided and tabulated in Appendix B.

#### 2.1.3.1 Internal Audits

The following internal audits were conducted in 2020 by Nordion:

1. Environmental Management System Audit
2. Safeguarded Material Physical Inventory Taking (PIT)
3. Process Safety Audit – Iridium
4. Process Safety Audit – Cell Opening and Items Being Removed from Cells
5. Non-production Radioactive Material Inventory (NPRMI)
6. QA Audit of the EHS Internal Audit Program
7. Public Information Program
8. Sealed Source Export Licenses
9. Operational Control, Monitoring and Measurement
10. Documentation, Control of Information, Documents, Records
11. Problem Identification, Nonconformity, Corrective and Preventative Action
12. Transportation Security – Access Authorization
13. Safety Analysis and Operational Control

The following internal audits were deferred in 2020 due to the COVID-19 pandemic:

1. Independent Assessment – Engineering
2. Emergency Response Programs – Sub-plans
3. Research and Development
4. Resources, Financial Resources, Competence/Training/Awareness Management Review
5. Sealed Source Reporting
6. Business Planning, Organization, Assessment

Refer to Appendix B for a summary of the findings associated with the internal audits conducted in 2020.

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****2.1.3.2 External Audits of Nordion**

The following external audits of Nordion were conducted in 2020:

| <b>Date</b>                      | <b>Description</b>  | <b>Result</b>   |
|----------------------------------|---|---|
| September 29 to October 1, 2020  | The CNSC conducted a Compliance Inspection focused on contractor management aspects of the management System for Safety.      | There were no findings resulting from this inspection.                                      |
| November 16 to November 19, 2020 | The CNSC conducted a general Compliance Inspection.   | There were 3 notices of non-compliance and 1 recommendation resulting from this inspection. |
| August 10 to 12, 2020            | A third party conducted an audit against the requirements from the ISO 14001:2015 standard (Environmental Management Systems) | There were two opportunities for improvement.   |

**2.1.3.3 External Audits Conducted by Nordion**

Nordion conducted 1 EHS audit of a supplier in 2020.

There were 8 opportunities for improvement resulting from the supplier audit.

**2.1.4 Management System for Safety Program Improvements**

Revisions were made to the procedure for management of work in the Medical Isotopes Facility to reflect that work is sub-contracted to BWXT ITG. The revisions capture the changes made to reflect BWXT ITG use of a standalone IT Common Business System (CBS), and to add details regarding workflow for design drawings changes, training, communications, problem identification and resolution and operations.

Improvements made to the Radiation Protection Program, Conventional Health and Safety Program, the Environmental Protection Program, the Emergency Preparedness Program, and the Fire Protection are discussed in Sections 2.7.8, 2.8.3 and 2.9.7, 2.10.4 and, 2.10.8, respectively.

In 2020 Nordion continued the implementation of a behavioural based safety awareness program to encourage safety discussions within the organization and to encourage employees to report near misses and hazard identifications.

**2.1.5 Summary of Organizational Structure and Key EHS Personnel**

Nordion is a business unit of Sotera Health Company but operates as a stand-alone company. Historically, Nordion has been comprised of two business units; one involving the processing of radioisotopes used in nuclear medicine (the Medical Isotopes Business Unit) and the other involving production of sealed sources used in cancer therapy and irradiation technologies (the Gamma Technologies Business Unit).

On July 30, 2018, the Medical Isotopes segment of Nordion was sold to BWXT ITG. Nordion continues to operate and be responsible for the Class 1B Facility and compliance with the facility license. BWXT ITG personnel act as subcontractors within the Medical Isotopes facility and are overseen by Nordion personnel. The list of EHS personnel for both Nordion and BWXT ITG as of December 2020 are provided below.

**Nordion - Gamma Technologies – EHS Compliance**

- Senior Vice President of Environmental, Health and Safety (Sotera Health)
- Director, Regulatory & EHS
- Administrative Assistant
- Manager, Corporate Security
- Contract Security Supervisor
- Contract Security Officers (15)
- Manager, Radiation Safety & Nuclear Transportation
- Senior EHS Compliance Specialist (2) (1 vacant)
- Senior Licensing Coordinator
- EHS Compliance Specialist (2)
- Manager, EHS
- Senior Radiation Surveyor
- Radiation Surveyor

**BWXT ITG- Medical Isotopes – EHS Compliance**

- Acting EHS and Compliance Lead
- Senior Manager, Nuclear Regulatory, EHS
- EHS Assistant
- Senior EHS Compliance Specialist (2)
- EHS Compliance Specialist (3)
- Occupational Health Specialist
- Senior Manager, Radiation Safety
- Senior Radiation Surveyor
- Radiation Surveyor (2)
- Junior Radiation Surveyor
- Senior Radiation & Contamination Monitor (3)
- Radiation and Contamination Monitor (4)
- Decontamination Helper/Operator (3)

2.1.6 Changes to the Organizational Structure and Roles and Responsibilities of Key Personnel in 2020:

**Nordion Changes:**

- In February 2020, the Nordion Facility Nuclear Compliance and Training Specialist moved from Nordion to BWXT ITG, in the role of Senior EHS Compliance Specialist.
- In July 2020, a EHS Compliance Specialist was added.

**BWXT ITG Changes**

- In February 2020, a EHS Senior Compliance Specialist was added, who had previously been in the role of the Nordion Facility Nuclear Compliance and Training Specialist.
- In July 2020, the vacant position of VP, QA, Regulatory & EHS Compliance was filled by the new President in the role of Acting EHS and Compliance Lead.
- In September 2020, the role of Head, Research, Development and Technology was added and the reporting line for the Senior Manager, Radiation Safety was changed from the President to this role.
- In September 2020, a Junior Radiation Surveyor was added.
- In August 2020, a Radiation and Contamination Monitor was added.

## 2.2 Human Performance Management

As per Section 1.1, in response to the COVID-19 pandemic, a deviation was initiated to defer any non-critical, in-class training due to the need to maximize social distancing. See Table 1 below for more information on EHS safety training courses that were deferred under this deviation (#10167).

### 2.2.1 Overall Performance of Human Performance Management

Employee training is provided in accordance with QAP AP-47, "Training Program and Management System" and SE-TRN-006 "Systematic Approach to Training System". Nordion provides EHS training for all employees as per SE-TRN-003 "Compliance Environmental, Health and Safety Training". In 2020, Nordion's training program continued to meet the requirements of CNSC REGDOC-2.2.2, "Personnel Training" and License Condition 3.1 of the Nordion License Condition Handbook (LCH) for the implementation and maintenance of a training program.

Nordion's Change Control procedure, QAP AP-45, requires that training requirements be assessed and documented for procedural changes. These requirements include assessment of the roles assigned to the document, the level of training to be completed and the training completion time. Most controlled documents require "read and understand" training regardless of the impact of changes. Change Leaders are required to consult with relevant managers and record whether this read and understand training needs to be supplemented by instructor-led classroom training and/or On-The-Job-Training (OJT). For changes assessed to have a high or medium risk safety impact, a "Training Needs Analysis" must be completed and EHS must review and approve of the final training decision.

#### 2.2.1.1 Training Attendance Rate

Nordion designed and maintains a variety of radiation safety training courses. New employees who are not classified as NEWs receive a basic course on Health, Safety and Environment, Level I, which provides information on the facilities, emergency response procedures and alarms, and basic procedures to follow for safety in the workplace. Nuclear Energy Workers receive a NEW Indoctrination Course. To be authorized to enter the Active Area unescorted, the employee must complete and pass a written test, as evidence of understanding the principles of radiation protection and Nordion safe work practices. NEW retraining and retesting are conducted on a three-year frequency. In addition, NEWs are provided with a half day Radiation Instrumentation Workshop, dealing specifically with the selection and use of radiation survey and contamination meters for the Active Area. In 2020, there were no radiation safety incidents attributed to employee radiation safety practices. This indicates that the radiation safety training was effective.

Supplementary training programs are provided to all personnel working on behalf of Nordion depending on the nature of the job and the requirements specified by their manager. These programs include, but are not limited to, such topics as "working with beta", emergency response awareness, care and use of respirators, material handling training, and working safely with fume-hoods.

Employees who transport, handle, or offer dangerous goods for transport are trained in the TDG requirements. The training program includes a one-day classroom training course that is required once on employment or upon job change. Retraining is conducted on a 2-year frequency and is accomplished through self-study. The self-study program is separated into three levels.

Employees are required to complete the self-study refresher training level that is appropriate for their job function. For each training course, participants must complete and pass a written test, as evidence of understanding the course contents.

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A summary of the key safety training programs is provided in Table 1.

In 2020, the number of scheduled participants that required safety training was 1042, and by the end of the year, 855 of the scheduled participants completed the training, which included refresher training. Of the 187 courses not completed, 13 represent employees away on extended leave and another 103 represent courses that were deferred due to COVID-19 under Nordion Deviation #10167. This accounts for 113 of the 187 courses not completed at the end of 2020. Therefore, the actual attendance completion rate for 2020 was 93% (968/1042).

**Table 1**  
**2020 Safety Training Programs**

| Program   | Duration             | # of Participants Requiring Training in 2020 | # of Participants who Completed Training in 2020 | # Participants who Did Not Attend Scheduled Training by the End of 2020 |
|---|----------------------|--|--|---|
| Nuclear Energy Worker (NEW) Indoctrination <sup>3</sup> and NEW Refresher | 4 Hours / Self Study | 122  | 117  | 5 (3 <sup>2</sup> )   |
| Radiation Instrumentation Workshop <sup>3</sup>                           | 3 Hours              | 81   | 65   | 16 (5 <sup>1</sup> +3 <sup>2</sup> )                                    |
| Radiation Safety Review for Operators <sup>3</sup>                        | Half Day             | 15   | 6  | 9 (8 <sup>1</sup> )   |
| Radioiodine Handling <sup>3</sup>   | 2 Hours              | 6  | 6  | 0   |
| Transport of Dangerous Goods Level I <sup>3</sup>                         | Self Study           | 3  | 3  | 0   |
| Transport of Dangerous Goods Level II <sup>3</sup>                        | Self Study           | 21   | 18   | 3 <sup>2</sup>  |
| Transport of Dangerous Goods Level III <sup>3</sup>                       | Self Study           | 34   | 31   | 3   |
| TDG for Contractors <sup>3</sup>  | Full Day             | 41   | 27   | 14 <sup>1</sup>   |
| Working with BETA <sup>3</sup>  | 1 Hour               | 57   | 50   | 7 (5 <sup>1</sup> +2 <sup>2</sup> )                                     |
| Crane   | Half Day             | 18   | 14   | 4 (3 <sup>1</sup> )   |
| Pallet  | Half Day             | 27   | 20   | 7 (2 <sup>2</sup> )   |
| Forklift  | Half Day             | 5  | 3  | 2 <sup>1</sup>  |
| Contractor Radiation Safety Protection Training <sup>3</sup>              | Half Day             | 279  | 276  | 3   |
| Contractor Radiation Safety Protection Refresher <sup>3</sup>             | 2 Hours              | 24   | 0  | 24  |
| Contractor EHS Training Level I <sup>3</sup>                              | 2 Hours              | 190  | 115  | 75 <sup>1</sup>   |
| In-Depth Security Awareness <sup>3</sup>                                  | 2 Hours              | 26   | 26   | 0   |
| Emergency Response Part 1 <sup>3</sup>                                    | 2 Hours              | 26   | 20   | 6   |
| Emergency Response Part 2 <sup>3</sup>                                    | 2 Hours              | 21   | 17   | 4   |
| Emergency Response Part 3 <sup>3</sup>                                    | 2 Hours              | 8  | 8  | 0   |
| Emergency Response: Security <sup>3</sup>                                 | 1 Hour               | 4  | 4  | 0   |
| Emergency Response: Site Security Volunteer <sup>3</sup>                  | 1 Hour               | 0  | 0  | 0   |
| Emergency Response: Monitors <sup>3</sup>                                 | 1 Hour               | 0  | 0  | 0   |

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|   |        |             |            |   |
|---|--------|-------------|------------|---|
| SCBA Part 1 <sup>3</sup> & 2 <sup>3</sup> | 1 Hour | 34          | 29         | 5 <sup>1</sup>                                    |
| <b>TOTAL</b>                              |        | <b>1042</b> | <b>855</b> | <b>187 (103<sup>1</sup>)<br/>(13<sup>2</sup>)</b> |
| <sup>1</sup> Training deviation # 10167   |        |             |            |   |
| <sup>2</sup> On Extended Leave            |        |             |            |   |

**2.2.2 Evaluation of Training Effectiveness****2.2.2.1 Trainee Reaction**

Trainee reaction is the degree to which participants find the training favourable, engaging, and relevant to their jobs. These three components are evaluated by analyzing data collected through the completion of training evaluation forms for all internally developed key EHS training courses and delivered by EHS classroom instructors. The data is analyzed so that corrective actions can be taken, if necessary, to improve content and delivery. The degree to which trainees find the training favourable is evaluated by analyzing the overall training assessment rating for each course. Overall training is assessed as one of five ratings: Excellent, Very Good, Good, Poor or Very Poor. The training evaluation form allows the trainee to select which aspects related to training engagement and relevance they perceived as strengths or weaknesses. In addition, a review of the optional comments section is completed to identify any issues that would contribute to trainees' discomfort and distraction that could have impacted employee engagement (such as room temperature, catering, lighting etc.).

For 2020:

- 98% of course evaluation forms had an overall rating of good, very good or excellent. The forms that had lower ratings were related to contractor radiation protection training and do not represent a negative trend in overall trainee satisfaction. Therefore, overall trainee satisfaction remains high.
- Training courses were perceived by trainees as engaging and relevant and trainees felt participation was encouraged.

**2.2.2.2 Trainee Learning**

Trainee learning is the degree to which trainees acquire the intended knowledge and skills based on their participation in the training. Learning is evaluated by the pass rate of tests written for key EHS training courses.

For 2020, 100% of trainees passed the assessment test for all key EHS training courses and there were no rescheduled tests due to failed attempts.

**2.2.2.3 Training Results**

Training results is the degree to which targeted outcomes occur as a result of the training. The effectiveness of training results are measured by the EHS significance (high, medium, low) and the frequency of unplanned events documented through processes such as the deviation process, the non-conformance process, investigations, and customer complaints where the root cause was determined to be related to human error or training. The targeted outcome is zero high risk unplanned events related to human error or training as well as no trend for recurrence (three or more) of the same unplanned event with the same human error or training root cause.

For 2020:

- There was one internal investigation that had a root cause attributed to training (understanding needs improvement) and one internal investigation with a root cause attributed to human error. These investigations were unrelated. Corrective actions are underway to address these root causes.

#### **2.2.3 Confirmation of Sufficient Number of Qualified Workers**

In 2020, Nordion ensured that at least the minimum number of responsible personnel was available to provide safety during overnight operations and during emergency situations. There were no changes to risk levels or available personnel.

Nordion Security is on site at all times. Radiation Surveyors are always on site when production involving radioactive materials is occurring. Nordion has key emergency response, Facilities and Production Managers on-call at all times. The Incident Manager, or the person in charge of the response, can initiate a call-in of both on-call and regular emergency response personnel. Currently there are approximately 60 Fire Wardens and Marshalls and over 70 other emergency response personnel.

Nordion routinely assesses the availability of qualified staff as part of the Emergency Response Program and through drills and exercises. Nordion tests its emergency call list annually and the results have demonstrated year over year that within one hour of the onset of an emergency, adequate emergency response personnel and at least one representative from each of the key emergency response groups would be available on-site (refer to Section 2.10).

There is a minimum of one and normally two Health Physicists on call who are qualified to establish and direct radiation safety activities to protect personnel, the public, and the environment from radiation hazards, and to develop safe work methods and procedures.

Nordion maintains a formal on-call roster that includes the Manager, Corporate Security (or designate) and the Director, Regulatory/EHS (or designate), who is also a qualified Health Physicist.

### **2.3 Operating Performance**

#### **2.3.1 Effectiveness in Carrying Out Licensed Activities**

Licensed activities were carried out according to Nordion's programs, policies and procedures resulting in no significant unplanned events.

Nordion's programs that are in place for auditing and capturing non-conformances continue to identify issues in areas that require corrective actions. These processes functioned as expected.

The 2020 EHS program objectives and results are shown in Table 2. All the EHS objectives listed in Table 2 were met in 2020 except for Non-Radiological Releases, and timely closure of EHS CAPAs. The number of Medical Treatment Incidents (three) met the target of  $\leq 4$  and the number of Lost Time Incidents (zero) met the target of zero. Further details of these incidents can be found in Section 2.8.4.

Radioactive materials emissions (0.122% of the Derived Release Limit (DRL)) continue to be well below the target of  $\leq 5\%$  DRL, but Non-Radiological releases were above the target of zero with one in 2020 (total suspended solids). The details of these releases are found in Section 1.2.

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The target of 80% of generated CAPAs closed within 1 year was not met in 2020. The average CAPA closure rate for 2020 was 67%. In recent years, fewer CAPAs have been initiated because of other EHS tools have been used to manage and address lower risk findings from audits and investigations. A new metric of 100% of CAPAs through Investigation phase was implanted in 2020. At year end this metric stood at 83%. It will take some time to collect sufficient data and see progress on this metric. As well, Nordion has implemented a "CAPA Review Board" comprised of representatives of EHS and Quality Assurance. This group reviews aging CAPAs, the relative importance of the initiating issue(s), the planned corrective actions and the associated timelines and provides additional support and resources where required.

The remainder of the EHS Targets and Objectives were met for 2020. Nordion diverted 63.9% of waste from landfills, the maximum employee dose rates were well under the target of  $\leq 7.5$  mSv/yr and Nordion completed a supplier audit by the end of 2020.

A system is in place to ensure that the manager self-assessment performance reviews are completed twice a year. The self-assessment process is audited annually. Deviations, Change Forms, and complaints are reviewed yearly at the Annual Joint Environmental Management System and Management System, for Safety review.

**Table 2**  
**2020 EHS Program Objectives and Results**

| <b>Objective</b>  | <b>Measure/Target *</b>  | <b>Result</b>   |
|---|--|---|
| Manage CAPAs and ensure timely closure of CAPAs   | <ul style="list-style-type: none"> <li>Close out aging CAPAs within your areas</li> <li>Ensure timely updates to and closure of CAPAs (no late CAPAs and request extensions as required)</li> </ul>  | <ul style="list-style-type: none"> <li>67% (average for 2020) CAPAs opened for &gt; 1 year</li> <li>12% (average for 2020) late CAPAs each month</li> </ul> |
| Minimize the number and extent of occupational injuries, environmental and radiation incidents. | <ul style="list-style-type: none"> <li>The number of Medical Treatment Incidents <math>\leq 4</math></li> <li>Lost time Incidents = 0</li> </ul>   | <ul style="list-style-type: none"> <li>The number of Medical Treatment Incidents = 3</li> <li>Lost time Incidents = 0</li> </ul>                            |
| Minimize the use and release of hazardous materials to the environment.                         | <ul style="list-style-type: none"> <li>Radioactive materials emissions to less than 2.0% of the Derived Release Limits (DRL)</li> <li>Zero reportable releases of radioactive and non-radioactive hazardous materials to the environment (sanitary sewer, air, groundwater, land)</li> </ul> | <ul style="list-style-type: none"> <li>0.122% of the DRL</li> <li>One Reportable Release – reportable release for total suspended solids.</li> </ul>        |
| Maintain radiation doses to employees as per ALARA principle.                                   | <ul style="list-style-type: none"> <li>Maximum employee dose rate <math>\leq 7.5</math> mSv/yr</li> </ul>  | <ul style="list-style-type: none"> <li>Maximum employee dose rate was 4.92 mSv/yr.</li> </ul>   |
| Maintain a healthy safety culture.  | <ul style="list-style-type: none"> <li>It is unacceptable to take risks in order to get the job done. Safety is every employee's <u>highest</u> responsibility.</li> <li>Provide/participate in regular safety discussions and training.</li> </ul>  | <ul style="list-style-type: none"> <li>Targets established to promote safety culture only (not measured).</li> </ul>  |

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|  |   |  |
|--|---|--|
|  | <ul style="list-style-type: none"> <li>Immediately report near-misses, hazard identifications, suspected ergonomic symptoms and workplace injuries to your Manager</li> </ul> |  |
|--|---|--|

\*Average taken over the year.

### 2.3.2 Effectiveness in Implementing Operational Controls and Improving Safety Culture

EHS operational controls are documented in a specific series of documents (SE-OP and SE-HS series) and safety critical steps are added into routine production procedures. These procedures are routinely updated using Nordion's change control process when safety improvements are identified or during the document's scheduled periodic review. In 2020 Nordion continued the practice of monthly behavioural based safety awareness campaigns to encourage safety discussions within the organization and to encourage employees to report near misses and hazard identifications.

### 2.3.3 Reportable Events

A list of reportable incidents, their causes and corrective actions is provided in Appendix A.

### 2.3.4 Sealed Source Tracking

Nordion has a process for reporting the transfer, receipt, export or import of sealed sources if the activity exceeds the threshold limits and within the specified timeframes as detailed in Nordion's LCH.

#### 2.3.4.1 Sealed Source Tracking Activities

Activities which took place in 2020 included the following:

- Corrective actions and continuous improvements to sealed source reporting processes are on-going.

#### 2.3.4.2 Sealed Source Tracking Improvements

There were no specific improvements to the sealed source tracking process in 2020.

### 2.3.5 Non-production Sealed and Unsealed Source Inventory

The inventory of non-production sealed and unsealed sources is provided in Appendix C.

### 2.3.6 Annual Production

Activities relating to the procurement, possession, processing and shipping of radioactive materials are conducted under Nuclear Substance Processing Facility Operating Licence, NSPFOL-11A.01/2025.

#### 2.3.6.1 Sealed Source Manufacturing/Radioisotope Processing

2020 data on sealed source manufacturing is shown in Table 3. Table 4 shows data on processing of nuclear medicine radioisotopes. [REDACTED]

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[REDACTED]

|            |            |            |            |            |
|------------|------------|------------|------------|------------|
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |

[REDACTED]

|            |            |            |            |            |            |
|------------|------------|------------|------------|------------|------------|
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |

[REDACTED]

[REDACTED]

2.3.6.3 Acquisitions of Finished Sealed Radioactive Sources

Sealed radioactive sources acquired by Nordion in 2020 included Co-60 double encapsulated sources that have been returned from customers for re-sale or disposal.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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**2.4 Safety Analysis****2.4.1 Validation and Maintenance of Overall Safety Case**

The overall safety case for the facility is effectively maintained in the overall primary Final Safety Analysis Reports (FSARs) for Nuclear Medicine, Cobalt Operations, and the Cobalt Pools. When modifications are made, an assessment is performed, and details are captured in the primary FSARs for the facility. The overall safety case for the facility is then validated by the EHS Committee.

**2.4.2 Modifications and Changes to Facility that May Affect Safety Analysis**

In 2020 there were no modifications that affected the facility's safety analysis.

**2.5 Physical Design**

The FSAR review process identifies areas of continuous improvement to ensure that the overall design basis for the facility is both validated and maintained. In 2020, there were no significant design issues identified through these reviews. Overall, Nordion's facility design has been maintained.

Initial construction work for a new hot cell in the Cobalt Operations Facility was started in 2020 (expected to be completed in 2021). This construction work did not impact the overall design basis for the facility.

The facility modifications and additions occurring in the leased Medical Isotopes facility areas did not impact the ability of the facility structures, systems and components (SSCs) to meet and maintain their design basis.

**2.6 Fitness for Service****2.6.1 Effectiveness of Maintenance and Testing Programs**

Nordion has a system in place for the maintenance and control of equipment that supports the facility. The program provides guidelines for the documentation and maintenance of the system to ensure responsibilities are identified, filing systems are maintained, and all necessary controls are in place for facility calibration and maintenance.

Nordion uses an Advanced Maintenance Management System (AMMS) to control Nordion's calibration and maintenance activities. The AMMS is used to catalogue all equipment requiring calibration or maintenance, record equipment information, schedule maintenance, and issue work orders.

Detailed processes and rules governing the preventative maintenance program are available in Facilities Master Plan documents.

The AMMS provides the necessary oversight to ensure equipment integrity. All equipment inspections and preventative maintenance schedules are dictated using the AMMS.

Unscheduled repairs are reviewed on an annual basis by Facilities to assess for trends in equipment failures. Recurring failures are reviewed by EHS Compliance for the determination of any additional corrective actions.

This continues to prove effective as during 2020, there were no major equipment failures.

**2.6.2 Effectiveness of Aging Management Strategies**

Every year a detailed review is carried out at the Senior Management level to discuss aging equipment at the site. This annual business plan review considers three criteria: safety of the facility, regulatory requirements, and site improvements. When approved, the work identified during the aging equipment review is executed as a project. Projects are prioritized into three categories and funds are allocated as required. This aging equipment review process, because of the link to the Senior Management team and Finance, has been effective in keeping the Nordion facility up to date with current technology.

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## 2.7 Radiation Protection

## 2.7.1 Dose Control Data

## 2.7.1.1 Occupational External Dosimetry

Tables 5 and 6 provide dosimetry data for employees grouped in various ranges of exposure. In general, most contractors are considered non-NEWs. The exception is BWXT ITG personnel who are considered NEWs. For the purposes of the data analysis in Sections 2.7.1 and 2.7.2, BWXT ITG personnel are considered as employees along with Nordion personnel and are not included within the contractor category. This ensures data remains consistent to previous years and allows for appropriate trending in relation to the NEW tasks and expected doses. In the analysis of the doses in this section, NEW roles undertaken by BWXT ITG personnel are denoted as such for further clarity. Data on the minimum, maximum and average doses for all employees are shown in Tables 7, 8 and 9. In Table 9.1, the data for 2020 is shown for Nordion and BWXT ITG NEWs. In 2020 there were 172 Active Area personnel monitored and 152 non-Active Area personnel, as shown in these tables. Of the 124 non-Active Area personnel, 7 support industrial irradiators (containing Co-60) at customer sites. These individuals are included in the Class 1B licence dosimetry as they may also receive dose from work at KOB during the dosimetry year.

**Table 5**  
**Personnel Dosimetry**

| Dose Range (mSv) | Number of Employees |      |      |      |      |           |      |      |      |      |      |      |      |      |
|------------------|---------------------|------|------|------|------|-----------|------|------|------|------|------|------|------|------|
|                  | Whole Body          |      |      |      |      | Skin      |      |      |      |      | Eye  |      |      |      |
|                  | 2016                | 2017 | 2018 | 2019 | 2020 | 2016      | 2017 | 2018 | 2019 | 2020 | 2017 | 2018 | 2019 | 2020 |
| 0                | 12                  | 39   | 60   | 47   | 70   | 11        | 42   | 69   | 44   | 73   | 39   | 62   | 45   | 65   |
| 0.01-1.00        | 218                 | 192  | 151  | 190  | 219  | 208       | 187  | 142  | 191  | 216  | 192  | 149  | 191  | 224  |
| 1.01-5.00        | 37                  | 31   | 37   | 41   | 35   | 47        | 33   | 37   | 43   | 35   | 31   | 37   | 42   | 35   |
| 5.01 - 10.00     | 0                   | 1    | 0    | 0    | 0    | 1         | 1    | 0    | 0    | 0    | 1    | 0    | 0    | 0    |
| 10.01 - 20.00    | 0                   | 0    | 0    | 0    | 0    | 0         | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| >20.00           | 0                   | 0    | 0    | 0    | 0    | 0         | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Dose Range (mSv) | Number of Employees |      |      |      |      |           |      |      |      |      |      |      |      |      |
|                  | Right Hand          |      |      |      |      | Left Hand |      |      |      |      |      |      |      |      |
|                  | 2016                | 2017 | 2018 | 2019 | 2020 | 2016      | 2017 | 2018 | 2019 | 2020 |      |      |      |      |
| 0                | 59                  | 94   | 44   | 50   | 61   | 52        | 88   | 44   | 52   | 93   |      |      |      |      |
| 0.01-1.00        | 44                  | 16   | 35   | 35   | 50   | 47        | 18   | 34   | 40   | 23   |      |      |      |      |
| 1.01-5.00        | 22                  | 13   | 35   | 39   | 38   | 25        | 16   | 35   | 33   | 33   |      |      |      |      |
| 5.01 - 10.00     | 3                   | 1    | 2    | 5    | 3    | 3         | 2    | 3    | 4    | 3    |      |      |      |      |
| 10.01 - 20.00    | 0                   | 1    | 0    | 0    | 1    | 0         | 1    | 0    | 1    | 1    |      |      |      |      |
| >20.00           | 0                   | 0    | 0    | 1    | 0    | 0         | 0    | 0    | 0    | 0    |      |      |      |      |

**Table 6**  
**Breakdown of Whole-Body Radiation Doses 5.0 to < 20 mSv**

| Year | Dose Range |         |           |           |
|------|------------|---------|-----------|-----------|
|      | 5<8 mSv    | 8<10mSv | 10<15 mSv | 15<20 mSv |
| 2016 | 0          | 0       | 0         | 0         |
| 2017 | 1          | 0       | 0         | 0         |
| 2018 | 0          | 0       | 0         | 0         |

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|      |   |   |   |   |
|------|---|---|---|---|
| 2019 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 |

**Table 7**  
**Average, Maximum and Minimum Worker Effective Doses (mSv)**

|                    |  | 2016 | 2017 | 2018 | 2019 | 2020 | CNSC<br>Regulatory<br>Limit |
|--------------------|--|------|------|------|------|------|-----------------------------|
| <b>NEWs</b>        | <b>Average</b>                                 | 0.49 | 0.42 | 0.45 | 0.48 | 0.36 | n/a                         |
|                    | <b>Average*</b>                                | 0.51 | 0.49 | 0.60 | 0.57 | 0.46 |                             |
|                    | <b>Maximum</b>                                 | 4.9  | 5.49 | 4.23 | 4.79 | 4.92 | 50/yr;<br>100/5yr           |
|                    | <b>Minimum</b>                                 | 0    | 0    | 0    | 0    | 0    | n/a                         |
|                    | <b>Number of<br/>NEWs<br/>Monitored</b>        | 267  | 263  | 248  | 278  | 324  |                             |
| <b>Contractors</b> | <b>Average</b>                                 | 0.07 | 0.02 | 0.05 | 0.03 | 0.01 | n/a                         |
|                    | <b>Average*</b>                                | 0.08 | 0.04 | 0.06 | 0.06 | 0.03 |                             |
|                    | <b>Maximum</b>                                 | 0.36 | 0.2  | 0.25 | 0.26 | 0.29 | 1/yr                        |
|                    | <b>Minimum</b>                                 | 0    | 0    | 0    | 0    | 0    | n/a                         |
|                    | <b>Number of<br/>Contractors<br/>Monitored</b> | 53   | 55   | 45   | 123  | 381  |                             |

\* This average is calculated excluding zero dose values

**Table 8**  
**Average, Maximum and Minimum Worker Skin Exposure Doses (mSv)**

|                    |  | 2016 | 2017 | 2018  | 2019 | 2020 | CNSC<br>Regulatory<br>Limit |
|--------------------|--|------|------|-------|------|------|-----------------------------|
| <b>NEWs</b>        | <b>Average</b>                                 | 0.59 | 0.42 | 0.45  | 0.49 | 0.37 | n/a                         |
|                    | <b>Maximum</b>                                 | 5.2  | 5.52 | 4.26  | 4.78 | 4.93 | 500/yr                      |
|                    | <b>Minimum</b>                                 | 0    | 0    | 0     | 0    | 0    | n/a                         |
|                    | <b>Number of<br/>NEWs<br/>Monitored</b>        | 267  | 263  | 248   | 278  | 324  |                             |
| <b>Contractors</b> | <b>Average</b>                                 | 0.07 | 0.02 | 0.05  | 0.03 | 0.01 | n/a                         |
|                    | <b>Maximum</b>                                 | 0.39 | 0.18 | 0.218 | 0.25 | 0.31 | 50/yr                       |
|                    | <b>Minimum</b>                                 | 0    | 0    | 0     | 0    | 0    | n/a                         |
|                    | <b>Number of<br/>Contractors<br/>Monitored</b> | 53   | 55   | 45    | 123  | 381  |                             |

|      |                                | 2016 | 2017 | 2018 | 2019  | 2020  | CNSC<br>Regulatory<br>Limit |
|------|--------------------------------|------|------|------|-------|-------|-----------------------------|
| NEWS | Average                        | 0.79 | 0.53 | 0.96 | 1.14  | 0.93  | n/a                         |
|      | Maximum                        | 8.3  | 16.4 | 9.08 | 20.93 | 16.48 | 500/yr                      |
|      | Minimum                        | 0    | 0    | 0    | 0     | 0     | n/a                         |
|      | Number of<br>NEWS<br>Monitored | 128  | 125  | 116  | 130   | 153   |                             |

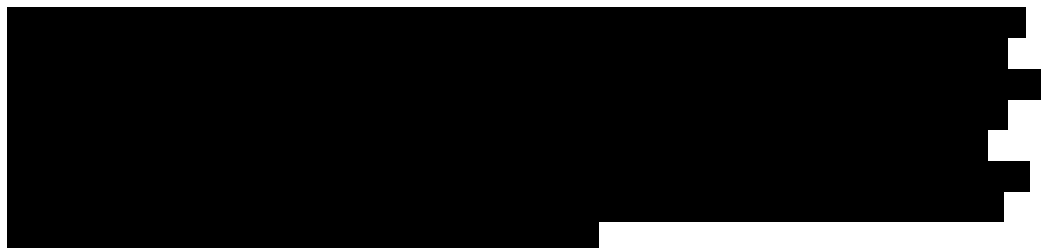
It is worthwhile noting that in 2020 there were only two non-Active Area personnel that exceeded 1 mSv. One employee (1.25 mSv) started the year as a Co-60 Production Technician but switched to a management job in 2020, the other (1.1 mSv) was to a BWXT ITG employee who performed increased work on the GammaCell 220 in 2020 due to medical leave. Installers of Co-60 at off-site irradiators account for the next four highest doses. These doses were 0.61 – 0.93 mSv. The next highest dose to a Nordion non-Active Area worker was 0.60 mSv. The workers that install Co-60 in off-site irradiators are included in the breakdown for effective, extremity and skin dose. One set of dosimetry data is used for those individuals working under both the Class 1B processing facilities license and Nordion's Class II servicing licence. [REDACTED]

[illegible]

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|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Table 8 shows similar results to Table 7 for skin exposure in 2020. In Appendix D similar values for dose to the lens of the eye are observed.



Y-90 has the potential to cause high doses to the skin, eyes, and extremities in short periods of time, however no such anomalous dose occurred.

The above analysis of trends demonstrates doses are well managed at Nordion and adherence to the ALARA principle in the execution of duties by Nordion personnel.

**Table 9.1 Summary of Employee doses broken down between Nordion and BWXT personnel.**

| Dose Range (mSv) | Effective Dose |      | Lens of Eye Dose |      | Skin Dose |      | Left Hand |      | Right Hand |      |
|------------------|----------------|------|------------------|------|-----------|------|-----------|------|------------|------|
|                  | Nordion        | BWXT | Nordion          | BWXT | Nordion   | BWXT | Nordion   | BWXT | Nordion    | BWXT |
| 0                | 7              | 63   | 6                | 57   | 9         | 64   | 14        | 49   | 11         | 50   |
| 0.01-1.00        | 85             | 134  | 86               | 140  | 83        | 133  | 8         | 45   | 11         | 39   |
| 1.01-5.00        | 28             | 7    | 28               | 7    | 28        | 7    | 16        | 17   | 16         | 22   |
| 5.01 - 10.00     | 0              | 0    | 0                | 0    | 0         | 0    | 2         | 1    | 2          | 1    |
| 10.01 - 20.00    | 0              | 0    | 0                | 0    | 0         | 0    | 0         | 1    | 0          | 1    |
| >20.00           | 0              | 0    | 0                | 0    | 0         | 0    | 0         | 0    | 0          | 0    |

|               | Effective Dose |      | Lens of Eye Dose |      | Skin Dose |      | Left Hand |       | Right Hand |       |
|---------------|----------------|------|------------------|------|-----------|------|-----------|-------|------------|-------|
|               | Nordion        | BWXT | Nordion          | BWXT | Nordion   | BWXT | Nordion   | BWXT  | Nordion    | BWXT  |
| Average (mSv) | 0.73           | 0.15 | 0.74             | 0.15 | 0.74      | 0.15 | 1.67      | 0.68  | 1.66       | 0.67  |
| Maximum (mSv) | 4.92           | 2.23 | 4.96             | 2.26 | 4.93      | 2.28 | 9.59      | 16.48 | 9.63       | 11.91 |
| Minimum (mSv) | 0              | 0    | 0                | 0    | 0         | 0    | 0         | 0     | 0          | 0     |
| # Monitored   | 120            | 204  | 120              | 204  | 120       | 204  | 40        | 113   | 40         | 113   |

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**2.7.1.2 Internal Occupational Radiation Doses**

Nordion's bioassay program had included thyroid monitoring on a scheduled routine basis and whole body counting or urine analysis if air/contamination monitoring indicates it is needed. [REDACTED]

[REDACTED] The Covid-19 pandemic questioned the ongoing necessity of this routine measurement, after performing decay calculations on the remaining waste inventory it was clear that routine thyroid bioassay was no longer needed, and so this process was halted in 2020. The thyroid bioassay equipment is still maintained to the same standard if there is a need to work with radioiodines.

During 2020, there were no cases of employees exceeding Nordion's administrative investigation level of 1000 Bq I-125 or I-131.

Whole body counting was not performed in 2020. No urinalysis was required in 2020. In 2020 no internal doses were assigned.

**2.7.2 Significance of Results for the Dose Control Data**

A further breakdown of dose trends by group, for the last five years is provided in Appendix E (Figures E.1 to E.19). The graphical trends show group average, individual maximum and group cumulative doses. This trend data is reviewed yearly at the EHS Committee and the Annual Joint Environmental Management System and Management System for Safety Review. There are a few general observations in the trend data: [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

### Table 10

[illegible]

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|   |  |  |
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| T |  |  |
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## 2.7.3 Dose to the Public

Table 11 shows the doses to the public from 2016 - 2020. It is important to note that a new set of DRL values came into effect in Nordion's LCH in January 2019. So although dose to public increased in 2020 and 2019 relative to 2018, it is solely due to the new DRL values. As shown in Section 2.9.1.2, the increased dose to public in 2020 is due to higher volumes of water effluent being released and Nordion's practice of assuming every release is at the MDA, when in fact it is more likely there was no release. This and other conservative practices, results in doses to public which, in reality, are more than 10 times lower than those reported in Table 11.

**Table 11**  
**Dose to Public**

| Year | (mSv)    |
|------|----------|
| 2016 | 0.0021   |
| 2017 | 0.000052 |
| 2018 | 0.000067 |
| 2019 | 0.00087  |
| 2020 | 0.00122  |

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****2.7.4 Contamination Control Data**

The contamination control program for the Active Area includes routine sampling and monitoring on a daily basis of the floors, benches, fume-hoods, gloveboxes, support/service areas, and on a weekly basis, change-rooms and inactive floors. Regular sampling, by wipe testing, of the corridors and office areas is conducted several times daily to ensure areas are maintained contamination free and, should contamination be found, to decontaminate immediately to the levels specified in the decontamination procedure. In addition, equipment and personnel leaving the Active Area is monitored for contamination.

During 2020 operations, there were 22 instances where contamination was found and subsequently contained within the Active Area. Of the 22 contamination incidents, fifteen (15) were related to contamination found on clothing, two (2) to contamination found on equipment, and five (5) where contamination was found directly on personnel. There was no significant increased dose to personnel as a result of these incidents.

The distribution of contamination incidents from 2016 to 2020 is shown in Table 12 and Table 13 and illustrated in Figure 1.

The number of contamination events in 2020 was slightly higher than in 2019 and 2018, but less than in of 2016. In 2020, six contamination incidents occurred in April. This was related to construction activities occurring on a specific hot cell during that month. The level of these contaminations was low therefore, dose to personnel was negligible.

The number of contamination events for “other” isotopes in Table 13 is less than in previous years. These “other” isotopes primarily correspond to various long-lived waste isotopes found that related to

**Table 12**  
**Contamination Incidents by Contamination Level**

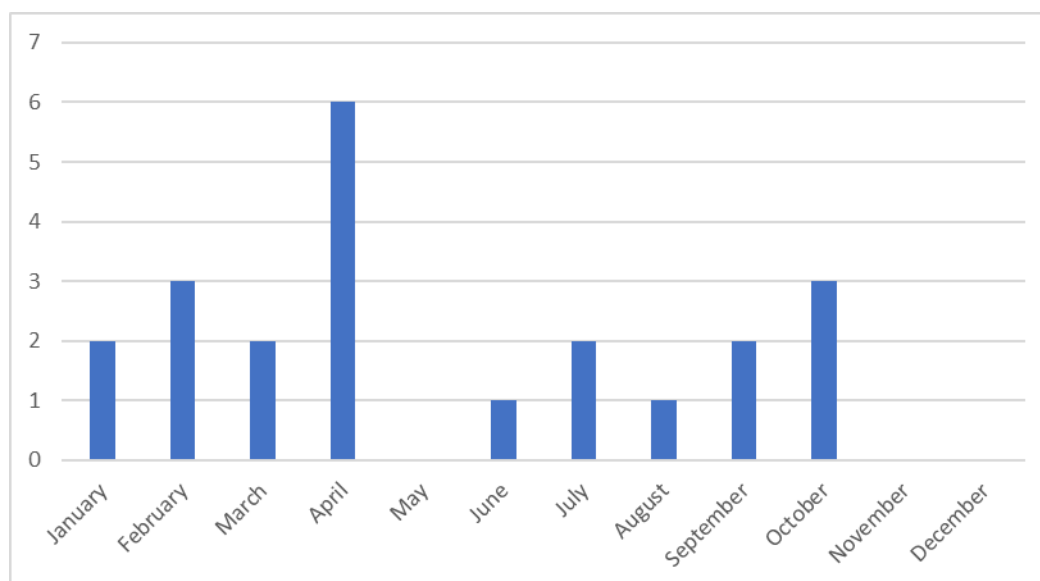
| Year | Not recorded | <500 cpm | >500 cpm, <2,000 cpm | >2,000 cpm, <10,000 cpm | > 10,000 cpm, < 50,000 cpm | >50,000 cpm | Annual Total |
|------|--------------|----------|----------------------|-------------------------|----------------------------|-------------|--------------|
| 2016 | 0            | 2        | 10                   | 8                       | 4                          | 2           | 26           |
| 2017 | 0            | 1        | 4                    | 6                       | 1                          | 2           | 14           |
| 2018 | 0            | 5        | 4                    | 6                       | 3                          | 0           | 18           |
| 2019 | 1            | 1        | 6                    | 6                       | 4                          | 0           | 18           |
| 2020 | 0            | 6        | 8                    | 4                       | 3                          | 1           | 22           |

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**Table 13**  
**Contamination Incidents by Radionuclide**

| Contamination Radionuclide | 2016      | 2017      | 2018      | 2019      | 2020      |
|----------------------------|-----------|-----------|-----------|-----------|-----------|
| Not recorded/unknown       | 0         | 2         | 1         | 0         | 0         |
| C-14                       | 0         | 0         | 0         | 0         | 1         |
| C-60                       | 6         | 4         | 4         | 4         | 5         |
| I-125                      | 2         | 0         | 0         | 0         | 0         |
| I-131                      | 6         | 0         | 1         | 0         | 0         |
| Mo-99                      | 6         | 0         | 0         | 0         | 2         |
| Y-90                       | 0         | 2         | 8         | 4         | 8         |
| Ir-192                     | 1         | 1         | 0         | 1         | 0         |
| Xe-133                     | 0         | 0         | 0         | 0         | 0         |
| Sr-82                      | 0         | 0         | 0         | 0         | 0         |
| In-111                     |           |           |           | 3         | 4         |
| Radon                      | 1         | 0         | 0         | 0         | 0         |
| Other                      | 4         | 5         | 4         | 6         | 2         |
| <b>Total</b>               | <b>26</b> | <b>14</b> | <b>18</b> | <b>18</b> | <b>22</b> |

**Figure 1: Contamination Incidents by Month in 2020**



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**2.7.5 Facility Radiological Conditions**

The radiation survey program involves radiation measurements within the Active Area, and on the perimeter and exterior of the KOB. Within the Active Area, radiation surveys are generally conducted daily, throughout all the labs and rooms. Areas where radiation fields are above 2.5 mrem/hr (0.025 mSv/hr) are posted with radiation warning signs, indicating the radiation fields. In addition, surveys are conducted at employee work areas, at cells, glove-boxes, and fume-hoods, during production and test operations, to ensure radiation fields during processing are within acceptable levels. Special surveys are conducted on new processes/equipment to provide information on the safety performance of new operations. Detailed surveys are conducted on each of the Cobalt Operations cells every three years, to check for integrity of the cells and ensure radiation levels are within acceptable levels. In 2019, detailed cell survey was conducted for hot cells in Cobalt Operations. No non-conformance was observed from the survey.

On a monthly basis, radiation surveys have been conducted on the perimeter of the Active Areas, and within the Inactive Office Areas. The monthly survey also includes measurement of radiation fields outside the KOB to ensure conditions have not changed in the operations that may impact the environment/exterior exposure. All the monthly surveys were conducted in 2020.

Breathing air was monitored at 12 Continuous Air Monitor (CAM) stations and at over 50 locations with 24-hour air filters. Due to construction activities in the Radiochemical area of Medical Isotopes two of the 12 CAMs were not accessible to be tested every week, but they were tested routinely throughout the year. In addition to having the capability of alarming locally, CAMs are monitored and logged at the Surveyor's control panel and on the building monitoring system.

The 24-hour air filters are measured at the end of the day shift daily. The 24-hour air filters are measured at the end of the day shift daily. In 2020, ten of the over fifty 24-hour air filters could not be changed out routinely due to construction activities. In all cases this was appropriate as there was no manipulation of radioactive material in the rooms at the time when there was no monitoring present.

For work known to have the possibility of creating radioactive contamination of the breathing air, a zone is demarcated, and signage is posted requiring respirators to be worn. Respirator requirements are removed only once air monitoring measurements are below the required levels. In 2020, all breathing air sampling was performed in accordance with procedures and results indicated that processes were in control. Facility radiological conditions were very stable and routine in 2020. There were no fluctuations in 2020 radiological conditions beyond the routine movement of containers through the facility when required. Contamination incidents are discussed in Section 2.7.4.

**2.7.6 Exceeding Regulatory Limits or Action Levels**

In 2020, there were no exceedances of either regulatory limits or actions limits.

**2.7.7 Radiation Protection Program Effectiveness**

The Radiation Protection (RP) Program is reviewed by conducting process audits and process safety audits. Data and performance of the RP Program is also reviewed regularly at EHS Committee meetings. The RP Protection program continued to operate effectively in 2020.

**2.7.8 Radiation Protection Program Improvements**

Improvements to the RP Program in 2020 included the following:

Three hand and foot barrier monitors were obtained in 2020 for Medical Isotopes which have ZnS(Ag) scintillator probes with improved detection efficiency over existing units. Additionally, these units separate out counts attributed to alpha emitters (from naturally

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occurring ubiquitous radon) and beta/gamma emitters which are processed on site which aids in investigation of positive detection of contamination.

Two packaging lines were designed in 2020 (to be commissioned in 2021) which will lower doses to Surveyors in Medical Isotopes by providing the ability to take package readings at a greater distance, lowering personal doses.

#### 2.7.9 Radiation Protection Program Performance

The objectives, goals and targets of the RP Program are shown in Table 2 of Section 2.3.1. The targets for maximum NEW dose and environmental releases were met in 2020. These targets are tracked as key performance indicators at EHS Committee meetings and in Monthly Operational reports. The targets are reviewed yearly at the Annual Joint Environmental Management System and Management System for Safety Review. Refer to Section 3.2 Table 23 for a summary of the initiatives and targets for the upcoming year.

#### 2.7.10 Continuous Improvements under ALARA Performance

ALARA objectives and performance is reviewed at EHS Committee meetings and all activities in the ALARA program are outlined in Nordion's internal procedure "Keeping Radiation Exposures and Doses as Low as Reasonably Achievable" (SE-RP-002). Safety is integrated into the design aspects of new builds, from design objectives, design review and to performing Hazard Risk Analysis and Third-Party Reviews of process flows

#### 2.7.11 Radiation Devices and Instruments Performance

Performance of the following equipment, alarms and monitoring devices is checked at various frequencies throughout the year. Test results are indicated to be satisfactory if the tested item functioned within acceptable parameters.

##### 2.7.11.1 Ventilation

Duplex fan tests are conducted every 6 months. This involves testing of more than 100 fans which form part of the Nuclear Ventilation System (NVS). During 2019, all High Efficiency Particulate Air (HEPA) and CAD filters were tested at the required frequency. HEPA filters were tested once, which meets the minimum testing frequency of once annually.

Table 14 details the results of the NVS Filter testing and replacement. The filters summarized in Table 14 are credited with mitigating releases in Nordion's Safety Analysis reports.

**Table 14**  
**NVS Filter Efficiency Testing/Replacements**

|   | Q1/Q2 | Q1/Q2 | Q3/Q4 | Q3/Q4 |
|---|-------|-------|-------|-------|
|   | HEPA  | CAD   | HEPA  | CAD   |
| Filters in fleet  | 240   | 73    | 240   | 73    |
| Number tested   | 0     | 67    | 230   | 67    |
| Filters which met specification                         | N/A   | 67    | 230   | 67    |
| Filters out of specification                            | N/A   | 2     | 0     | 0     |
| Out of specification filters replaced during test cycle | N/A   | 2     | 0     | 0     |
| Not tested  | 240   | 6     | 10    | 6     |
| Total replaced during this cycle                        | 0     | 4     | 0     | 1     |
| Filters (systems) removed from service                  | 0     | 0     | 0     | 0     |
| New Filters (systems) Added                             | 0     | 0     | 0     | 0     |

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Comments Q1/Q2 HEPA: The other 228 filters were tested, and all passed.

There was a total of 12 filters not tested.

-One of them is not in service and another inaccessible.

-There were an additional 8 Trench HEPA filters that were not tested. The trench filters are in the construction zone and not accessible because of construction activities.

There was no processing of radioactive materials in the construction zone in 2020 and all Mechanical Room filters downstream of the trenches were tested.

-The last two are from a system where the ventilation was shut down for an extended period of time due to construction.

A total of 7 filters were changed due to increased Delta 'P' flow issues. All filters were tested after and passed.

Comments Q1/Q2 CAD: Total of 67 filters tested.

- Due to lack of radioiodine processing and storage in the KRMF/Radiopharmaceutical facilities, 21 CADs servicing those areas are not tested against the performance criteria, but continue to be tested regularly to research the filter performance

Six trench filters were not tested but are changed every three years as per procedure normally, although one trench filter still from 2019 was not changed on three-year routine due to construction. The trench filter is in the construction zone and not accessible because of construction activities. There was no processing of radioactive materials in the construction zone in 2019/2020 and all Mechanical Room filters downstream of the trenches were tested. This filter will be changed out when construction is over.

A total of 4 CADs that were supposed to have been changed out due to shelf life expiration, were not. Their change out has been but on hold till after construction, due to the construction and lack of activity on those systems. The CADs were still tested, and all passed.

One regular CAD filter was replaced due to shelf life expiration; a successful in-situ test was performed on this filter.

Comments Q3/Q4 HEPA: 154 filters were tested, and all passed.

There was a total of 86 filters not tested.

-One of them is not in service and another inaccessible.

-There were an additional 8 Trench HEPA filters that were

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not tested. The trench filters are in the construction zone and not accessible because of construction activities. There was no processing of radioactive materials in the construction zone in 2020 and all Mechanical Room filters downstream of the trenches were tested.

-There were six from two systems in the KOB where the ventilation was shut down for an extended period of time due to construction.

- When the testing equipment broke, we had not gotten to the KRMF and Cobalt filters yet, so those 70 filters were not tested. Due to these unforeseen circumstances, the testing equipment did not return before the end of year. So HEPA testing was performed only in the first half of 2020. This meets the minimum required testing frequency.

A total of 11 filters were changed due to increased Delta 'P' flow issues. Of the 11, 4 were trench filters. All filters, but one was tested after and passed. Our testing equipment broke before we could test one trench filter after installation. Since it was not tested, the trench air flow was routed through the tested filter only. Once the equipment is back and working, we will test the filter in-situ.

Comments Q3/Q4 CAD: Total of 51 filters tested.  
- Due to lack of radioiodine processing and storage in the KRMF/Radiopharmaceutical facilities, 21 CADs servicing those areas are not tested against the performance criteria but continue to be tested regularly to research the filter performance.... The 14 CADs from the KRMF fan room were not tested this half due to the construction.

Six trench filters were not tested but are changed every three years as per procedure normally, although one trench filter still from 2019 was not changed on three-year routine due to construction. The trench filter is in the construction zone and not accessible because of construction activities. There was no processing of radioactive materials in the construction zone in 2019/2020 and all Mechanical Room filters downstream of the trenches were tested. This filter will be changed out when construction is over.

Two CADs from one system were not tested for construction had the ventilation for this system down for an extended period.

Two filters were replaced. One trench filter was changed out due to shelf life expiration (was tested and passed prior to installation) and one regular CAD filter was replaced due to shelf life expiration, which had a successful in-situ test performed afterwards.

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A total of 6 CADs that were supposed to have been changed out due to shelf life expiration, were not. Their change out has been but on hold till after construction, due to the construction and lack of activity on those systems. The CADs were still tested, and all passed.

Nuclear Medicine in-cell charcoal roughing filters are on a preventative maintenance schedule and replaced typically every six months. These filters are not credited with mitigating releases in Nordion's Safety Analysis reports. None of the cells were used for processing in 2020, and as the area is a construction site in-cell filters were not changed this year.

**2.7.11.2 Back-up Power Facilities**

The emergency generators, which supply emergency power to the KOB, KRMF and the Heating Plant, are tested monthly. Testing in 2020 was performed at the required frequency.

**2.7.11.3 Radiation Evacuation Alarms**

Radiation evacuation alarms are tested weekly and quarterly by the Radiation Surveyors. They are additionally tested biannually by Facilities. Testing in 2020 was performed at the required frequency and results were satisfactory.

**2.7.11.4 Radiation Alarms**

The radiation alarms are scheduled for testing on a weekly basis and were tested every week in 2020. The tests verify that the alarms sound at the pre-set alarm levels and that the alarms register on the Metasys monitoring system. If the alarms do not function as required, adjustments to the alarm levels and/or the Metasys are conducted immediately by Facilities. The results were satisfactory.

**2.7.11.5 Sprinkler System Fire Alarms**

The sprinkler system fire alarms in KOB, KRMF and the Heating Plant are tested every month. Testing in 2020 was performed at the required frequency and results were satisfactory. All dry systems were tested and verified in good operating condition in 2020 as required by the National Fire Protection Association (NFPA).

**2.7.11.6 Fire Alarm Panels**

The fire alarm panels for KOB, KRMF and the Heating Plant are tested and verified by the manufacturer once a year.

The fire alarm panels that monitor the KOB, KRMF and the Heating Plant are tested monthly. Testing in 2020 was performed at the required frequency and results were satisfactory.

**2.7.11.7 Contamination Monitoring Equipment**

Handheld contamination monitoring equipment is maintained twice a year. Area monitors are checked daily. Testing in 2020 was performed at the required frequency and results were satisfactory.

**2.7.11.8 Contamination Control Equipment**

The hand and foot monitors are calibrated twice a year, tested weekly and serviced on a routine basis. They are also repaired as required, which is typically two to three times a year. Testing in 2020 was performed at the required frequency and the results were satisfactory.

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**2.7.11.9 Environmental Monitoring Equipment**

Environmental monitoring equipment is tested on a weekly basis. If required, repairs to equipment are carried out immediately after the testing by Facilities personnel or in some instances the Surveyor. In 2020, a total of 12 work orders were generated for issues that were identified during weekly equipment testing.

Six work orders were due to issues with barrier monitors (Hand and Foot or Whole-Body Contamination Monitors). The issues with the barrier monitors were typically due to faulty probes or software/hardware issues causing the monitor to go "Out of Service". If a barrier monitor is malfunctioning, Nordion employees will perform checks using an adjacent barrier monitor or a handheld contamination monitor.

Two work orders involved issues with air sampling pumps; however, these issues were at locations considered to be of secondary importance and alarms on the Building Management System (BMS) are not triggered for failure of these pumps. There are several spare pumps and they are replaced typically within 24 hours.

Two work orders were generated for an alarm signal not registering at the BMS. The issues were corrected.

There were two other issues which generated work orders, one involved the alarm pre-set on a detector to be set at an incorrect value, and the other involved a faulty keypad door lock which made one area temporarily inaccessible.

Overall, the results were very good and demonstrate the value of continuing weekly performance checks, but also that failures of components are not compromising safety.

**2.7.11.10 Radiation Survey Instruments**

Radiation Survey Instruments are tested on a monthly, bi-annual, or annual basis as required. In 2020, for all of the 731 calibrations performed, the "As Found" results did not constitute a safety or regulatory concern. Testing in 2020 was performed at the required frequency and the results were satisfactory. At the end of 2020, there was one out of 731 survey meters past due for the internal frequency requirements. The majority of meters are calibrated every six months. The regulatory requirement for calibration frequency is 12 months.

**2.7.11.11 Trends**

There were no trends identified.

**2.7.12 Radiation Protection Training Program and Effectiveness**

Refer to Sections 2.2.1 and 2.2.2.

**2.8 Conventional Health and Safety****2.8.1 Conventional Health and Safety Program Effectiveness**

The Conventional Health & Safety Program is reviewed by conducting program audits, process audits, regular inspections by both employees and management, and a review of revised safety programs is performed by the Workplace Health & Safety Committee. The Workplace Health & Safety Committee is also responsible for reviewing the Hazard Prevention Program. In addition, the EHS Committee sets targets each year that are used to monitor the effectiveness of the safety program.

Targets were established for less than 4 Medical Treatment Incidents and zero Lost Time incidents. In addition, Near Miss Reports and Hazard Identification Reports are tracked and are reported monthly to senior management and are provided to the EHS Committee for review.

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Process safety audits are conducted annually.

Refer to Section 2.1.3 and Appendix B for a description of audits and inspections for 2020.

#### 2.8.2 Conventional Health and Safety Committee

The KOB Workplace Health and Safety Committee is represented by union and management and typically meets monthly.

The Nordion Workplace Health and Safety Committee met ten times in 2020, and the BWXT ITG Workplace Health and Safety Committee met eleven times in 2020. The 2020 accomplishments for these Committees were their continued review of new or changes to applicable EHS policies and programs. In addition, the Workplace Committees continued to review operational ergonomics as a standing agenda item for each meeting.

#### 2.8.3 Conventional Health and Safety Program Improvements

Improvements to the Conventional Health and Safety Program in 2020 included the following:

- Continuation of a behavioural based safety awareness campaigns
- Improvements to the Respirator Program
- Creation of a Machine Guarding Program
- Improvements to the Hearing Conservation Program
- Creation of COVID related programs/processes (education, response, decontamination)
- Updates to Safety Analysis Reports

#### 2.8.4 Conventional Health and Safety Occurrences

During 2020, there were three medical treatment incidents (one Nordion and two for BWXT ITG contracted employees) and no lost time injuries. The details are summarized below. Figures 2 and 3 illustrate the number of Incidents by year and the Number of Days Lost by year respectively.

**Lost Time Incidents: None to report for Nordion or BWXT ITG.**

#### **Medical Treatment Incidents:**

| <b>Business Unit</b> | <b>Medical Treatment Injury</b>  | <b>Action Taken</b>   |
|----------------------|--|---|
| Nordion              | Employee moved a box onto a crate. As they bent forward with the box, they felt a sharp pain shooting through their mid/lower back and down their right leg. | Manager discussed with team importance proper manual material handling techniques.  |
| BWXT ITG             | Pain to right elbow that employee is relating to repetitive tasks of job.  | Employees reminded on the benefits of stretching before, during and after activities; Ergonomic assessment completed and reviewed by multidisciplinary team. Changes made to process. |

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|          |   |  |
|----------|---|--|
| BWXT ITG | Employee bent over to pick up equipment off of the floor and injured lower back. Object was on a bench and after it had slipped off the bench, employee picked it up off the floor. | Manager discussed with team importance of body mechanics and lifting techniques. |
|----------|---|--|

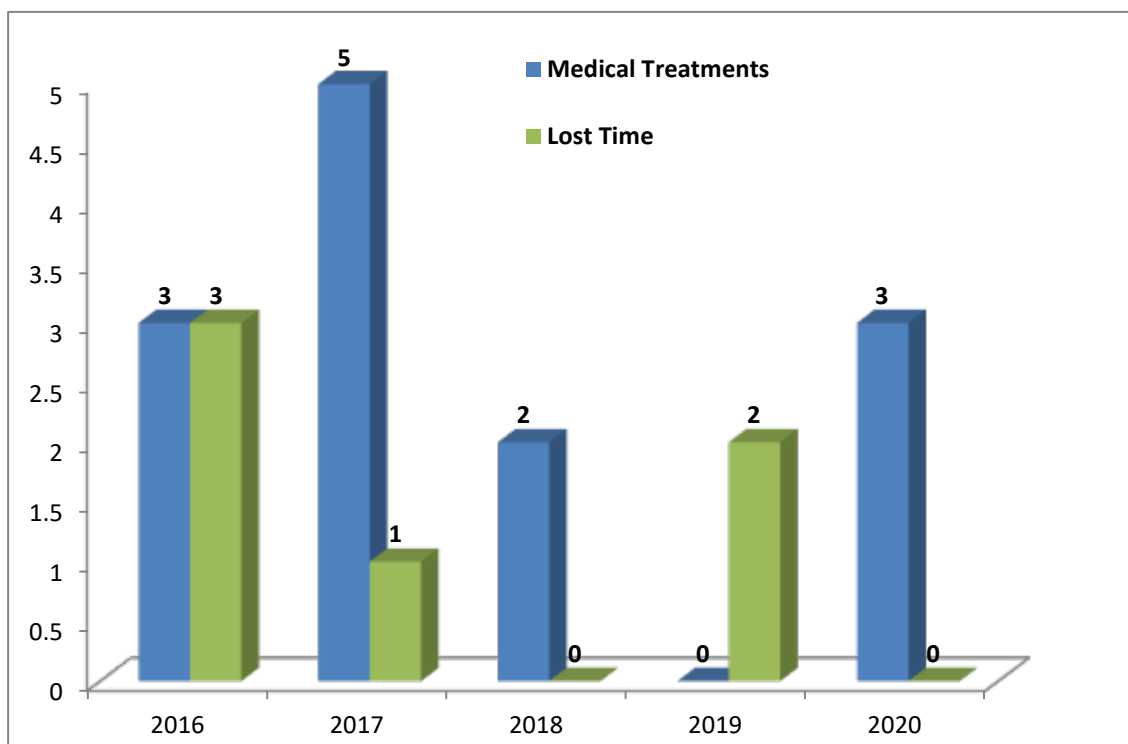


Figure 2: Number of Medical Treatments and Lost Time Incidents by Year

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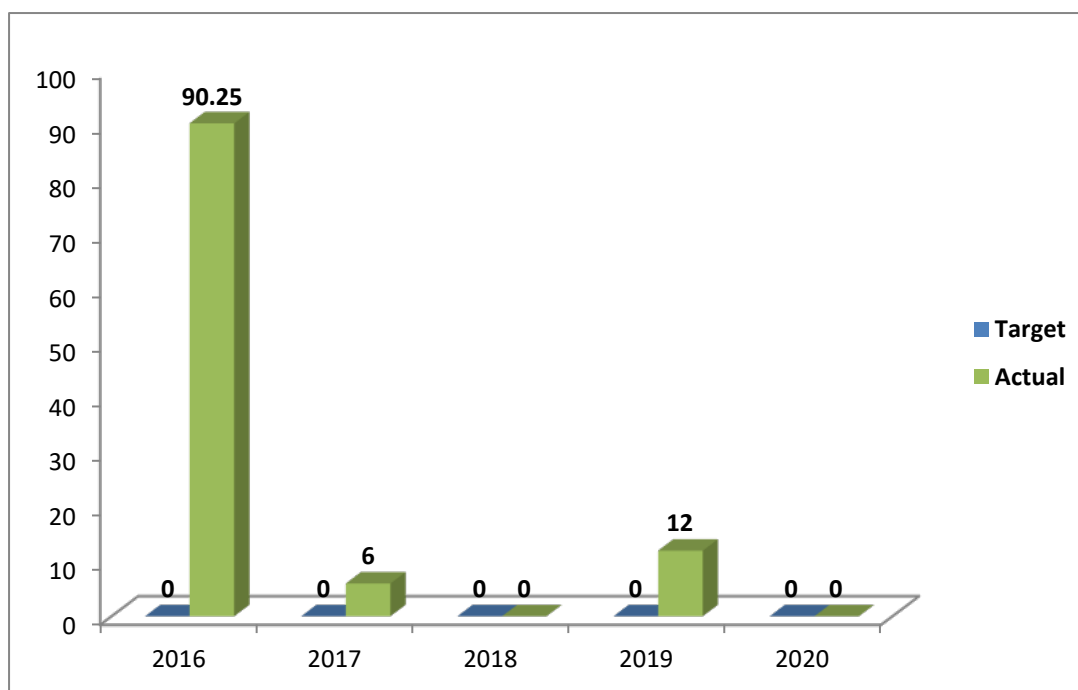


Figure 3: Number of Lost Time Days by Year

## Nordion-BWXT Lost Time Injury Statistics for 2020

|                                   | 2020 |
|-----------------------------------|------|
| # Lost-Time Injuries <sup>1</sup> | 0    |
| Severity Rate <sup>2</sup>        | 0    |
| Frequency Rate <sup>3</sup>       | 0    |

1 An injury that takes place at work and results in the worker being unable to return to work for a period of time.

2 The accident severity rate measures the total number of days lost to injury for every 200,000 person-hours worked at the site. Severity =  $[(\# \text{ of days lost in last 12 months}) / (\# \text{ of hours worked in last 12 months})] \times 200,000$ .

3 The accident frequency rate measuring the number of LTIs for every 200,000 person-hours worked at the site. Frequency =  $[(\# \text{ of injuries in last 12 months}) / (\# \text{ of hours worked in last 12 months})] \times 200,000$ .

## 2.9 Environmental Protection

## 2.9.1 Air and Water Release Monitoring

The environmental monitoring program is designed to monitor and measure effluent releases to the environment and to determine radiation levels in areas exterior to the KOB. The program includes the following elements:

- Continuous monitoring of process ventilation, exhausts ductwork, and stack emissions by use of in-situ detectors and samplers and computerized recording
- Weekly air sampling and analyses for KOB exhaust stack emissions
- Holding tanks for Active Area liquid effluent to allow sampling, analysis, and authorized release of liquid effluent
- Environmental TLD program
- Soil sampling
- Groundwater sampling

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Ventilation and stack sampling is conducted by using particulate and/or activated charcoal filters, depending on the physical and chemical nature of the radionuclide. Radioiodine sampling involves the use of activated charcoal filter cartridges, and analyses by gamma measurement. Particulates are sampled by use of cellulose filter papers and analyzed by gamma measurement.

All production operations are contained within cells, gloveboxes and/or fume-hoods. Ventilated air from these containment systems is filtered through roughing and HEPA filters and, where appropriate, activated charcoal adsorbers. These systems are designed with redundant fan/motor and filtration units that include pre-filters, primary and secondary filtration units. The Nuclear Ventilation System (NVS) has been designed and is maintained to prevent the unnecessary release of radioisotopes to the atmosphere.

**2.9.1.1 Airborne Effluent**

A revised LCH was issued to Nordion in January 2019 containing the DRL values submitted by Nordion in 2016 and approved by CNSC.

In 2020 there were no measurable air releases. No Action Levels were exceeded in 2020. There was no contribution to dose to public from air releases in 2020. Note that in 2019 there was only two weeks when Co-60 was quantified, but below the MDA – this means 2019 and 2020 air release measurements provided equivalent results. If Nordion was to attribute the MDA values weekly as detectable air releases, then it would be 0.00004 GBq similar to what was reported in 2019. Note that both of these values were a small percentage of the dose to public from liquid effluent.

I-125 with its longer half-life is still present in some waste and Nuclear Ventilation Systems but no releases were detected.

Note that air release activity measurements have an uncertainty of  $\pm 25\%$  for radioiodines and particulates and  $\pm 6\%$  for radioxenons.

**Table 15**  
**Airborne Releases**

| Year                        | Co-60<br>(GBq/yr) | I-125<br>(GBq/yr) | I-131<br>(GBq/yr) | Xe-133<br>(GBq/yr) | Xe-135<br>(GBq/yr) | Xe-135m<br>(GBq/yr) |
|-----------------------------|-------------------|-------------------|-------------------|--------------------|--------------------|---------------------|
| 2016                        | 0.006             | 0.21              | 0.35              | 7,277              | 4,299              | 5,421               |
| 2017                        | 0.0034            | 0.0012            | 0.0008            | 0                  | 0                  | 0                   |
| 2018                        | 0.002             | 0                 | 0.006             | 0                  | 0                  | 0                   |
| 2019                        | 0.00002           | 0                 | 0                 | 0                  | 0                  | 0                   |
| 2020                        | 0                 | 0                 | 0                 | 0                  | 0                  | 0                   |
| Action Levels<br>(GBq/week) | 0.001             | 0.1               | 0.2               | 3,000              | N/A                | N/A                 |

|              | Co-60 | I-125 | I-131 | Xe-133      | Xe-135      | Xe-135m    |
|--------------|-------|-------|-------|-------------|-------------|------------|
| DRL (GBq/yr) | 250   | 952   | 686   | 677,000,000 | 102,000,000 | 69,000,000 |
| % DRL        | 0     | 0     | 0     | 0           | 0           | 0          |

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****2.9.1.2 Liquid Effluent**

A revised LCH was issued to Nordion in January 2019 containing the DRL values submitted by Nordion in 2016 and approved by CNSC.

Allowable liquid effluent releases to the environment are also limited to values in SE-OP-013, "Water Effluent Monitoring". The five-year variation in activities released is listed in Table 16. Each release of liquid effluent in 2020 was well below the values in SE-OP-013 (exceedance of which would be Action Level reporting). All liquid effluent releases have been below the Nordion action levels and well within CNSC licensed limits. A summary of liquid releases, expressed as a % DRL, is provided in Table 16.

The City of Ottawa is informed whenever a release to the sanitary sewer takes place. In addition, a monthly summary report of the activity levels released is provided to the City of Ottawa.

Note that liquid release activity measurements have an uncertainty of  $\pm 10\%$ .

**Table 16**  
**Liquid Releases (GBq/yr)**

| Year  | Litres  | β<1MeV  | β>1MeV | I-125  | I-131  | Mo-99  | Co-60  | Nb-95  | Zr-95       | Cs-137  |
|---|---------|---------|--------|--------|--------|--------|--------|--------|-------------|---------|
| 2016  | 680559  | 0.222   | 0.051  | 0.144  | 0.006  | 0.052  | 0.026  | 0.001  | 0.0015      | 0.0007  |
| 2017  | 661376  | 0.212   | 0.048  | 0.145  | 0.006  | 0.049  | 0.022  | 0.001  | 0.002       | 0.0007  |
| 2018  | 713224  | 0.243   | 0.055  | 0.146  | 0.007  | 0.055  | 0.027  | 0.001  | 0.0017      | 0.0007  |
| 2019  | 576800  | 0.162   | 0.038  | 0.063  | 0.004  | 0.036  | 0.020  | 0.002  | 0.0019      | 0.0007  |
| 2020  | 747902  | 0.226   | 0.057  | 0      | 0      | 0      | 0.031  | 0.0015 | 0.0013      | 0.00076 |
| Nordion SE-OP-013 (19) Constraints on each delay tank release (pH or GBq/Release) |         |         |        |        |        |        |        |        |             |         |
| pH  | β<1MeV* | β>1MeV* | I-125  | I-131  | Mo-99  | Co-60  | Nb-95  | Zr-95  | Cs-137      |         |
| 6-9.5   | <0.086  | <0.021  | <0.006 | <0.003 | <0.132 | <0.015 | <0.047 | <0.047 | <0.002<br>4 |         |

|  | β<1MeV*  | β>1MeV*  | I-125 | I-131 | Mo-99  | Co-60    | Nb-95    | Zr-95    | Cs-137   |
|--|----------|----------|-------|-------|--------|----------|----------|----------|----------|
| DRL (GBq/yr)                                       | 763      | 35,000   | 1,190 | 389   | 10,200 | 35.4     | 3,250    | 2,060    | 24.8     |
| % DRL  | 2.96E-02 | 1.63E-04 | N/A   | N/A   | N/A    | 8.89E-02 | 4.54E-05 | 6.44E-05 | 3.04E-03 |
| *β<1MeV Ni-63 DRL value used, β>1MeV Y-90 DRL used |          |          |       |       |        |          |          |          |          |

Liquid releases are listed in Table 16 against both the DRL limits as well as the constraints Nordion places on every delay tank before it can be released from the building.

Meaning that less than 10% of the reported releases to liquid are real values and the rest are the reported MDA values instead of using zeroes. This is typical for every year in Table 16, therefore releases and subsequent dose to public are significant, conservative overestimates.

If the critical receptor was the same group for all radionuclides the dose to public would be 1.22  $\mu$ Sv. This value is a conservative over-estimate because the critical receptor has been used as the same receptor and because the DRLs are conservatively calculated.

### 2.9.1.3 Environmental TLDs

The locations of environmental TLDs are shown in Appendix G and listed in Table 17. The existing environmental TLD placement corresponds roughly to the historical locations of these dosimeters. The dosimeters are deployed to generally cover the points of a compass and preferentially to the east of the facility, which is the direction of the prevailing winds. The TLDs are also placed in residences of Nordion employees.

All environmental TLD readings for 2020 were well below the public limit of 1 mSv. The similarity in the recorded dose in these locations year over year, taken with the absence of any contamination found in soil illustrates that the variation between locations is due to variations in natural background radiation at these different times and locations.

The TLD for location [REDACTED], was not located when the TLDs were collected at the end of the year. This occurs occasionally. It is likely the TLD fell from its location sometime during the year and was lost. Nordion does not use these TLD measurements for any calculation of public or environmental dose. As such, the loss of any one TLD does not imply any loss in determining the effectiveness of the environmental protection program. The remaining 2020 TLDs are scattered around the site and still provide a complete assessment of the environmental program, which is well managed.

**Table 17 – Environmental TLDs**

|   |   | 2016<br>(mSv) | 2017<br>(mSv) | 2018<br>(mSv) | 2019<br>(mSv) | 2020<br>(mSv) |
|---|---|---------------|---------------|---------------|---------------|---------------|
| ■ | ■ | 0.133         | 0.032         | 0.086         | 0.096         | *             |
| ■ | ■ | 0.241         | 0.169         | 0.132         | 0.164         | 0.103         |
| ■ | ■ | 0.035         | -0.052        | -0.071        | -0.086        | -0.092        |
| ■ | ■ | 0.128         | 0.037         | 0.08          | 0.039         | -0.044        |
| ■ | ■ | 0.078         | 0.061         | 0.079         | 0.093         | 0.081         |
| ■ | ■ | 0.037         | -0.041        | 0.031         | -0.011        | -0.04         |
| ■ | ■ | 0.003         | -0.057        | 0.036         | -0.004        | -0.083        |
| ■ | ■ | 0.161         | 0.036         | 0.082         | 0.078         | 0.067         |
| ■ | ■ | 0.004         | -0.047        | 0.003         | -0.018        | -0.061        |
| ■ | ■ | 0.149         | 0.046         | 0.144         | 0.140         | 0.068         |

\* missing TLD

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**2.9.2 Significance of Air and Water Release Monitoring Results**

[REDACTED]

[REDACTED]

It has been the practice of Nordion to only quantify air releases which have been identified first by reports generated by multi-channel analyzers, but in 2020 it was there was no inventory of radioiodines even in decayed waste or on contaminated equipment or hot cells.

If Nordion were to apply MDA values to Co-60 releases in 2020 would be 0.00004 GBq of Co-60. This is still several orders of magnitude lower than the releases via liquid (both in %DRL or dose to public).

[REDACTED]

As in previous years, liquid releases closely followed liquid release volumes due to Nordion's practice of assuming the MDA is the level of the release. No other specific trends were noted.

Trends in changes in volumes of water released from the facility continue to be generally proportional to activities released. Nordion employs a conservative practice of assuming the MDA is always released in liquid effluent. This explains why the year over year trend very closely follows the number of litres released.

In fact, only less than 10% of the total measurements done on liquid effluent in 2020 were above the MDA. This is an increase year over year from 7% in 2019, but only because of the reduction of measurements counted (with I-125, I-131 and Mo-99 being removed). Therefore, the liquid effluent monitoring results indicate a dose to the public that is based on activity values which were over-estimated by a factor of ten (10) at a minimum. Due to the conservative approach used by Nordion, the estimated dose to the public from liquid effluent is greatly over estimated.

**2.9.3 Exceeding Regulatory Limits or Action Levels**

There were no instances of exceeding CNSC environmental regulatory limits or action levels in 2020.

**2.9.4 Spills to the Environment**

Aside from the unplanned release reported in Section 1.2, there were no spills to the environment in 2020.

**2.9.5 Environmental Protection Program Effectiveness**

A review of the performance related to the Environmental Protection Program and the Environmental Management System is conducted on an annual basis. In 2020, this review was held during the Annual EHS Program Review on July 7, 2020. The results of the review are summarized in Section 2.1.2.

Refer to Section 2.1.3 for a summary of internal and external inspections, audits and reviews. A list of the internal audits and associated findings and opportunities for improvement are provided in Appendix B.

**2.9.6 Environmental Protection Program Activities**

Activities which took place in 2020 included the following:

- Conducting a total of 13 fire and environmental inspections to identify areas for improvement and/or concerns,

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- Conducting a supplier audit of a supplier whose goods/services could have a significant impact on the environment,
- Nordion was subject to an ISO 14001:2015 maintenance audit. No non-conformances were identified and two opportunities for improvement were identified during this audit.

**2.9.7 Environmental Protection Program Improvements**

In 2020, Nordion made the following improvements to the Environmental Protection Program.

- Third party quality control assessment of groundwater and soil samples was conducted in 2020

**2.9.8 Environmental Protection Program Performance**

A description of the Environmental Protection Program Initiatives is provided in Table 18, along with the results/outcomes.

A summary of initiatives and targets for the upcoming year is provided in Table 19.

**Table 18****2020 Environmental Objectives**

| Objective   | Target   | Status  |
|---|--|---|
| Conduct an audit of a supplier whose goods and/or services could have a significant impact on the environment.  | Complete one supplier audit in accordance with SE-ENV-019 "External Supplier Environmental Audits by the end of December 2020. | Audit of a supplier whose goods and/or services can have a significant impact on the environment is complete. |
| Investigate energy reduction opportunities.   | Estimated savings of 7,500 kWh per year.   | Complete, an estimated 92,000 kWh energy savings annually as a result of lighting retrofits.                  |
| Assess opportunities to reduce releases to water.   | Investigate and implement (as feasible) opportunities to reduce releases to water from the Gamma Technologies area             | On-track. The target date for this objective is December 31, 2021.  |
| Investigate possible opportunities for using less environmentally harmful chemical products and/or reducing chemical use in processes, product support, facility operation and maintenance activities where feasible. | Investigate and implement (as feasible) opportunities to reduce, remove or replace hazardous chemicals with less harmful ones. | On-track. The target date for this objective is December 31, 2021.  |
| Investigate energy reduction opportunities.   | Investigate implementation of "Behind the Meter" energy storage.   | On-track. The target date for this objective is December 31, 2021.  |
| Investigate potential options for reducing the volume of Cobalt waste by 2022   | Complete investigation and implement viable options by the end of 2021   | On-track. The target date for this objective is December 31, 2021.  |

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**Table 19**  
**2021 Environmental Objectives and Targets**

| Objective  | Target   |
|--|--|
| New - Conduct an audit of a supplier whose goods and/or services could have a significant impact on the environment.   | Complete one supplier audit in accordance with SE-ENV-019 "External Supplier Environmental Audits by the end of December 2021. |
| New - Investigate energy reduction opportunities   | Estimated savings of 7,500 kWh per year  |
| Continued from 2020 - Assess opportunities to reduce releases to water.  | Investigate and implement (as feasible) opportunities to reduce releases to water from the Gamma Technologies area             |
| Continued from 2020 - Investigate possible opportunities for using less environmentally harmful chemical products and/or reducing chemical use in processes, product support, facility operation and maintenance activities where feasible | Investigate and implement (as feasible) opportunities to reduce, remove or replace hazardous chemicals with less harmful ones  |
| Continued from 2020 - Investigate energy reduction opportunities   | Investigate implementation of "Behind the Meter" energy storage.   |
| Investigate potential options for reducing the volume of Cobalt waste by 2022  | Complete investigation and implement viable options by the end of 2021   |

### 2.9.9 Groundwater and Soil Sampling and Monitoring

#### 2.9.9.1 Soil Sampling

Soil samples were taken at 19 locations around the Nordion site in August 2020, as shown in Figures G.4 and G. 5 in Appendix G. Samples were placed in plastic bags, labeled with the site location, and then analyzed on the MCA for 8 hrs as per Nordion's procedure. Background measurements (no sample, empty chamber) were also taken for reference. The radioisotope primarily analyzed was Co60. The MDA is determined for each sample individually and ranged between 0.8 – 1.9 Bq. When accounting for background Co60 fields present in the facility, all 19 samples were determined to be less than the MDA. As such, no radionuclides attributable to licensed activities were detected in the soil samples.

#### 2.9.9.2 Groundwater Sampling

Figure G.3 (Appendix G) shows current groundwater well locations.

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**2.9.9.2.1 Non-Radiological Sampling**

Non-radiological groundwater samples were taken on October 5, 2020. Results, including those from the recent analysis, from five years previous and from the original sampling in 2005 are provided in Appendix F by borehole, with borehole two (2005-BH2) representing background conditions.

The results of this analysis demonstrated that there were no significant changes in the groundwater in 2020 compared to past years. This indicates that Nordion's operations have not had a significant impact on the groundwater.

**2.9.9.2.2 Radiological Sampling**

Nordion monitors groundwater at least once per year.

Samples are taken in from the following boreholes to assess potential radiological contaminants:

- 1991-BH1
- 1991-BH2
- 1991-BH3
- 1991-BH4
- 2012-BH1

Samples were placed in 1L Nalgene bottles and analyzed on the MCA for 8 hrs as per Nordion procedure. The radioisotope primarily analyzed was Co60. The MDA is determined for each sample individually and ranged between 0.6 – 1.3 Bq. When accounting for background Co60 fields present in the facility, all 5 samples were determined to be less than the MDA. As such, no radionuclides attributable to licensed activities were detected in the water samples.

**2.10 Emergency Management and Fire Protection****2.10.1 Emergency Preparedness Program Effectiveness**

Management has assessed the existing program and deemed it effective through historical success in meeting the response objectives during exercises.

Nordion completed most of its scheduled activities for 2020 however a few planned exercises had to be postponed due to COVID-19 and the need for physical distancing. Exercises that were held were modified to limit risk to participants.

**2.10.2 Emergency Preparedness Program Activities**

Nordion has an extensive emergency preparedness program to respond to various types of emergency situations, including on-site and off-site emergencies. During 2020, a number of Emergency Response (ER) exercises were conducted to test these emergency response plans and response personnel. In addition to these exercises, two false alarms acted as "real-world" exercises.

Activities which took place in 2020 included:

- A building evacuation of the KOB building on March 11, 2020 due to a false alarm.
- A building evacuation of the KOB, KRMF and Cobalt buildings on April 6, 2020 due to a false alarm.
- A hybrid desktop and Incident Command Post activation exercise was conducted with Ottawa Fire Services participation on October 9, 2020
- Testing of the Fire Safety Plan in each of the RE Building and Heating Plant including alarm activation and full evacuation,

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- Testing of the ER Contact List to ensure accuracy of telephone numbers listed, to determine availability of personnel, and to estimate response times.

**2.10.3 Emergency Preparedness Program Performance**

The emergency preparedness program performance was tested during the exercises and drills noted in the previous section. During these exercises and drills, Nordion executed an effective response and demonstrated good interoperability with city first responders.

Overall compliance with the Emergency Management Program was proven satisfactory. There were no events (planned or actual) demonstrating non-compliance with the Emergency Management Program.

There were no deficiencies with the Emergency Management Program systems or equipment in 2020.

**2.10.4 Emergency Preparedness Program Improvements**

The response to the pandemic was the primary focus in 2020. Significant effort was required to maintain a safe facility and to reduce any impacts. Continuous adaptation was required as the external situation and guidelines changed very frequently. These adaptations were active program improvements and Nordion was very successful in mitigating the pandemic's impact.

**2.10.5 Fire Protection Program Effectiveness**

Fire exercises/evacuations were conducted in the Heating Plant, the RE Building and the KOB in 2020. There were no significant findings identified as a result of these exercises.

The objective of the fire protection program is to promote life safety, the conservation of property and essential equipment, the protection of the environment and the continuity of operations through provisions of fire prevention and fire protection measures. Nordion met all scheduled activities related to the fire protection program in 2020. An annual facility condition inspection was conducted by a third party in 2020 with two minor findings.

**2.10.6 Fire Protection Program Activities**

The Fire Protection Program Activities that took place in 2020 include:

- Testing of the fire safety plans. This test involved evacuation of the Heating Plant and RE buildings by activation of the building fire alarm system, and a test of the KOB fire safety plan and emergency response plan which included participation with Ottawa Fire Services.
- Conducting 13 fire and environmental inspections
- Conducting an annual facility condition inspection with two minor findings noted.

A fire protection program audit was conducted in 2019 and is conducted every three years as required by CSA standard N393, "Fire protection for facilities that process, handle, or store nuclear substances".

**2.10.7 Fire Protection Program Performance**

Overall, compliance with the Fire Protection Program was satisfactory.

**2.10.8 Fire Protection Program Improvements**

Improvements to the Fire Protection Program in 2020 included:

- Initiated updates to the Fire Hazard Analysis, which will be finalized in 2021
- Updating the Fire Safety Plan and Fire Warden and Fire Marshall Responsibilities procedures.
- Updated the Fire Protection Program
- Creation of a new "Fire Protection System Impairments" procedure to supplement the "Work Permit Authorization Program"

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There were no changes to training, methods, instrumentation, or equipment in 2020.

**2.11 Waste Management****2.11.1 Effectiveness of Waste Segregation and Minimization**

Nordion production facilities have been designed and operated in a manner to prevent radioactive waste being released to municipal garbage or sewer systems and to ensure that releases to the environment via air or water emissions are within limits approved by the CNSC. All radioactive waste that is generated through the production operations is collected and sent to a CNSC approved radioactive waste management facility.

Nordion has designated space and processes to store and segregate radioactive waste that is generated in Operations. [REDACTED]

[REDACTED] Space is also designated for storage of containers and management of waste being prepared for shipment to the external waste management facilities.

Nordion's non-radiological waste diversion rate in 2020 was 63.9%. This is lower than the 2019 diversion rate of 65.1%, [REDACTED]

**2.11.2 Identification and Characterization of Waste Streams**

[REDACTED]

**2.11.3 Waste Shipments**

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

In 2020, approximately [REDACTED] of solid and liquid hazardous (chemical) waste was disposed of [REDACTED] via a licensed waste disposal company. [REDACTED] disposed of approximately [REDACTED] of solid and liquid hazardous (chemical) waste via a licensed waste disposal company in 2020.

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In 2020, [REDACTED] that met CNSC unconditional clearance levels was disposed of to a landfill as part of the waste diversion program.

| [REDACTED] |            |            |            |
|------------|------------|------------|------------|
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |

| [REDACTED] |            |            |            |            |
|------------|------------|------------|------------|------------|
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |

| [REDACTED] |            |            |            |
|------------|------------|------------|------------|
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |
| [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] |

#### 2.11.4 Waste Management Program Performance

- Nordion diverted an estimated 63.9% of waste from landfill in 2020,
- The amount of waste diverted from licensed radioactive waste facilities – [REDACTED] that met CNSC unconditional clearance levels was disposed of to landfill as part of the waste diversion program.

The waste management program was audited in 2018 and is on a three-year frequency for internal auditing. Nordion has an annual waste audit conducted by a third party (non-hazardous waste only). The results of the 2020 annual third-party audit are summarized below:

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- 63.9% diversion rate,
- 90%+ diversion rate for:
  - Aluminum food/beverage cans & foil,
  - Scrap Metal,
  - Cardboard,
  - Fine Paper,
  - Newsprint/Packing Paper,
  - Wood/Skids,
  - Spent lighting tubes/bulbs/ballasts,
  - Shredded Paper.
  - Glass food and beverage bottles

**2.11.5 Waste Management Program Improvements**

Improvements to the Waste Management Program in 2020 included the following:

- [REDACTED] of returned Cobalt sources were cut back to raw material and added to inventory in 2020 to support the recycling program.
- [REDACTED] of returned Cobalt sources were cut back to raw material and recycled into new source manufacturing,  
[REDACTED] of returned Cobalt sources were re-encapsulated into new sources for resale.

**2.12 Nuclear Security**

Details of Nordion security and any security improvements of 2019 were provided in the Nordion Physical Security Report and Security Plan for 2020, submitted in February 2020. These safeguards and improvements are prescribed information and were reviewed and accepted by CNSC Security.

**2.13 Safeguards and Non-proliferation****2.13.1 Safeguards Program Effectiveness**

Nordion has a safeguards program that meets the safeguards requirements of the CNSC regulatory document REGDOC 2.13.1-Safeguards and Nuclear Material Accountancy, *CNSC Nuclear Non-Proliferation Import and Export Control Regulations*, the *Nuclear Safety and Control Act* and *General Nuclear Safety and Control Regulations*.

**2.13.2 Safeguards Program Performance**

In 2020, Nordion performed accounting and reporting of nuclear material as required by REGDOC 2.13.1-Safeguards and Nuclear Material Accountancy. Nordion completed a PIT of safeguarded material from which there was two minor findings, six observations and two opportunities for improvement (refer to Appendix B).

In October 2019, the IAEA performed a Physical Inventory Verification (PIV) and a Complementary Access Inspection. There were no outstanding actions at the conclusion of the inspection. The IAEA statement of results was received by Nordion and confirmed the results of the inspection were satisfactory.

**2.13.3 Safeguards Program Improvements**

There were no specific improvements to the safeguards program in 2020.

**2.14 Packaging and Transport of Nuclear Substances**

Nordion routinely ships both sealed and unsealed sources of nuclear substances in Type B, Type A and Excepted packages. Nordion also routinely ships waste materials in these same package types. Shipments of Nordion's products are made via road, air and sea. Shipments of waste are routinely made via road transport.

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In 2020, Nordion shipped approximately [REDACTED] packages containing various radioactive materials.

The Packaging and Transportation Program at Nordion provides a high-level overview of Nordion's transportation of radioactive materials program. The program applies to employees involved in design, production, use, inspection, maintenance and repair of packages, and the preparation, consigning, handling, loading, carriage, storage during transport, receipt at final destination, and unloading of packages. It applies to various types of packages including Type A, Type B, and Excepted packages. The content of the program was modeled on regulatory requirements listed in the CNSC *Packaging and Transportation of Nuclear Substances Regulations 2015*, Transport Canada *Transportation of Dangerous Goods Regulations*, IAEA *SSR-6 Regulations for the Safe Transport of Radioactive Material* (2018 Edition), US DOT 49 CFR, and US NRC 10 CFR part 71.

In 2020, Nordion reported five non-conformances related to packaging and transport of nuclear substances. These five reportable non-conformances were reported as "dangerous occurrences" pursuant to subsection 37(1) of the *Packaging and Transportation of Nuclear Substances Regulations*. All were the result of other parties (carriers or customers) handling Nordion packages. Refer to Appendix A for further information regarding these incidents. Additionally, as noted in Section 1.5, there was one non-compliance as a result of Nordion exceeding of a package activity limit for a shipment of sealed sources, due to the inadvertent loading of an incorrect source with a slightly higher activity than planned.

## 2.15 Public Information Program (PIP)

### 2.15.1 Public Information Program Activities

Nordion is committed to fully disclosing its activities to the public to maintain transparency to the surrounding community and to the City of Ottawa. Nordion's website is the primary communications vehicle. In 2020, 9,859 unique users visited the Nordion.com website.

In absence of offering on-site facility tours to the general public, Nordion offers the general public a glimpse into our campus through an online Nordion Virtual Tour.

Approximately every two years, Nordion hosts a community event with the general public. Such an event was held in 2018. Due to COVID-19, Nordion deferred a community outreach event in 2020. A community outreach event is planned for early 2021.

In 2020, Nordion published the following information in their "Public Disclosure" web page:

- October: evacuation of administrative building as part of an emergency response exercise.
- October: notice of a emergency response plan training exercise, including participation of Ottawa Fire Services.
- April: evacuation of the operations facility because of a false fire alarm.
- March: notice of a vehicle accident of the Nordion property.
- March: evacuation of the operations facility as a result of a false fire alarm.
- Q1, Q2, Q3, and Q4: 2020 Event reports posted.

Nordion's website includes a feedback survey form in the Social Responsibility section as a mechanism to invite the public to provide feedback on Nordion's Public Information Program and to learn how the public would like the program to evolve. A copy of the feedback survey form is provided in Appendix H. There were no feedback forms submitted by members of the public in 2020. In 2020 there were no questions pertaining to Nordion's public information program received through the general contact form.

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Nordion issues news releases to inform the public of company initiatives, achievements, and issues that the business may be facing. In 2020, there were no media articles related to Nordion environment, health and safety issues or topics. As the context of media coverage referring to Nordion was business-oriented, there was no media analysis of public opinion.

Nordion uses social media programs such as Facebook, Twitter, and LinkedIn to inform the public of the company's initiatives. In 2020, there were no negative comments pertaining to events or questions related to environment, health, and safety.

On December 10, 2020, Nordion published an ad in the *Community Voice*, a bi-weekly newspaper distributed to 85,000 homes and businesses across Ottawa and the surrounding areas. A copy of the ad is provided in Appendix I. The ad underlined Nordion's ongoing commitment to protect the safety of employees, the community and the environment, referred to the Kanata facility as a Class 1B nuclear facility, noted that Nordion is certified to ISO 14001, an international standard for environmental management systems; and encouraged the public to contact Nordion with any questions, comments, or concerns.

**2.15.2 Public Information Program Summary of Questions/Concerns Raised by the Public**

There were no specific questions or concerns raised by members of the public in 2020.

**2.15.3 Public Information Program Improvements**

Through the year, Nordion updates its website content to keep it current.

In 2020, the Nordion Public Information Program was updated to address gaps identified with CNSC REGDOC-3.2.1 and CNSC REGDOC-2.9.1 including, but not limited to, including specific reference to local indigenous groups, to make reference to the specific records required to be retained for the Public Information Program and to make other minor improvements and updates required.

**2.16 Financial Guarantee**

The Financial Guarantee, as approved by the Commission and based on the Facility's Decommissioning Plan, remains valid and in effect.

**2.17 Site Specific Information**

Nordion's site-specific reporting requirements are as follows:

- Nordion shall submit a written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs, and methods, referred to in the licensing basis,
- Nordion shall, when aware that an action level has been reached, notify the Commission within seven days,
- Nordion shall prepare and submit to the Commission an Annual Compliance Report by March 31<sup>st</sup> of each year,
- Nordion shall report the transfer, receipt, export or import of sealed sources if the activity exceeds the threshold limits and within the specified timeframes as detailed in the LCH,
- Nordion shall report annually to the CNSC on the status of the financial guarantee, to inform that it remains valid, in effect and adequate to fund decommissioning of the facility.

In 2020, Nordion submitted written notification of changes to programs and documents to the CNSC as required.

In 2020, there were no exceedances of action levels.

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Nordion submitted its Annual Compliance Report to the CNSC on April 30, 2020, with the extended timeframe approved by the CNSC due to the impacts of the COVID-19 remote working requirements.

In 2020, there were two events with regards to sealed source reporting:

- Nordion reported an incorrect sealed source shipped from the facility. Nordion provided a subsequent correction to the CNSC. In response to the occurrence, Nordion implemented improvements to the internal processes for the independent verification of source serial numbers during container loadings.
- Nordion did not report the receipt of radioactive sources within the required 48-hour timeframe. Nordion subsequently provided the required report for the receipt. In response to the occurrence, Nordion broadened the distribution list for source receipt notifications to include the Director, Regulatory & EHS and is conducting an on-going review of its processes related to off-hours reporting of source receipts.

These events were not reportable to the CNSC. There were no trends identified in 2020 with regard to SSTs-related events.

Nordion continues to work on continuous improvements to sealed source reporting processes.

Nordion complied with all other site-specific reporting requirements. Nordion reported as required to the CNSC in 2020 on the status of the financial guarantee. Nordion submitted a 5-year update to its Preliminary Decommissioning Plan as required in 2020.

### **3. FUTURE PLANS AND CONCLUDING REMARKS**

#### **3.1 Improvement Plans and Future Outlook**

Work was initiated in 2020 for the installation of an additional cell (Cell 1) in Nordion's Cobalt Operations Facility. This work is expected to be completed in 2021.

The new electronic Quality Management System (eQMS) for the management of documents and training records was implemented in 2020.

Nordion is planning to implement increased storage rack capacity within the Cobalt Operations Facility in 2021.

The forecasted plans for next year that would require CNSC regulatory oversight are as follows:

- License amendment due to the sale of Nordion's Medical Isotopes business to BWXT ITG, when BWXT ITG obtains an operating license from the CNSC.
- The installation of an additional Cell (Cell 1) in Nordion's Cobalt Operations Facility.

#### **3.2 Safety Performance Objectives for 2021**

Nordion's 2021 EHS Program Objectives and Targets and Health and Safety Objectives are shown in Table 23.

#### **3.3 Concluding Remarks**

Based on the information provided in this report, Nordion continues to demonstrate its capacity to operate in a manner that protects the safety of employees and causes no adverse effects to the public or the environment.

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**Table 23**  
**2021 EHS Program Objectives and Targets**

| <b>Objective</b>   | <b>Measure/Target *</b>   |
|--|---|
| Manage CAPAs and ensure timely closure of CAPAs  | <ul style="list-style-type: none"> <li>• Ensure timely updates to and closure of CAPAs (no late CAPAs and request extensions as required)</li> </ul>  |
| Close out Quality/EHS Management Systems in a timely manner (where applicable to your areas) | <ul style="list-style-type: none"> <li>- Ensure documents under your ownership are maintained and reflect current practices</li> <li>- Complete Complaint Investigations within the target of 14 days from initiation and closure within 60 days</li> <li>- Ensure target dates are set for all Change Control forms</li> <li>- Overall percentage of overdue training <math>\leq 2\%</math></li> </ul> |
| Minimize the number and extent of occupational injuries                                      | <ul style="list-style-type: none"> <li>• The number of Medical Treatment Incidents <math>\leq 4</math>,</li> <li>• Lost time Incidents = 0.</li> </ul>  |
| Minimize the use and release of hazardous materials to the environment.                      | <ul style="list-style-type: none"> <li>• Radioactive materials emissions to <math>&lt; 2.0\%</math> of the Derived Release Limits (DRL) (Ottawa),</li> <li>• No reportable releases of radioactive and non-radioactive hazardous materials to the environment (sanitary sewer, air, groundwater, land)</li> </ul>   |
| Maintain radiation doses to employees as per ALARA principle.                                | <ul style="list-style-type: none"> <li>• Maximum employee dose rate <math>\leq 7.5</math> mSv/yr. (Ottawa)</li> </ul>   |
| Maintain a healthy safety culture. *   | <ul style="list-style-type: none"> <li>– It is unacceptable to take risks in order to get the job done. Safety is every employee's <b>highest</b> responsibility.</li> <li>– Actively participate in regular safety discussions and training.</li> <li>– Immediately report near-misses, hazard identifications, suspected ergonomic symptoms and workplace injuries to your Manager.</li> </ul>        |

**\*Note: Some Health and Safety Targets have been established to promote safety culture only and are therefore not measurable.**

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### APPENDIX A

#### 2020 Reportable Events

| Date of Occurrence | Incident No. | Description   | Regulation/Requirement to which the Event is Non-compliant and/or Reporting Requirement   | Causes   | Corrective Actions  |
|--------------------|--------------|---|---|--|---|
| March 11, 2020     | 20-06        | On March 11, 2020 the fire alarm sounded in the Nordion KOB initiating an evacuation. It was determined to be a false alarm due to a high heat sensor reading. The fire department arrived at the Nordion site and left once it was determined to be a false alarm. | This incident was deemed reportable to regulatory agencies as a false alarm and since emergency vehicles arrived on site (Reg Doc 2.10.1 Section 5.1.12). | The root cause was determined to be due to high heat generated ■■■■■ due to a unique building heating configuration on March 11, 2020. | It was determined that the heat sensor was operating normally. Corrective actions are currently being assessed to ensure heat build-up remains below sensor activation. |
| April 6, 2020      | N/A          | During the evening shift on April 6, 2020, there was a false low flow alarm from the fire protection system that lead to evacuation of the KOB and the fire department arriving on-site.  | This incident was deemed reportable to regulatory agencies as a false alarm and since emergency vehicles arrived on site (Reg Doc 2.10.1 Section 5.1.12). | It was determined that the alarm was caused by a false low flow detector alarm in the sprinkler system.                                | While no fault was found with the sensor, a new sensor was installed as this was the most probable point of failure and cause of the false alarm.                       |

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| Date of Occurrence | Incident No. | Description   | Regulation/Requirement to which the Event is Non-compliant and/or Reporting Requirement | Causes  | Corrective Actions  |
|--------------------|--------------|---|---|---|---|
| April 21, 2020     | 20-07        | During construction work a contractor inadvertently damaged fire alarm panel wires resulting in the fire alarm system being temporarily disabled. | The incident was reported to the duty officer.  | Nordion provided a preliminary report regarding the inactivation of the fire alarm in the [REDACTED] to the CNSC Duty Officer on Tuesday, April 21, 2020. The incident was reportable under GNSCR 21 (f) and REGDOC 3.1.2 as it was determined to be an impairment of a fire protection system. | <p>The following actions were taken immediately follow the event:</p> <ul style="list-style-type: none"> <li>- The contractor communicated to their staff that use of procedure for cutting/coring and completion of the associated checklist, is mandatory for all cutting and coring work and ensured sufficient copies of the cutting/coring procedure are provided in readily accessible locations. The contractor will ensure completion of checklist, including supervisor sign off.</li> <li>- The contractor has provided training on inspection technique to ensure that areas requiring close inspection are reviewed closely and the use of sufficient lighting to observe the area to perform the inspection adequately.</li> </ul> <p>CAPA 200550 was been initiated to implement broader corrective actions including, but not limited to:</p> <ul style="list-style-type: none"> <li>- Ensuring adequately lighting is available for inspections,</li> <li>- Ensuring review of as-built drawing with Facilities staff prior to cutting or coring through doors, walls, ceiling, or floors,</li> <li>- Implementing methods to measure and limit (drill stop) the depth of cuts or cores.</li> <li>- Implementing procedures incorporating independent second person inspections and appropriate work checklists,</li> <li>- Increased auditing of records to verify that independent verification is being completed as required</li> </ul> |

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| Date of Occurrence | Incident No.    | Description  | Regulation/Requirement to which the Event is Non-compliant and/or Reporting Requirement   | Causes   | Corrective Actions   |
|--------------------|-----------------|--|---|--|--|
| 20-Feb-25          | 20-02           | It was noted that an incoming Type B package was received with a loose lid on the leak proof insert.   | Reportable under Section 37 (1) of PTNSR as the shipment met the description of other dangerous situation as per Section 35 (g) of the PTNSR  | Consignor did not prepare the package appropriately                        | Feedback was provided to consignor.  |
| April 20, 2020     | 20-08,<br>20-32 | On April 20, 2020 a shipment of Co-60 sealed sources was exported from Canada. The shipment inadvertently contained one incorrect source. This resulted in the shipment marginally exceeding the allowed activity for the CNSC export license, [REDACTED], Nordion submitting incorrect sealed source tracking information for the shipment, and the package activity limit being marginally exceeded. | The incident was a non-compliance with the license conditions of [REDACTED]. The incident was a non-compliance with section 4.2 of Nordion's LCH regarding reporting of sources prior to shipment. While the incident is also a non-compliance with the transport certificate, the minor increase in activity did not constitute a dangerous occurrence and therefore was a reportable event. | The incorrect source was inadvertently loaded for the shipment at Nordion. | Internal procedures have been revised to implement more robust requirements for independent verification of sources during loading operations.<br><br>Nordion is also investigating improvements to the processes and tools used by EHS to assess the reportability of incidents as part of corrective actions related to this occurrence. |
| May 12, 2020       | 20-11           | Type A package received damaged while in transit.  | Reportable under Section 37 (1) of PTNSR as the shipment was damaged in transit as per Section 35 (b) of the PTNSR  | Package was damaged in transit   | Carrier reported damage to US DOT. Package to be repaired or removed from fleet.   |

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| Date of Occurrence | Incident No. | Description  | Regulation/Requirement to which the Event is Non-compliant and/or Reporting Requirement                            | Causes  | Corrective Actions  |
|--------------------|--------------|--|--|---|---|
| July 13, 2020      | 20-14        | It was determined that Nordion had conducted imports of thoriated welding rods without obtaining CNSC import licenses. | Disclosure to CNSC required as per REGDOC-2.13.2 Section 8.2/Appendix B.   | At the time the thoriated welding rods were approved as an inventory item, the requirement for a CNSC import license when ordering from non-Canadian suppliers was not identified and noted on the Item Master. | A review of all inventory items was completed to identify any other items that may require regulatory approvals prior to ordering (with no further items found). Improvements to procedures and related job aids to clarify when EHS approval is required new/updated inventory items and/or prior to ordering or shipment of certain procured items. |
| September 17, 2020 | 20-21        | A Type A package was reported missing in transit.  | Reportable under Section 37 (1) of PTNSR as the shipment was missing in transit as per Section 35 (c) of the PTNSR | Package was lost in transit.  | Package was not found, however radioactivity decayed below exemption quantities.  |
| September 22, 2020 | 20-24        | A Type A package was reported missing in transit.  | Reportable under Section 37 (1) of PTNSR as the shipment was missing in transit as per Section 35 (c) of the PTNSR | Package was lost in transit.  | Carrier was able to find the package.   |
| December 2, 2020   | 20-31        | A Type A package was reported missing in transit.  | Reportable under Section 37 (1) of PTNSR as the shipment was missing in transit as per Section 35 (c) of the PTNSR | Package was lost in transit.  | Carrier was able to find the package.   |

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### Appendix B

#### Summary of Corrective Actions Associated with the Internal Audits Conducted in 2020

CAPA = Corrective Action Preventive Action  
 Gensuite ID# = BWXT ITG Gensuite Compliance Action  
 CHR = Change Request in EQMS

AC-CMP = Velocity EHS Compliance Action  
 CF = Change Form  
 OFI – Opportunity for Improvement

|   | Audit Title                          | # of Findings/<br>OFIs  | Action Reference No.            | Finding/Observation/OFI                                     | Corrective Action  | Status      |
|---|--------------------------------------|---|---------------------------------|---|--|-------------|
| 1 | Independent Assessment – Engineering | N/A – Audit deferred as per Deviation 6373 because of covid-19 pandemic | N/A                             | N/A   | N/A  | N/A         |
| 2 | EMS Audit                            | 3 OFI's.  | VEHS Action AC-CMP-20210129-001 | Several EMS documents still reference Vancouver Operations. | Nordion will submit pending changes requests to relevant EMS documents to remove reference to Vancouver Ops. | In-Progress |
|   |                                      |   | VEHS Action AC-CMP-20210129-002 | Outdated EMS data was posted on @nordion website.           | The 2020 EMS objectives have been posted on the internal @nordion website.                                   | Complete    |
|   |                                      |   | CF# 9313                        | Outdated EHS contact information was shown in SE-LIC-010.   | The EHS contact information in SE-LIC-010 has been updated.  | Complete.   |

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|   |                                      |                  |                                 |   |   |                          |
|---|--------------------------------------|------------------|---------------------------------|---|---|--------------------------|
| 3 | Safeguarded Physical Inventory (PIT) | 2 Minor Findings | CAPA 201103                     | Source carrier serial numbers had been incorrectly entered into Nordion's tracking system.  | The source carrier serial numbers were corrected, including submitting updated ICDs to the CNSC. CAPA 201103 underway to implement broader corrective actions.    | CAPA 201103 in progress. |
|   |                                      |                  | CAPA 201103                     | An error was made for the DU weight recorded/submitted on ICD #D3539.   | The weight was corrected including the submission of an updated ICD to the CNSC. CAPA 201103 underway to implement broader corrective actions.                    | CAPA 201103 in progress. |
|   |                                      | 6 Observations   | Gensuite Action# 181            | Lists generated from CBS/CMS shows container [REDACTED], from the DU Group 1B List of the LII as in-hand in Kanata and Vancouver at the same time.                                    | The container was physically verified in Kanata. The container expiry date was updated in Oracle and the container was transacted out of the Vancouver inventory. | Complete                 |
|   |                                      |                  | N/A                             | Source carriers [REDACTED] were incorrectly logged in the Non-Production Material Inventory (NPRMI) spreadsheet.  | The carriers were removed from NPRMI spreadsheet. No further action needed.   | Complete                 |
|   |                                      |                  | VEHS Action AC-CMP-20201130-008 | The Oracle on-hand list for the [REDACTED] indicated [REDACTED] containers [REDACTED] were on-site in quarantine. These containers were not on the Group 1A LII and were not on site. | The status for the containers was corrected in Oracle.  | Complete                 |
|   |                                      |                  | VEHS Action AC-CMP-20201130-009 | The serial number for a DU source carrier was not retroactively recorded on ICD #D3522 once it was known.   | The serial number was added to the ICD. The serial number is not a requirement for submission of ICDs to the CNSC.  | Complete                 |
|   |                                      |                  |                                 |   |   |                          |

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|    |   |                  |  |   |  |          |
|----|---|------------------|--|---|--|----------|
|    |   |                  | VEHS Action<br>AC-CMP-<br>20201130-010 | There appeared to be no record of foreign receipt for containers [REDACTED] between two records of foreign shipment   | One ICD for foreign shipment of the containers was a duplicate submitted in error. The duplicate ICD was cancelled.  | Complete |
|    |   |                  | None                                   | Source [REDACTED] was in [REDACTED] and not [REDACTED] as per Oracle.   | The source was moved back to the secure cabinet in [REDACTED].   | Complete |
|    |   | 2 OFIs           | Gensuite<br>Action #183                | Containers [REDACTED] from the DU Group 1B LII were not on either of the on-hand or in-field lists.   | The containers were added to the Oracle collection plan. The [REDACTED] will ensure all future containers are added to the Oracle collection plan as needed. | Complete |
|    |   |                  | Gensuite<br>Action #182                | Containers from the DU Group 1B LII and on-hand CBS/CMP list, were not shown as being in Kanata but were determined to be in Vancouver.   | The location of the containers was corrected.  | Complete |
| 4  | Indium Process<br>Safety Audit                        | 1<br>Observation | CHR-3941-<br>NUM                       | Section 5.1 of 070526.SOP does not include [REDACTED] in the waste segregation table. 070526.SOP should also make reference to the [REDACTED] waste disposal document 020502.SOP. | Pending Change CHR-3941-<br>NUM raised to make changes to 070526.SOP as required.  | Open     |
| Op | Cell Opening and<br>Items Being<br>Removed from Cells | 1<br>Observation | Work Request<br>44922                  | There were no signs indicating location of eye wash stations  | Signs have been posted   | Closed   |
|    |   | 3 OFI's          | VEHS Action<br>AC-CMP-<br>20210326-001 | Roles and responsibilities are not well defined. Further definition should be provided to the term M&DS to specify which groups are able to open cell doors.                      | The procedure will be updated to better define the roles and responsibilities for cell door opening.   | Open     |

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|   |   |                 |  |  |   |                             |
|---|---|-----------------|--|--|---|-----------------------------|
|   |   |                 | VEHS Action<br>AC-CMP-<br>20210326-001 | Consider performing visual inspection of pass-through doors prior to opening cell door as indicator lights could burn out.   | Visual inspection of the pass-through will be considered and included in the updated procedure if appropriate.                          | Open                        |
|   |   |                 | VEHS Action<br>AC-CMP-<br>20210326-001 | Consider adding a requirement in the procedure to swipe cell door.   | Addition of a cell door swipe will be considered and included in the updated procedure if appropriate.                                  | Open                        |
| 6 | Non-Production<br>Radioactive Material<br>Inventory (NPRMI) | 1 Major Finding | IR 21-1                                | Source [REDACTED] was not physically located.  | IR-21-01 has been initiated too investigate this finding further, conduct root cause analysis and propose corrective actions as needed. | IR-21-01 in-progress        |
|   |   | 1 Minor Finding | CAPA 210201                            | Oracle did not generate the 4 <sup>th</sup> cycle count for [REDACTED].  | CAPA 210201 initiated   | CAPA 210201 in-progress     |
|   |   | Observation     | None                                   | Source [REDACTED], from the Sharepoint NPRMI list, was recorded as being in [REDACTED] but was not found. Upon investigation it was found the source had been sent for disposal, however, had not been removed from the Sharepoint list. | The source was removed from the Sharepoint list before the audit of the R&D sources was completed. No further action required.          | No further action required  |
|   |   | 3 OFIs          | None                                   | A pail containing 6 sources was found in [REDACTED]. These sources should have been in [REDACTED] as they are recorded as being identified for disposal and are not in Oracle.   | The sources have been returned to [REDACTED]. No further action required.   | No further action required. |

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|   |  |   |  |   |  |             |
|---|--|---|--|---|--|-------------|
|   |  |   | VEHS Action<br>AC-CMP-<br>20210210-001 | Several sources were found in the incorrect locator. The locators were corrected during the audit.  | It is recommended that Nordion assign/clarify responsibilities for NPRMI tasks and ensure personnel are trained. | In-progress |
|   |  |   | VEHS Action<br>AC-CMP-<br>20210210-002 | A wall mounted source was found in [REDACTED] instead of locator [REDACTED] as identified on the cycle count report. The Oracle locator does not accurately identify the location of the source as there is no intent to move the source. | It is recommended that Nordion create a new locator for this source.   | In-progress |
| 7 | Independent Assessment - QA Audit of EHS Audit Program | 2 Observations  | VEHS Action<br>AC-20210305-001         | One inconsistency was recorded between the Audit schedule and the Audit report verification.  | The inconsistency will be corrected as needed.   | Open        |
|   |  |   | VEHS Action<br>AC-20210305-002         | External Audit Report No. 19120710 does not reflect current audit report forms and the report was not signed by Director Regulatory EHS.  | Corrective actions are currently being investigated.   | Open        |
| 8 | Emergency Response Program – Sub-plans                 | N/A – Audit deferred as per Deviation 6373 because of covid-19 pandemic | N/A                                    | N/A   | N/A  | N/A         |

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|    |                            |   |          |   |   |           |
|----|----------------------------|---|----------|---|---|-----------|
| 9  | Public Information Program | 4 OFI's   | CF #9313 | While the website contains a summary of the Nordion Public Disclosure Protocol and access to Nordion's public disclosures, the actual Protocol itself is not made available on the website. | The Protocol has been made available on Nordion's website.  | Complete  |
|    |                            |   | CF #9313 | SE-LIC-010 could be updated to indicate what records are required to be maintained regarding the PIP and how these records are to be maintained.  | SE-LIC-010 has been updated to indicate what types of records need to be maintained regarding the PIP.  | Complete  |
|    |                            |   | CF #9313 | Consider revising SE-LIC-001 to reflect the current state of media monitoring and what media-related data is to be reviewed as part of the PIP review.                                      | SE-LIC-010 has been updated to reflect the current media-monitoring by Nordion.                         | Complete  |
|    |                            |   | CF #9313 | The intent of the wording in SE-LIC-010 Section 5.2.1 should be reviewed and clarified as needed, or the practice of annually reviewing SE-OP-045 should be documented.                     | SE-LIC-010 has been updated to clarify when SE-OP-045 is to be followed for EHS related communications. | Complete. |
| 10 | Research and Development   | N/A – Audit deferred as per Deviation 6373 because of covid-19 pandemic | N/A      | N/A   | N/A   | N/A       |

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|    |  |  |  |  |   |        |
|----|--|--|--|--|---|--------|
| 11 | Resources, Financial Resources, Competence, Training & Awareness, Management Review              | N/A – Audit deferred as per Deviation 6373 because of covid-19 pandemic  | N/A  | N/A  | N/A   | N/A    |
| 12 | Sealed Source Export Licenses  | 1 OFI  | N/A  | Global Logistics should consider generating electronic records of key regulatory information associated with Export Controls requirements. This could be beneficial during both filing and record retrieval. | Global Logistics to consider moving towards electronic record retention instead of paper records.   | Open   |
| 13 | Operational Control, monitoring and maintenance, Operational Control, Monitoring and Measurement | TBD – The report, including the summary of findings, for this internal audit is being finalized as the audit was conducted late in 2020. |  |  |   |        |
| 14 | Documentation of MS, Information, Documents, Records, Control of Documents/Records               | 1 Minor Finding  | CAPA 201004                                  | Service of the [REDACTED] is to be completed once every 5 years. The most recent service report available is 2014. The last service was completed in 2018; however, this report could not be located.        | [REDACTED] Excel Inspection Procedure - Field Function Only" has been revised. The revision includes more information about the approval of the document, including returning the Service Report to Physics for filing. | Closed |
|    |  | 3 Observations   | Gensuite Action #143<br>Gensuite Action #145 | Minor deficiencies were found on Daily Contamination Survey records.   | These deficiencies were corrected.  | Closed |
|    |  |  | N/A  | A Validation Record not stamped as per 000030.SOP Appendix A.  | The record was corrected (stamped) during the audit.  | Closed |

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|    |  |         |                             |   |  |                    |
|----|--|---------|-----------------------------|---|--|--------------------|
|    |  |         | Gensuite Action #147        | Certain Controlled Copy documents reviewed for the audit did not contain the most recent document versions. Three controlled procedures need to be uploaded into the BWXT electronic Quality Management System (eQMS).                            | The documents were replaced with the current revisions where needed.<br><br>The three documents will be entered into the BWXT eQMS system.                                 | Closed<br><br>Open |
|    |  | 1 OFI   | VEHS Action AC-20201125-001 | Controlled Copy Set 107 could be re-organized to have the documents in the same order as the Controlled Copy Set Content List.  | The Production Manager will consider re-ordering the Controlled Copy set to align with the Content List  | Open               |
| 15 | Problem Identification and Resolution, Nonconformity, Corrective and Preventative Action, Monitoring and Measurement | 4 OFI's | Gensuite Action #197        | Both Nordion and BWXT had empty spaces in the excel database.   | The complaint table is only used as an internal tracking tool. Revision of the related procedure will be considered to make the use of the database clearer.               | Open               |
|    |  |         | N/A                         | Two First Aid kits were missing the First Aid Injury Reports due to recent injuries.  | The forms were replaced, and a reminder was sent to ensure these forms are checked during inspections.   | Closed             |
|    |  |         | N/A                         | NCMR10076, Section A of F2 identifies material as Cleanroom Mask, supporting documentation from "memo" notes sterile gloves as the material. As this NCMR is pertaining to supplier name change this observation is noted as documentation error. | An email was sent to the auditor on 2020-12-04 QA explaining that the "sterile glove" documentation was an example showing the name change. No further action is required. | Closed             |
|    |  |         | N/A                         | Nordion Deviation #6219 – root cause analysis not clearly defined.  | Deviation was revised 2020-12-09 to provide more description of the root cause prior to closure of the audit. No further action is required.                               | Closed             |

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|    |  |                 |                             |  |  |             |
|----|--|-----------------|-----------------------------|--|--|-------------|
| 16 | Transportation Security (access Authorization) | 1 Minor Finding | VEHS Action AC-CMP-0405     | There was no evidence of annual review of the Hazardous Materials Transportation Security Plan.  | Velocity EHS is now used to track annual review.   | Closed      |
|    |  | 1 Observation   | N/A                         | Nordion is not submitting a 48h pre-shipment plan to CNSC.   | CNSC security group has indicated this is no longer required and they will update the applicable RegDoc during the next review.  | Open        |
| 17 | Safety Analysis, Operational Control           | 1 Minor         | CAPA 201003                 | Two FSARs were observed to not have the appropriate Area Director sign-off.  | FSARs are a standing action item on the EHS committee. The EHS committee minutes shall be updated to contain a reminder note in the FSAR agenda item to review and ensure proper individuals are identified as needing sign-off on the FSAR. | In-progress |
|    |  | 3 Observations  | VEHS Action AC-20201016-001 | The FSAR Template in MS Word "My Templates" does not reflect the FSAR content as described in Section 12 of CPM-6-20.                    | The FSAR template in MS Word will be updated to reflect the content in Section 12 of CPM-06-20.  | Open        |
|    |  |                 | VEHS Action AC-20201019-001 | Content titles and numbering throughout the FSAR, IS/SR 1849 Y90 [4], is not consistent with Section 12 of CPM-6-20.                     | The content titles will be updated when the FSAR is next revised.  | Open        |
|    |  |                 | VEHS Action AC-20201019-002 | Discrepancies between the FSAR tracking spreadsheet and the FSAR Point Chart that is generated from the Tracking Spreadsheet were noted. | The discrepancies will be corrected where required.  | Open        |

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|    |   |   |                                    |   |          |      |
|----|---|---|------------------------------------|---|----------|------|
|    |   | 1<br>Opportunity<br>for<br>Improvement                                  | VEHS Action<br>AC-20201019-<br>003 | The EHS Committee approved the FSAR [REDACTED] [2] in the current format as per EHS Committee meeting minutes of 19-06 and 20-1, however, there is no written record that the EHS Committee Secretary waived the formatting requirements for this FSAR. | <insert> | Open |
| 18 | Sealed Source Reporting                     | N/A – Audit deferred as per Deviation 6373 because of covid-19 pandemic | N/A                                | N/A   | N/A      | N/A  |
| 19 | Business Planning, Organization, Assessment | N/A – Audit deferred as per Deviation 6373 because of covid-19 pandemic | N/A                                | N/A   | N/A      | N/A  |

Deviation #6373 has raised to defer certain EHS internal audits scheduled for 2020 due to the need to implement remote working conditions in response to the COVID-19 pandemic.

NOTE: The actions from the Supplier audit (listed in Section 2.1.3.1) have not been included in the above table however findings are being managed in accordance with internal procedures.

## Appendix C

### Non-Production Sealed and Unsealed Source Inventory

[illegible]

## 2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility

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## 2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility

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**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility**

## Appendix D

### Additional Radiation Dose Data – Effective and Equivalent Dose and Lens of the Eye

Note: For consistency in data report with previous years NEW data in the appendix includes data for both Nordion and BWXT NEWs.

**Table D.1**  
**Minimum, Maximum and Average Worker Effective Doses (Active Area and Non-Active Area Personnel) (mSv)**

|   |                         | 2016 | 2017 | 2018 | 2019 | 2020 | CNSC Regulatory Limit |
|---|-------------------------|------|------|------|------|------|-----------------------|
| <b>Active Area Personnel (NEWs)</b>     | <b>Average</b>          | 0.75 | 0.67 | 0.71 | 0.76 | 0.62 | n/a                   |
|   | <b>Maximum</b>          | 4.9  | 5.49 | 4.23 | 4.79 | 4.92 | 50/yr; 100/5yr        |
|   | <b>Minimum</b>          | 0    | 0    | 0    | 0    | 0    | n/a                   |
|   | <b>Number Monitored</b> |      | 141  | 137  | 154  | 172  |                       |
| <b>Non-Active Area Personnel (NEWs)</b> | <b>Average</b>          | 0.2  | 0.13 | 0.14 | 0.13 | 0.07 | n/a                   |
|   | <b>Maximum</b>          | 2.06 | 1.5  | 2.07 | 1.79 | 1.25 | 50/yr; 100/5yr        |
|   | <b>Minimum</b>          | 0    | 0    | 0    | 0    | 0    | n/a                   |
|   | <b>Number Monitored</b> |      | 122  | 111  | 124  | 152  |                       |

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**Table D.2**  
**Minimum, Maximum and Average Equivalent Skin Exposure Doses (mSv)**

|   |                             | 2016 | 2017 | 2018 | 2019 | 2020 | CNSC<br>Regulatory<br>Limit |
|---|-----------------------------|------|------|------|------|------|-----------------------------|
| <b>NEWs<br/>(Nordion and<br/>BWXT)</b>  | <b>Average</b>              | 0.59 | 0.42 | 0.45 | 0.49 | 0.37 | n/a                         |
|   | <b>Maximum</b>              | 5.2  | 5.5  | 4.26 | 4.78 | 4.93 | 500/yr                      |
|   | <b>Minimum</b>              | 0    | 0    | 0    | 0    | 0    | n/a                         |
|   | <b>Number<br/>Monitored</b> | 267  | 263  | 248  | 278  | 324  |                             |
| <b>Contractors<br/>(non-NEW)</b>  | <b>Average</b>              | 0.07 | 0.02 | 0.05 | 0.03 | 0.01 | n/a                         |
|   | <b>Maximum</b>              | 0.39 | 0.18 | 0.28 | 0.25 | 0.31 | 50/yr                       |
|   | <b>Minimum</b>              | 0    | 0    | 0    | 0    | 0    | n/a                         |
|   | <b>Number<br/>Monitored</b> | 51   | 55   | 45   | 123  | 381  |                             |
| <b>Active Area<br/>Personnel<br/>(NEWs – both<br/>Nordion and<br/>BWXT)</b>         | <b>Average</b>              | 0.92 | 0.67 | 0.7  | 0.78 | 0.64 | n/a                         |
|   | <b>Maximum</b>              | 5.2  | 5.52 | 4.26 | 4.78 | 4.93 | 500/yr                      |
|   | <b>Minimum</b>              | 0    | 0    | 0    | 0    | 0    | n/a                         |
|   | <b>Number<br/>Monitored</b> |      | 141  | 137  | 154  | 172  |                             |
| <b>Non-Active<br/>Area<br/>Personnel<br/>(NEWs – both<br/>Nordion and<br/>BWXT)</b> | <b>Average</b>              | 0.22 | 0.13 | 0.14 | 0.13 | 0.07 | n/a                         |
|   | <b>Maximum</b>              | 2.09 | 1.59 | 2.06 | 1.80 | 1.25 | 500/yr                      |
|   | <b>Minimum</b>              | 0    | 0    | 0    | 0    | 0    | n/a                         |
|   | <b>Number<br/>Monitored</b> |      | 122  | 111  | 124  | 152  |                             |

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**Table D.3**  
**Minimum, Maximum and Average Equivalent Extremity Doses (mSv)**  
**Data includes both Nordion and BWXT NEWs.**

|   |                         | 2016        | 2017        | 2018        | 2019         | 2020         | CNSC<br>Regulatory<br>Limit |
|---|-------------------------|-------------|-------------|-------------|--------------|--------------|-----------------------------|
| <b>NEWs</b>   | <b>Average</b>          | <b>0.79</b> | <b>0.53</b> | <b>0.96</b> | <b>1.14</b>  | <b>0.93</b>  | <b>n/a</b>                  |
|   | <b>Maximum</b>          | <b>8.3</b>  | <b>16.4</b> | <b>9.08</b> | <b>20.93</b> | <b>16.48</b> | <b>500/yr</b>               |
|   | <b>Minimum</b>          | <b>0</b>    | <b>0</b>    | <b>0</b>    | <b>0</b>     | <b>0</b>     | <b>n/a</b>                  |
|   | <b>Number Monitored</b> | <b>128</b>  | <b>125</b>  | <b>116</b>  | <b>130</b>   | <b>153</b>   |                             |
| <b>Active<br/>Area<br/>Personnel<br/>(NEWs)</b>     | <b>Average</b>          | <b>0.86</b> | <b>0.58</b> | <b>1.03</b> | <b>1.21</b>  | <b>0.97</b>  | <b>n/a</b>                  |
|   | <b>Maximum</b>          | <b>8.3</b>  | <b>16.4</b> | <b>9.08</b> | <b>20.93</b> | <b>16.48</b> | <b>500/yr</b>               |
|   | <b>Minimum</b>          | <b>0</b>    | <b>0</b>    | <b>0</b>    | <b>0</b>     | <b>0</b>     | <b>n/a</b>                  |
|   | <b>Number Monitored</b> |             | <b>109</b>  | <b>106</b>  | <b>121</b>   | <b>142</b>   |                             |
| <b>Non-Active<br/>Area<br/>Personnel<br/>(NEWs)</b> | <b>Average</b>          | <b>0</b>    | <b>0.2</b>  | <b>0.23</b> | <b>0.17</b>  | <b>0.43</b>  | <b>n/a</b>                  |
|   | <b>Maximum</b>          | <b>0</b>    | <b>1.8</b>  | <b>1.66</b> | <b>0.81</b>  | <b>3.70</b>  | <b>500/yr</b>               |
|   | <b>Minimum</b>          | <b>0</b>    | <b>0</b>    | <b>0</b>    | <b>0</b>     | <b>0</b>     | <b>n/a</b>                  |
|   | <b>Number Monitored</b> |             | <b>16</b>   | <b>10</b>   | <b>10</b>    | <b>11</b>    |                             |

**Note:** Contractors are not monitored for extremity dose.

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****Table D.4****Minimum, Maximum and Average Equivalent Dose for Lens of the Eye  
(mSv)**

|  |                             | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020</b> | <b>CNSC<br/>Regulatory<br/>Limit</b> |
|--|-----------------------------|-------------|-------------|-------------|-------------|--------------------------------------|
| <b>NEWs<br/>(Nordion and<br/>BWXT)</b>   | <b>Average</b>              | 0.42        | 0.45        | 0.49        | 0.37        | n/a                                  |
|  | <b>Maximum</b>              | 5.52        | 4.27        | 4.81        | 4.96        | <b>50/yr;<br/>100/5yr</b>            |
|  | <b>Minimum</b>              | 0           | 0           | 0           | 0           | n/a                                  |
|  | <b>Number<br/>Monitored</b> | 263         | 248         | 278         | 324         |                                      |
| <b>Contractors<br/>(non-NEW)</b>   | <b>Average</b>              | 0.022       | 0.05        | 0.03        | 0.01        | n/a                                  |
|  | <b>Maximum</b>              | 0.2         | 0.26        | 0.26        | 0.30        |                                      |
|  | <b>Minimum</b>              | 0           | 0           | 0           | 0           | n/a                                  |
|  | <b>Number<br/>Monitored</b> | 55          | 45          | 123         | 381         |                                      |
| <b>Active Area<br/>Personnel<br/>(NEWs – both<br/>Nordion and<br/>BWXT)</b>        | <b>Average</b>              | 0.67        | 0.71        | 0.77        | 0.63        | n/a                                  |
|  | <b>Maximum</b>              | 5.52        | 4.27        | 4.81        | 4.96        | <b>50/yr;<br/>100/5yr</b>            |
|  | <b>Minimum</b>              | 0           | 0           | 0           | 0           | n/a                                  |
|  | <b>Number<br/>Monitored</b> | 141         | 137         | 154         | 172         |                                      |
| <b>Non-Active<br/>Area<br/>Personnel<br/>(NEWs- both<br/>Nordion and<br/>BWXT)</b> | <b>Average</b>              | 0.13        | 0.14        | 0.13        | 0.08        | n/a                                  |
|  | <b>Maximum</b>              | 1.61        | 2.06        | 1.80        | 1.24        | <b>50/yr;<br/>100/5yr</b>            |
|  | <b>Minimum</b>              | 0           | 0           | 0           | 0           | n/a                                  |
|  | <b>Number<br/>Monitored</b> | 122         | 111         | 124         | 152         |                                      |

## APPENDIX E

### 5-Year Trending of Whole Body Doses for NEW Groups at Nordion

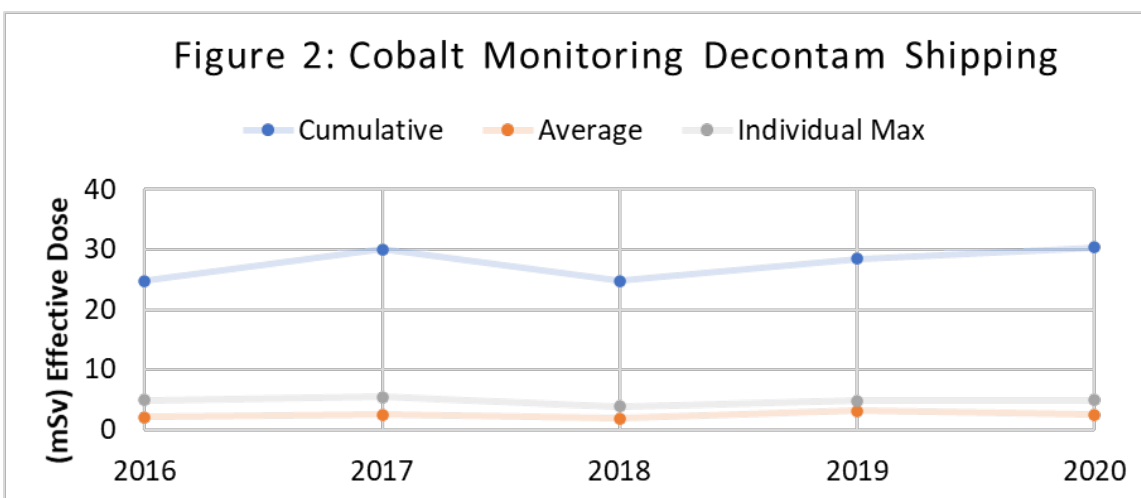
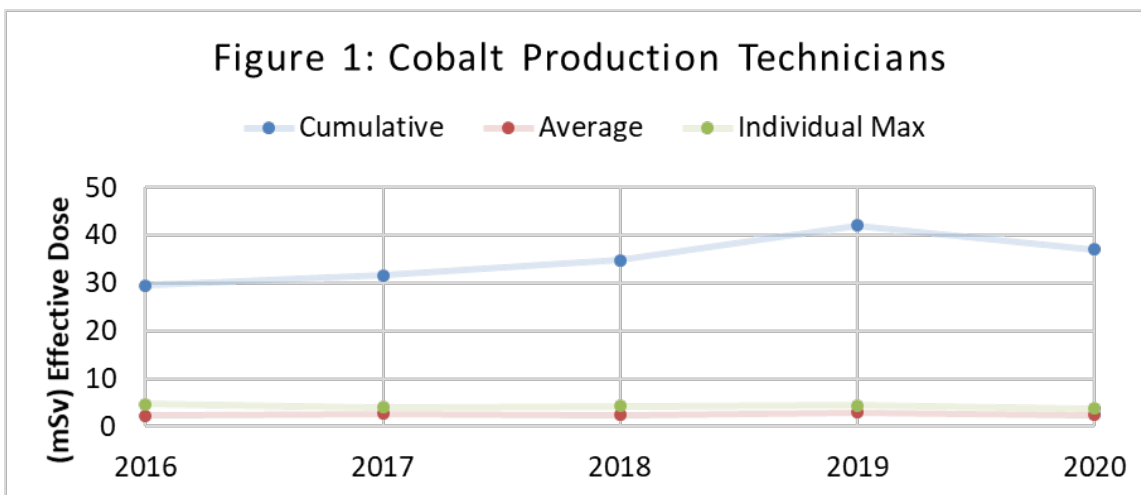


Figure 3: Cobalt Development

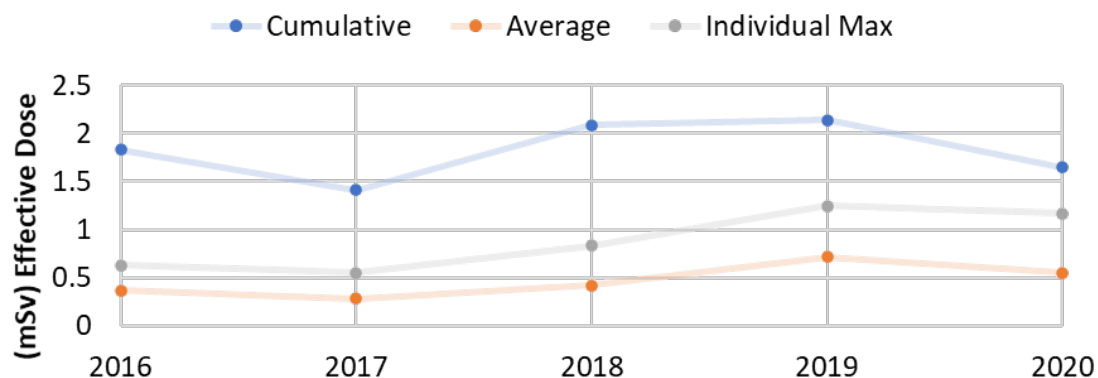
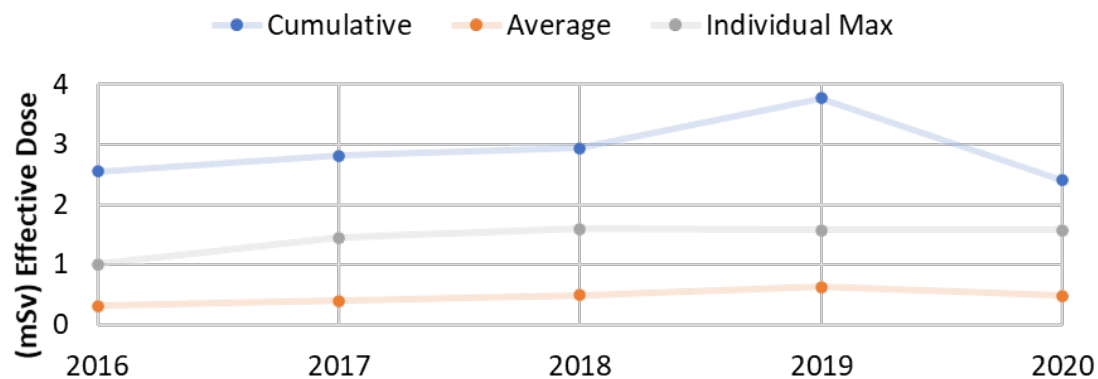


Figure 4: Cobalt QC



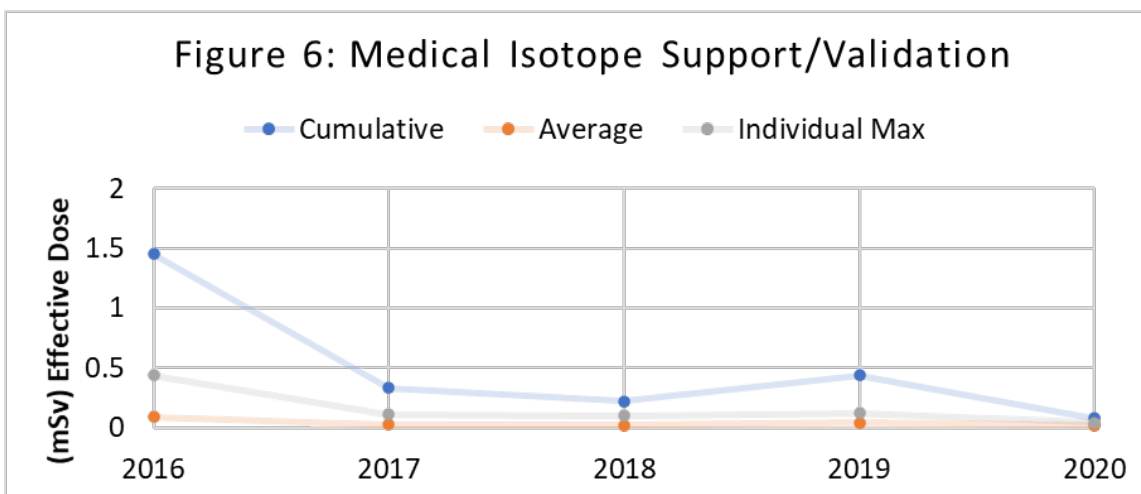
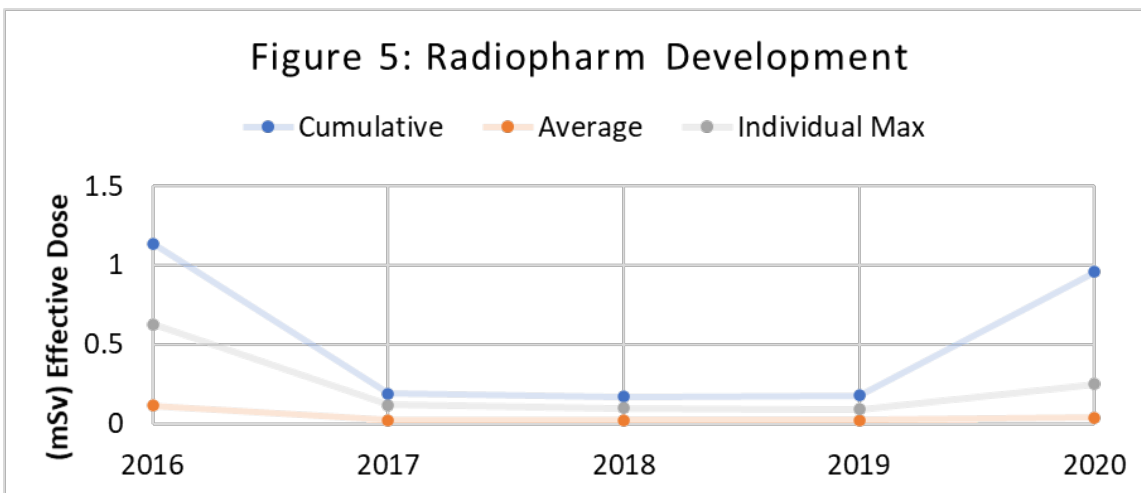


Figure 7: MI Shipping, Waste, Container Maintenance

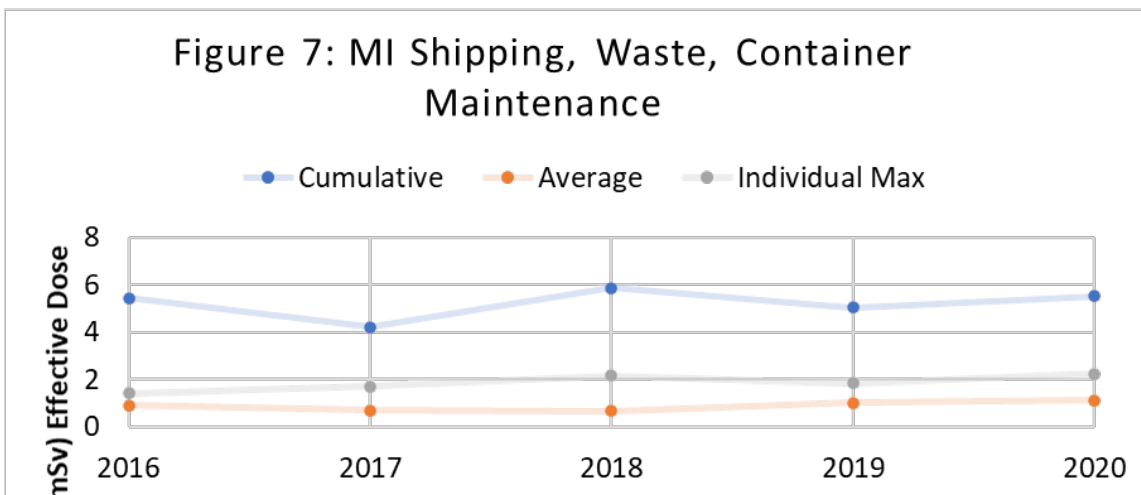


Figure 8: I-125, I-131 & Ir-192 Production

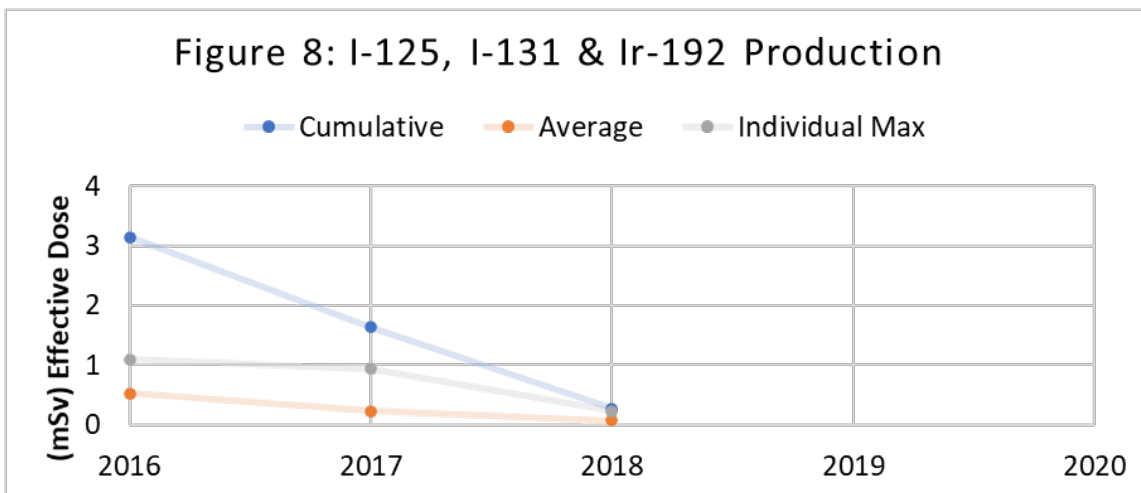


Figure 9: Mo-99, Xe-133 & Sr-82 Production

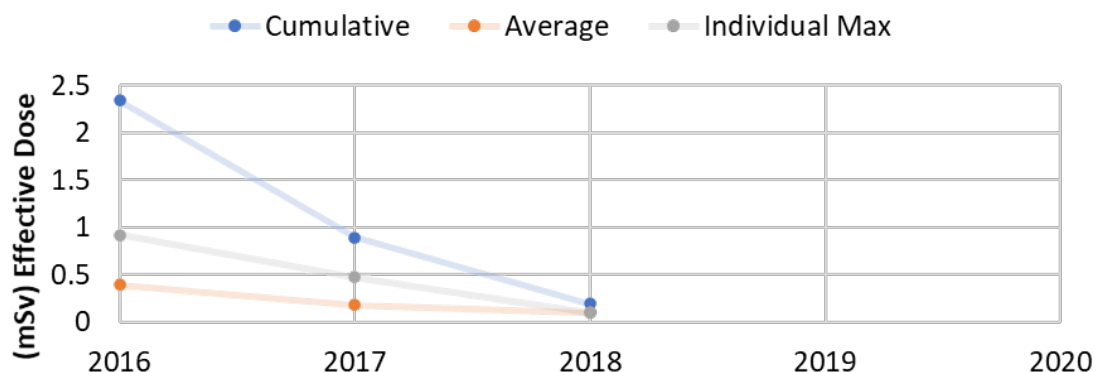


Figure 10: Radiopharm Production Technicians

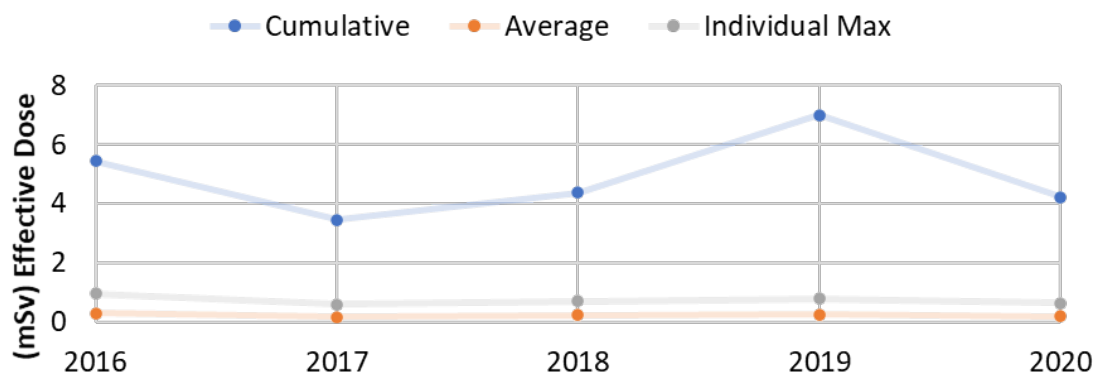


Figure 11: Machinists

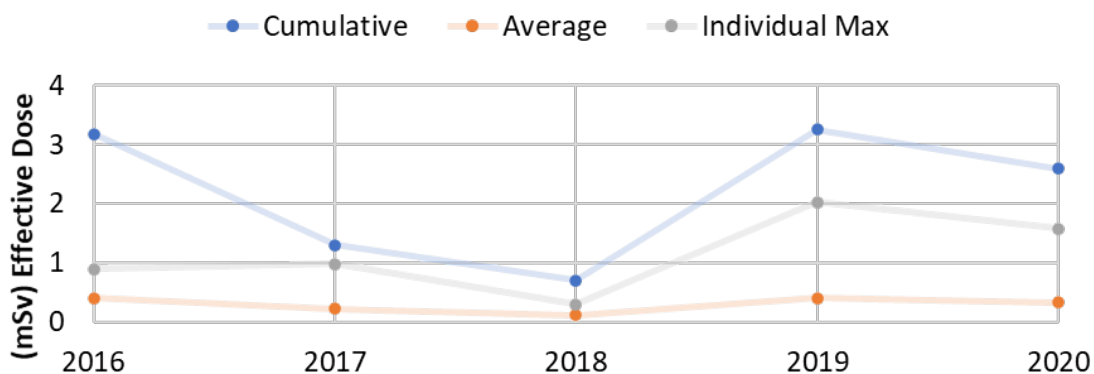


Figure 12: Medical Isotopes QC

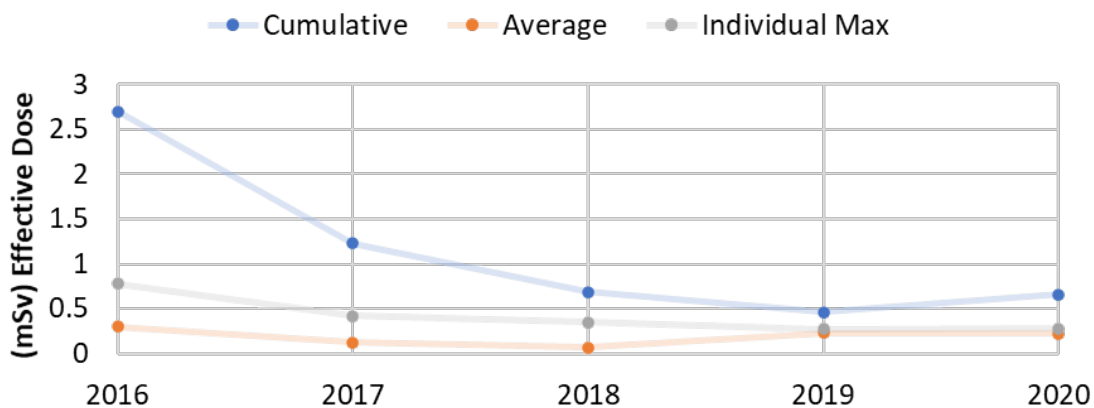


Figure 13: Surveyors

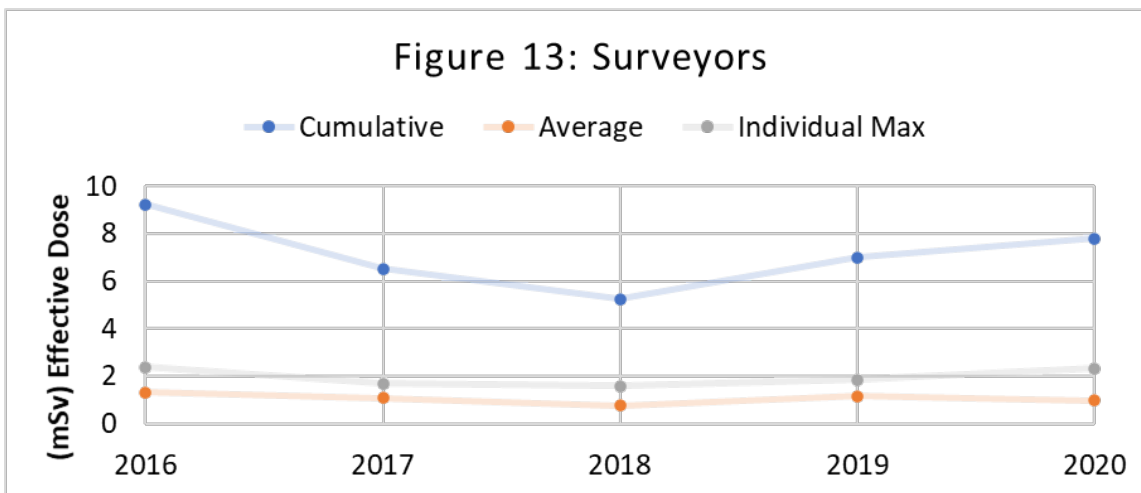


Figure 14: Medical Isotopes Decontam Helpers

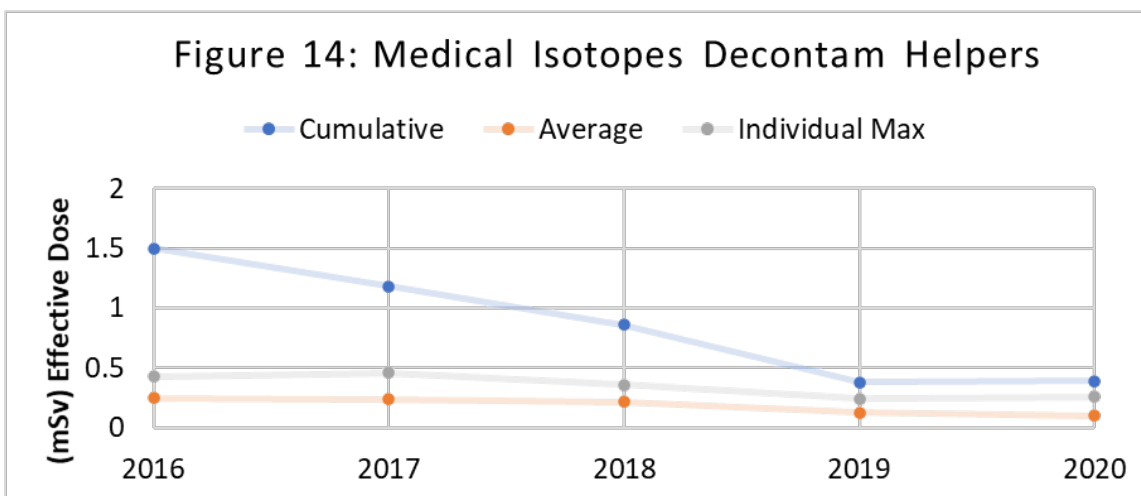


Figure 15: Medical Isotopes Monitors

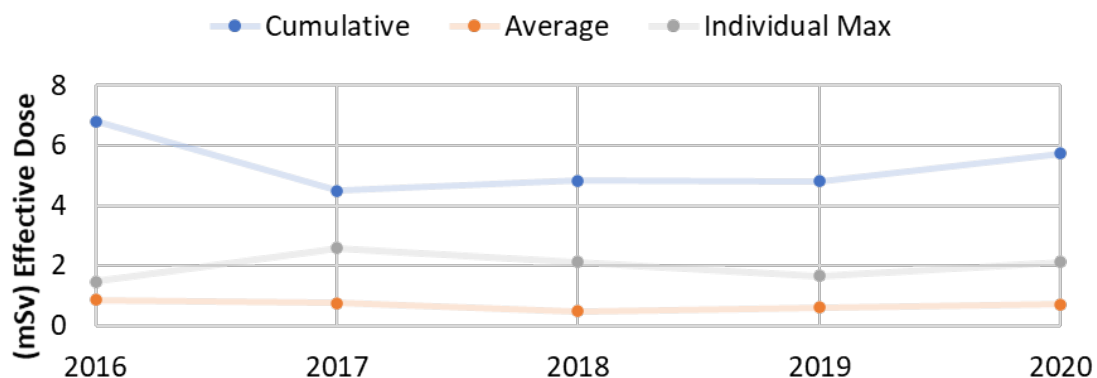


Figure 16: Facilities, Motor Pool

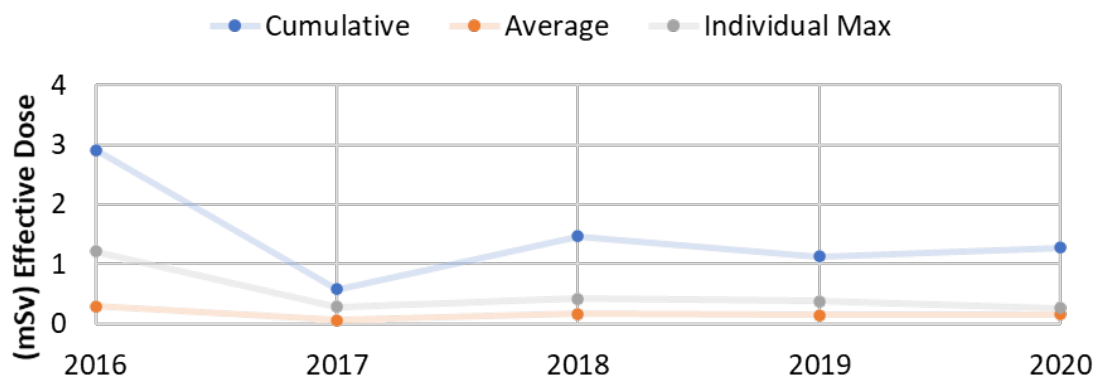


Figure 17: Facilities, Mechanical

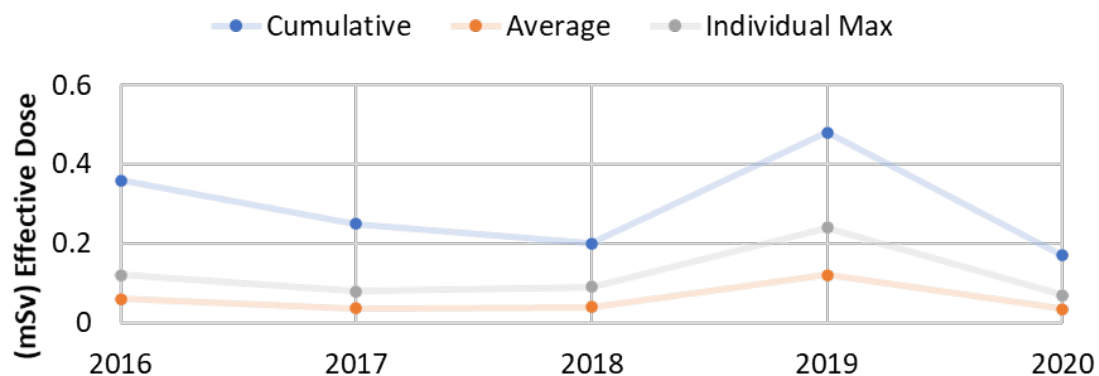
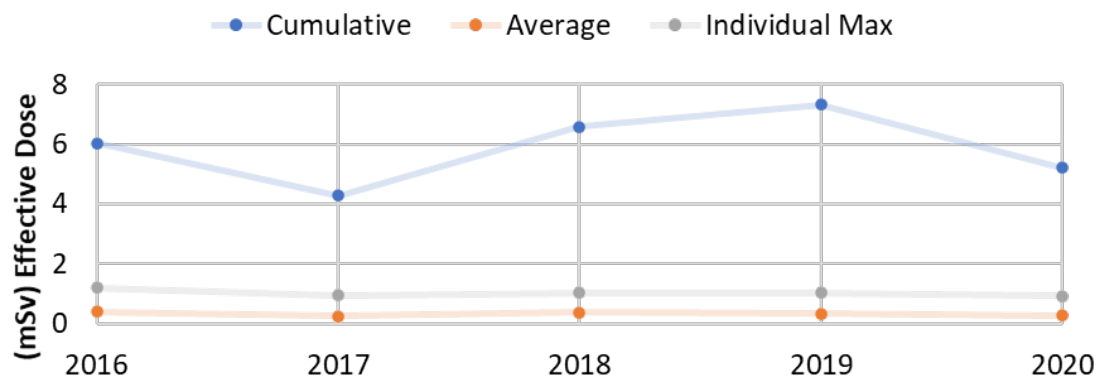
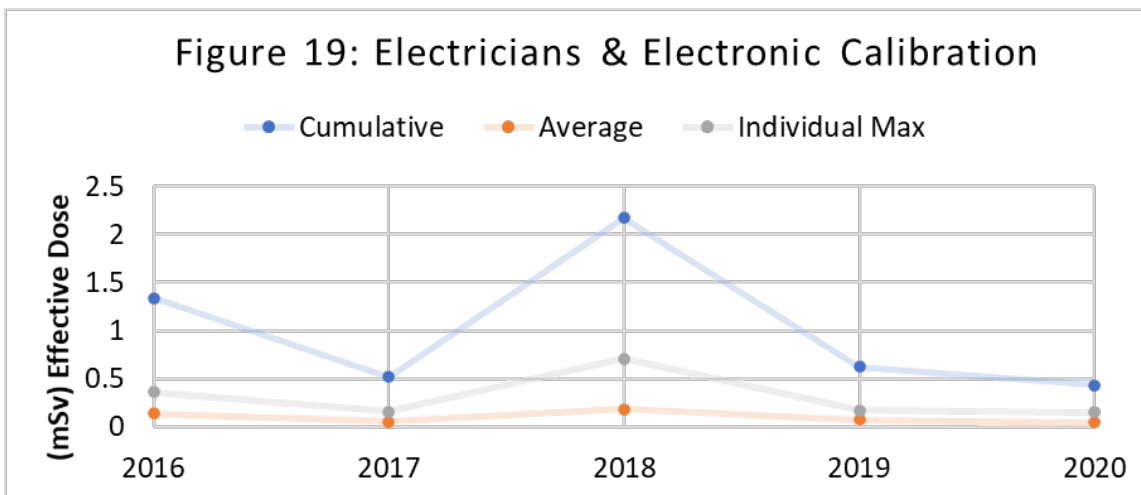


Figure 18: Radiopharm QC



**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****Figure 19: Electricians & Electronic Calibration**

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility**

### Appendix F Groundwater Sampling (Non-radiological) Borehole #1 (2005-BH1)

| Sample Date:                    |       |      | 2020-10-05 | 2019-08-19 | 2018-06-08 | 2017-10-06 | 2016-11-02 | 2015-10-05 | 2005-04-07<br>(Initial Sample) |
|---------------------------------|-------|------|------------|------------|------------|------------|------------|------------|--------------------------------|
| Sample ID:                      |       |      | 2005-BH1   | 2005-BH1   | 2005-BH1   | 2005-BH1   | 2005-BH1   | 2005-BH1   | 2005-BH1                       |
| Parameter                       | UNITS | MDL  |            |            |            |            |            |            |                                |
| Alkalinity as CaCO <sub>3</sub> | mg/L  | 5    | 433        | 359        | 440        | 448        | 336        | 337        | 278                            |
| Biochemical Oxygen Demand       | mg/L  | 1    | < 3        | <3         | <3         | <3         | <3         | <1         | <1                             |
| Chemical Oxygen Demand          | mg/L  | 5    | < 5        | 13         | <5         | 83         | <5         | 9          | 7                              |
| Chloride (Cl)                   | mg/L  | 1    | 75         | 16.8       | 48         | 68.2       | 176        | 141        | 40                             |
| Conductivity                    | µS/cm | 5    | 1120       | 766        | 1010       | 1110       | 1200       | 1100       | 676                            |
| Dissolved Organic Carbon        | mg/L  | 0.5  | 3.1        | 2.6        | 2.3        | 5.0        | 0.7        | 2.8        | 1.6                            |
| N-NH <sub>3</sub> (Ammonia)     | mg/L  | 0.02 | 0.14       | 0.07       | 0.03       | 0.05       | <0.01      | <0.025     | 0.02                           |
| N-NO <sub>3</sub> (Nitrate)     | mg/L  | 0.1  | < 0.05     | 0.05       | <0.05      | <0.05      | 1          | 0          | 0.53                           |
| pH                              |       |      | 7.96       | 8.04       | 8.02       | 7.96       | 7.88       | 7.77       | 7.71                           |
| Sulphate (SO <sub>4</sub> )     | mg/L  | 1    | 51         | 28         | 51         | 35         | 25         | 24         | 22                             |
| TDS (COND - CALC)               | mg/L  | 5    | 676        | 408        | 623        | 634        | 816        | 715        | 439                            |
| Total Suspended Solids          | mg/L  | 2    | 570        | 286        | 304        | <3         | <3         | 81         | 1390                           |
| Calcium (Ca)                    | mg/L  | 1    | 150        | 66.3       | 125        | 133        | 134        | 124        | 80                             |
| Magnesium (Mg)                  | mg/L  | 1    | 63.7       | 30.0       | 53.2       | 61.3       | 50         | 48         | 29                             |
| Sodium (Na)                     | mg/L  | 2    | 59.6       | 45.1       | 70.8       | 54.4       | 47         | 36         | 18                             |
| Barium (Ba)                     | mg/L  | 0.01 | 0.217      | 0.053      | 0.190      | 0.195      | 0.02       | 0.03       | 0.02                           |
| Boron (B)                       | mg/L  | 0.01 | 0.086      | 0.016      | 0.054      | 0.084      | 0.01       | 0.03       | 0.07                           |
| Iron (Fe)                       | mg/L  | 0.03 | 3.13       | <0.005     | 2.12       | 1.82       | 0.09       | 0.62       | <0.01                          |
| PHC F1 (C6-C10)                 | mg/L  | 0.2  | <0.05      | <0.02      | <0.02      | <0.02      | <0.02      | <0.2       | <0.2                           |
| PHC F2 (C10-C16)                | mg/L  | 0.2  | <0.05      | <0.05      | <0.05      | <0.05      | <0.05      | <0.2       | <0.2                           |
| PHC F3 (C16-C34)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |
| PHC F4 (C34-C50)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |

\* Note: The initial sample from 2005-BH1 taken September 18, 2013 indicated 0.5 mg/L of F3 (hydrocarbon). As a result, a second sample was taken from 2005-BH1 November 16, 2013. Results from the second sample indicated that F3 was below detectable limits (< 200 µg/L).

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****Borehole #2 (2005-BH2)  
(Background Well)**

| Sample Date:                    |       |      | 2020-10-05 | 2019-08-19 | 2018-06-08 | 2017-10-06 | 2016-11-02 | 2015-10-05 | 2005-04-07<br>(Initial Sample) |
|---------------------------------|-------|------|------------|------------|------------|------------|------------|------------|--------------------------------|
| Sample ID:                      |       |      | 2005-BH2   | 2005-BH2   | 2005-BH2   | 2005-BH2   | 2005-BH2   | 2005-BH2   | 2005-BH2                       |
| Parameter                       | UNITS | MDL  |            |            |            |            |            |            |                                |
| Alkalinity as CaCO <sub>3</sub> | mg/L  | 5    | 286        | 285        | 322        | 322        | 336        | 337        | 278                            |
| Biochemical Oxygen Demand       | mg/L  | 1    | <3         | <3         | <3         | <3         | <3         | <1         | <1                             |
| Chemical Oxygen Demand          | mg/L  | 5    | <5         | 5          | <5         | <5         | <5         | 9          | 7                              |
| Chloride (Cl)                   | mg/L  | 1    | 166        | 215        | 184        | 139        | 176        | 141        | 40                             |
| Conductivity                    | µS/cm | 5    | 1100       | 1250       | 1200       | 1140       | 1200       | 1100       | 676                            |
| Dissolved Organic Carbon        | mg/L  | 0.5  | 0.8        | 1.4        | 0.8        | 1.9        | 0.7        | 2.8        | 1.6                            |
| N-NH <sub>3</sub> (Ammonia)     | mg/L  | 0.02 | 0.020      | 0.03       | <0.01      | <0.01      | <0.01      | <0.025     | 0.02                           |
| N-NO <sub>3</sub> (Nitrate)     | mg/L  | 0.1  | < 0.05     | 1.410      | 0.950      | 1          | 1          | 0          | 0.53                           |
| pH                              |       |      | 8.07       | 8.01       | 7.94       | 7.96       | 7.88       | 7.77       | 7.71                           |
| Sulphate (SO <sub>4</sub> )     | mg/L  | 1    | 26         | 26         | 27         | 21         | 25         | 24         | 22                             |
| TDS (COND - CALC)               | mg/L  | 5    | 599        | 635        | 651        | 581        | 816        | 715        | 439                            |
| Total Suspended Solids          | mg/L  | 2    | 620        | 140        | 5          | <3         | <3         | 81         | 1390                           |
| Calcium (Ca)                    | mg/L  | 1    | 130        | 121        | 137        | 126        | 134        | 124        | 80                             |
| Magnesium (Mg)                  | mg/L  | 1    | 46         | 47         | 51         | 49         | 50         | 48         | 29                             |
| Sodium (Na)                     | mg/L  | 2    | 50         | 48         | 51         | 46         | 47         | 36         | 18                             |
| Barium (Ba)                     | mg/L  | 0.01 | 0.05       | 0.01       | 0.02       | 0.03       | 0.02       | 0.03       | 0.02                           |
| Boron (B)                       | mg/L  | 0.01 | 0.03       | 0.01       | 0.02       | 0.03       | 0.01       | 0.03       | 0.07                           |
| Iron (Fe)                       | mg/L  | 0.03 | 1.45       | <0.005     | 0.194      | 0.81       | 0.09       | 0.62       | <0.01                          |
| PHC F1 (C6-C10)                 | mg/L  | 0.2  | <0.05      | <0.02      | <0.02      | <0.02      | <0.02      | <0.2       | <0.2                           |
| PHC F2 (C10-C16)                | mg/L  | 0.2  | <0.05      | <0.05      | <0.05      | <0.05      | <0.05      | <0.2       | <0.2                           |
| PHC F3 (C16-C34)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |
| PHC F4 (C34-C50)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****Borehole #3 (2005-BH3)**

| Sample Date:                    |       |      | 2020-10-05 | 2019-08-19 | 2018-06-08 | 2017-10-06 | 2016-11-02 | 2015-10-05 | 2005-04-07<br>(Initial Sample) |
|---------------------------------|-------|------|------------|------------|------------|------------|------------|------------|--------------------------------|
| Sample ID:                      |       |      | 2005-BH3   | 2005-BH3   | 2005-BH3   | 2005-BH3   | 2005-BH3   | 2005-BH3   | 2005-BH3                       |
| Parameter                       | UNITS | MDL  |            |            |            |            |            |            |                                |
| Alkalinity as CaCO <sub>3</sub> | mg/L  | 5    | 420        | 433        | 474        | 467        | 493        | 484        | 471                            |
| Biochemical Oxygen Demand       | mg/L  | 1    | <3         | <3         | <3         | <3         | <3         | 2          | <1                             |
| Chemical Oxygen Demand          | mg/L  | 5    | <5         | 12         | 6          | 6          | <5         | 12         | 10                             |
| Chloride (Cl)                   | mg/L  | 1    | 62         | 67         | 76         | 60         | 63         | 69         | 64                             |
| Conductivity                    | µS/cm | 5    | 1080       | 1110       | 1180       | 1160       | 1170       | 1150       | 1170                           |
| Dissolved Organic Carbon        | mg/L  | 0.5  | 1.9        | 3.4        | 2.7        | 4.4        | 2.5        | 4.6        | 3.3                            |
| N-NH <sub>3</sub> (Ammonia)     | mg/L  | 0.02 | 0.06       | 0.04       | 0.03       | 0.13       | <0.01      | 0.07       | 0.09                           |
| N-NO <sub>3</sub> (Nitrate)     | mg/L  | 0.1  | 0.08       | 0.42       | 0.82       | 0.55       | 0.40       | 0.31       | <0.10                          |
| pH                              |       |      | 8.08       | 8.05       | 8.02       | 7.98       | 7.94       | 7.81       | 7.49                           |
| Sulphate (SO <sub>4</sub> )     | mg/L  | 1    | 61         | 61         | 66         | 56         | 73         | 63         | 81                             |
| TDS (COND - CALC)               | mg/L  | 5    | 620        | 608        | 693        | 653        | 796        | 748        | 761                            |
| Total Suspended Solids          | mg/L  | 2    | 75         | 7          | 6          | <3         | <3         | 22         | 496                            |
| Calcium (Ca)                    | mg/L  | 1    | 105        | 89         | 122        | 119        | 114        | 109        | 121                            |
| Magnesium (Mg)                  | mg/L  | 1    | 47         | 46         | 57         | 56         | 52         | 50         | 51                             |
| Sodium (Na)                     | mg/L  | 2    | 81.6       | 77         | 77         | 72         | 85         | 84         | 63                             |
| Barium (Ba)                     | mg/L  | 0.01 | 0.0820     | 0.05       | 0.07       | 0.09       | 0.08       | 0.08       | 0.06                           |
| Boron (B)                       | mg/L  | 0.01 | 0.2650     | 0.198      | 0.193      | 0.21       | 0.24       | 0.24       | 0.14                           |
| Iron (Fe)                       | mg/L  | 0.03 | 0.402      | <0.005     | 0.067      | 0.14       | 0.05       | 0.07       | <0.01                          |
| PHC F1 (C6-C10)                 | mg/L  | 0.2  | <0.05      | <0.02      | <0.02      | <0.02      | <0.02      | <0.2       | <0.2                           |
| PHC F2 (C10-C16)                | mg/L  | 0.2  | <0.05      | <0.05      | <0.05      | <0.05      | <0.05      | <0.2       | <0.2                           |
| PHC F3 (C16-C34)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |
| PHC F4 (C34-C50)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility****Borehole #4 (2005-BH4)**

| Sample Date:                    |       |      | 2020-10-05 | 2019-08-19 | 2018-06-08 | 2017-10-06 | 2016-11-02 | 2015-10-05 | 2005-04-07<br>(Initial Sample) |
|---------------------------------|-------|------|------------|------------|------------|------------|------------|------------|--------------------------------|
| Sample ID:                      |       |      | 2005-BH4   | 2005-BH4   | 2005-BH4   | 2005-BH4   | 2005-BH4   | 2005-BH4   | 2005-BH4                       |
| Parameter                       | UNITS | MDL  |            |            |            |            |            |            |                                |
| Alkalinity as CaCO <sub>3</sub> | mg/L  | 5    | 237        | 243        | 263        | 259        | 297        | 271        | 279                            |
| Biochemical Oxygen Demand       | mg/L  | 1    | < 3        | <3         | <3         | <3         | <3         | 1          | <1                             |
| Chemical Oxygen Demand          | mg/L  | 5    | 8          | <5         | 5          | 9          | <5         | 11         | 6                              |
| Chloride (Cl)                   | mg/L  | 1    | 22         | 22         | 25         | 22         | 25         | 28         | 15                             |
| Conductivity                    | µS/cm | 5    | 625        | 641        | 663        | 665        | 670        | 701        | 646                            |
| Dissolved Organic Carbon        | mg/L  | 0.5  | 3.3        | 3.0        | 2.2        | 3.6        | 3.3        | 3.2        | 2.1                            |
| N-NH <sub>3</sub> (Ammonia)     | mg/L  | 0.02 | 0.13       | 0.18       | 0.17       | 0.14       | 0.06       | 0.18       | 0.17                           |
| N-NO <sub>3</sub> (Nitrate)     | mg/L  | 0.1  | < 0.05     | 0.080      | <0.05      | <0.05      | <0.1       | <0.10      | <0.10                          |
| pH                              |       |      | 8.07       | 8.08       | 8.18       | 8.03       | 7.99       | 7.85       | 7.84                           |
| Sulphate (SO <sub>4</sub> )     | mg/L  | 1    | 48         | 52         | 49         | 43         | 54         | 56         | 41                             |
| TDS (COND - CALC)               | mg/L  | 5    | 353        | 354        | 395        | 371        | 450        | 456        | 420                            |
| Total Suspended Solids          | mg/L  | 2    | 6          | 3          | 4          | <3         | <3         | <2         | 175                            |
| Calcium (Ca)                    | mg/L  | 1    | 51         | 27         | 41         | 45         | 49         | 54         | 39                             |
| Magnesium (Mg)                  | mg/L  | 1    | 20         | 14         | 18         | 20         | 21         | 22         | 18                             |
| Sodium (Na)                     | mg/L  | 2    | 61         | 84         | 96         | 75         | 71         | 70         | 76                             |
| Barium (Ba)                     | mg/L  | 0.01 | 0.08       | 0.04       | 0.07       | 0.08       | 0.08       | 0.08       | 0.07                           |
| Boron (B)                       | mg/L  | 0.01 | 0.187      | 0.222      | 0.26       | 0.26       | 0.20       | 0.21       | 0.19                           |
| Iron (Fe)                       | mg/L  | 0.03 | 0.513      | <0.005     | 0.48       | 0.48       | 0.43       | 0.69       | 0.16                           |
| PHC F1 (C6-C10)                 | mg/L  | 0.2  | <0.05      | <0.02      | <0.02      | <0.02      | <0.02      | <0.2       | <0.2                           |
| PHC F2 (C10-C16)                | mg/L  | 0.2  | <0.05      | <0.05      | <0.05      | <0.05      | <0.05      | <0.2       | <0.2                           |
| PHC F3 (C16-C34)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |
| PHC F4 (C34-C50)                | mg/L  | 0.5  | <0.4       | <0.4       | <0.4       | <0.4       | <0.4       | <0.5       | <0.2                           |

**2020 Annual Compliance and Operational Performance Report - Nordion Class 1B Facility**

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