CONFIDENTIAL

Nordion®
A Sotera Health company

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

License Number: NSPFOL-11A.01/2025

## 2023 ANNUAL COMPLIANCE AND OPERATIONAL PERFORMANCE REPORT to the Canadian Nuclear Safety Commission for the period JANUARY to DECEMBER 2023

### Signatures

Prepared by: [redacted]

Approved by: [redacted]

447 March Road
Ottawa, ON Canada K2K 1X8
613-592-3400 | nordion.com

## EXECUTIVE SUMMARY

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 2024 Environmental, Health and Safety (EHS) Objectives

The key points of this report are as follows:

- All key measures were implemented to ensure continued 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.
- Nordion did not have any instances in which there was potential to exceed a regulatory limit.
- Nordion had no lost time injury and two injuries that required medical treatment.
  Nordion had no non-radiological or radiological exceedances of an environmental regulatory limit or action level in 2023.

In 2023, 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 save for eleven non-compliances with the NSC Act, the regulations and within Nordion's site license NSPFOL-11A.01/2025. Nordion had eight incidents that were reportable to the CNSC in 2023 (see Appendix A). All non-compliances were promptly followed up with corrective actions and all reportable incidents were promptly disclosed with the full intent to ensure diligent resolution.

# TABLE OF CONTENTS

## GLOSSARY

| | |
|---|---|
| ACOPR | Annual Compliance and Operational Performance Report |
| ALARA | As Low As Reasonably Achievable |
| AOPFN | Algonquins of Pikwakanagan First Nation |
| AMMS | Advanced Maintenance Monitoring System |
| BH | Borehole |
| BWXT | BWXT Medical Ltd |
| CAM | Continuous Air Monitor |
| CAPA | Corrective Action/Preventative Action |
| COF | Cobalt Operations Facility |
| [redacted] | [redacted] |
| CNSC | Canadian Nuclear Safety Commission |
| CSA | Canadian Standards Association |
| DRL | Derived Release Limit |
| EHS | Environment, Health and Safety |
| EMS | Environmental Management System |
| FSAR | Final Safety Analysis Reports |
| HEPA | High Efficiency Particulate Air |
| IAEA | International Atomic Energy Association |
| ICP | Incident Command Post |
| KOB | Kanata Operations Building |
| LCH | Licence Conditions Handbook |
| MDA | Minimum Detectable Activity |
| MSFS | Management System for Safety |
| NEW | Nuclear Energy Worker |
| NSC | Nuclear Safety and Control |
| NVS | Nuclear Ventilation System |
| RE | Roy Errington |
| SCBA | Self Contained Breathing Apparatus |
| 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 an indirect, wholly owned subsidiary of Sotera Health Company (Sotera Health), a recognized global leader in contract sterilization. Nordion's Class 1B Facility is dedicated to the manufacturing of sealed sources used in cancer therapy and irradiation technologies (Gamma Technologies).

Production operations for Gamma Technologies are housed in the Cobalt Operations Facility (COF) portion of the Kanata Operations Building (KOB).

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 Compliance with Other Regulations

Nordion reports to the Workplace Safety Insurance Board (WSIB) whenever a reportable occupational injury or illness occurs. In 2023, Nordion reported two medical treatment incidents to WSIB.

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 Transportation (US DOT) and US Nuclear Regulatory Commission (US NRC).

Nordion reported one unintentional release of 3-5 gallons of glycol/water mix (50/50) that went into the sanitary system as a result of an o-ring failure. This resulted in the water mixture entering a floor drains. This was reported to the City of Ottawa on April 28, 2023.

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.

## 1.2 New Licensed Activities

There were no new licensed activities in 2023.

## 1.3 Significant Modifications or Changes to Site or Facility

Significant modifications and repairs that were carried out in 2023 include:

- Construction work for a new hot cell (Cell 1) in the COF was completed in 2023.

### 1.3.1 Changes to Procedures Related to Operations Safety and Control

In 2023, the following modifications were made to procedures related to operational safety and control:

- Updates to SE-HS-007 "Control of Hazardous Energy – Lockout and Tagout Systems"
- Development of a new procedure, SE-HS-054, "Hand Protection Procedure"

## 1.4 Operational Challenges

In 2023, the following operational challenges were experienced by Nordion.

- Ensuring uninterrupted manufacturing of sources for customers from diverse global Co-60 supply that was very concentrated in the second half of the calendar year. This challenge was effectively handled by the Nordion operational team.

# 2. SAFETY AND CONTROL AREA

## 2.1 Management System

### 2.1.1 Applicable Activities

The Management System for Safety (MSFS) 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 for the manufacture of sealed sources for medical and industrial applications. Nordion manufactures sealed sources that are 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 may also service, 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. No such activity occurred in 2023.

### 2.1.2 Management System for Safety Program Effectiveness

The annual management review of the Environmental Management System (EMS) and the MSFS was conducted on June 16th, 2023, by the EHS Committee to review the 2022 EHS Performance Report. This report assessed the performance related to the 14 Safety and Control Areas over the past three years where this information was available. Any trends identified were addressed and tracked via a Nordion non-conformance system. The 2023 Environmental Objectives and Targets were reviewed and were on track. Resource requirements for the EMS and MSFS were discussed. The EHS Committee agreed that the programs are resourced adequately to ensure that critical issues were being addressed. Financial and specialized skills resources were felt to be adequate. The Committee made seven recommendations for future reports and requested fifteen revisions and clarifications to the EHS Performance Report.

The Committee concluded that they were satisfied with the effectiveness of the EMS and the MSFS.

### 2.1.3 Internal and External Audits

Nordion uses both internal and external audits as a key part of the MSFS and the EMS.

#### 2.1.3.1 Internal Audits

In 2023, there were twenty internal audits completed by Nordion EHS.

In addition, as part of the inspection program, Nordion conducted a total of fourteen health and safety inspections, and ten environmental and fire inspections.

These audits included an audit of production areas and supporting functions as well as policy and program audits.

All findings were actioned using Nordion’s corrective action system.

#### 2.1.3.2 External Audits of Nordion

There were four CNSC inspections.

The inspections topics and their results were as follows:

| CNSC Inspection Topic | Result |
|---|---|
| Security | One non-compliance and one recommendation |
| General Type II | Three non-compliances and six recommendations |
| Human Performance | Two non-compliances and one recommendation |
| Radiation Protection & Environmental Protection | Three non-compliances and two recommendations |

The CNSC findings for the Security, General, and Human Performance inspections have been addressed. The findings related to the Radiation Protection and Environmental Protection audit were received on February 29th, 2024, and are being addressed.

There was an additional audit of Nordion by an external party.

| External party | Result |
|---|---|
| BSI | Three Opportunities for Improvement |

These five external audits of Nordion were conducted in February, March, May, July and December 2023.

2.1.3.3 External Audits Conducted by Nordion

Nordion conducted one EHS audit of a supplier in 2023. There was one finding resulting from the supplier audit.

2.1.4 Management System for Safety Program Improvements

There was no revision or changes to the Nordion Management System for Safety Program in 2023.

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

2.1.5 Summary of Organizational Structure and Key EHS Personnel

Nordion is an indirect, wholly owned subsidiary of Sotera Health Company and operates as a stand-alone company.

The list of EHS personnel for Nordion as of December 2023 is provided below.

**Nordion – Gamma Technologies – EHS Compliance**

- Senior Vice President of Sotera Environmental, Health and Safety (Sotera Health)
- Director, Regulatory & EHS
- Administrative Assistant
- Director, Global Security
- Manager, Security
- Contract Security Analyst
- Contract Security Supervisor
- Contract Security Assistant Supervisor
- Contract Security Protection Officers [redacted]
- Manager, Radiation Safety & Nuclear Transportation

- Radiation Surveyor
- Senior EHS Compliance Specialist (2)
- Senior Licensing Coordinator
- Senior EHS Specialist / Radiation Safety Officer
- Manager, EHS
- EHS Compliance Specialist
- EHS Specialist

2.1.6 Changes to the Organizational Structure and Roles and Responsibilities of Key Personnel in 2023:

**EHS Compliance Organization Changes:**

- In 2023, one Junior Radiation Surveyor transition to the role of Radiation Surveyor.
- In 2023, a new Contract Security Assistant Supervisor was hired.

## 2.2 Human Performance Management

2.2.1 Overall Performance of Human Performance Management

Employee training was 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 2023, 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 LCH for the implementation and maintenance of a training program.

Nordion’s Change Control procedure, QAP AP-45, required 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 were 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. 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 Nuclear Energy Workers (NEWs) receive a basic course on EHS which provides information on the facilities, emergency response procedures and alarms, and basic procedures for safety in the workplace. NEWs received 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 2023, 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 topics such as 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 an online course training that is required once on employment or upon job change. Retraining is conducted on a two-year frequency.

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

In 2023, the number of scheduled participants that required safety training was 313, and by the end of the year, 293 of the scheduled participants completed the training, which included refresher training. Therefore, the actual attendance completion rate for 2023 was 94%. A number of the uncompleted trainings are related to personnel hired late in 2023 and are planned to be completed in 2024 as per Nordion processes.

**Table 1**
**2023 Safety Training Programs**

| Program | Number of Participants Requiring Training in 2023 | Number of Participants Completed Training in 2023 |
|---|---|---|
| Nuclear Energy Worker (NEW) Indoctrination[3] and NEW Refresher | 39 | 36 |
| Radiation Instrumentation Workshop[3] | 32 | 31 |
| Radiation Safety Review for Operators[3] | 16 | 13 |
| TDG online | 29 | 28 |
| TDG Advance | 31 | 27 |
| Crane | 16 | 16 |
| Pallet Truck | 12 | 12 |
| Forklift | 3 | 1 |
| Contractor Radiation Safety Protection Training[3] | 1 | 1 |
| Contractor Radiation Safety Protection Refresher[3] | 11 | 11 |
| Contractor EHS Training Level I[3] | 62 | 62 |
| In-Depth Security Awareness[3] | 18 | 13 |
| Emergency Response Part 1[3] | 9 | 9 |
| Emergency Response Part 2[3] | 8 | 8 |
| Emergency Response Part 3[3] | 5 | 5 |
| Emergency Response: Security[3] | 6 | 6 |
| Emergency Response: Site Security Volunteer[3] | 3 | 3 |
| Emergency Response: Monitors[3] | 2 | 2 |
| Self Contained Breathing Apparatus (SCBA) Part 1[3] and 2[3] | 10 | 10 |
| **TOTAL** | **313** | **293** |

[3] Key EHS course

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.

In 2023:

- 100% of course evaluation forms had an overall rating of good, very good or excellent. 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.

In 2023, 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 is measured by the EHS significance (high, medium, and 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.

In 2023, there were no unplanned events where the root cause was attributed to Nordion training or human error.

2.2.3 Confirmation of Sufficient Number of Qualified Workers

In 2023, Nordion ensured that at least the minimum number of responsible personnel were available to provide safety during overnight operations and during emergency situations. There were no changes to risk levels or available personnel.

Nordion Security is always on-site. Radiation Surveyors are always on site when production involving radioactive materials is occurring. Nordion's key emergency response personnel, Facilities and Production Managers are 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 58 Fire Wardens and Marshalls and over 100 other emergency response personnel. Due to the fact that both Nordion and BWXT Medical operate different portions of the same facility, the emergency response program and roles continue to include personnel from both Nordion and BWXT as needed.

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 (see Section 2.10).

There is at least 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 in accordance with 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 2023 EHS program objectives and results are shown in Table 2. The EHS objectives that did not meet the target in 2023 were Medical Treatment incidents, Timely closure of CAPAs within 60 days, reportable releases of non-radioactive hazardous materials, Sotera Health EHS Culture participation rate and safety improvement rate.

The number of Medical Treatment Incidents (2) did not meet the target of ≤1. Further details of these incidents can be found in Section 2.8.4.

The timely closure of CAPAs within 60 days (74%) did not meet the target of 90% in 2023. Performance results for this target are reviewed monthly with the Senior Leadership Team to continue to drive performance in this area.

There was one reportable release of non-radioactive materials, therefore did not meet the zero target.

In 2023, a new safety culture program was implemented that consisted of quarterly webinars on key safety topics for managers, coupled with employee safety talks. The participation rate of 82% for the year was below the 90% target. This program will continue into 2024.

The safety improvement rate (107.8) was below target (110).

The remainder of the EHS Targets and Objectives were met for 2023. Overdue training (1.4%) was less than the target of <2%. The maximum employee dose rates (4.58 mSv/yr) were well under the target of ≤ 7.5 mSv/yr. Nordion's radioactive materials emissions (0.038% of the Derived Release Limit (DRL)) continue to be well below the target of ≤ 2% DRL. The safety walkthroughs (35) exceeded the target (30).

Nordion diverted 62% of waste from landfills and completed a supplier audit by the end of 2023.

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 EMS and MSFS review.

## Table 2
## 2023 EHS Program Objectives and Results

| Objective | Measure/Target * | Result |
|---|---|---|
| Timely CAPA Closure | • Ensure timely closure of CAPA (90% completed within 60 days) | • Timely closure of CAPA = 74% completed within 60 days |
| EHS Management System Effectiveness | • Ensure documents under your ownership are maintained and reflect current practices *<br>• Overall percentage of overdue training ≤ 2% | • Overall percentage of overdue training = 1.4% |
| Minimize the number and extent of occupational injuries | • The number of Medical Treatment Incidents ≤ 1<br>• Lost time Incidents = 0 | • The number of Medical Treatment Incidents = 2<br>• Lost time Incidents = 0 |
| Minimize the use and release of hazardous materials to the environment and ensure adherence to permissible levels | • Radioactive materials emissions to ≤ 2.0% DRL (Ottawa)<br>• Reportable releases of radioactive and non-radioactive hazardous materials to the environment (sanitary or storm sewer, air, groundwater, land) = 0 | • Radioactive materials emissions = 0.038% DRL (Ottawa)<br>• Reportable releases of radioactive and non-radioactive hazardous materials to the environment (sanitary or storm sewer, air, groundwater, land) = 1 |
| Actively limit radiation doses to employees as per ALARA principle | • Maximum employee dose rate < 7.5 mSv/yr | • Maximum employee dose rate = 4.58 mSv/yr |
| Maintain a healthy safety culture. * | • Actively participate in the monthly safety culture program<br>○ Target: 90% participation rate<br><br>• Immediately report, and where possible, correct near-misses and hazard identifications<br>○ Target: Safety Improvement Rate – 110 (includes near miss reports, hazard identifications, etc).<br>○ Target: 30 safety walkthroughs over the year | • Actively participate monthly safety culture program<br>○ 82% participation rate<br><br>• Immediately report, and where possible, correct near-misses and hazard identifications<br>○ Safety Improvement Rate = 107.8 (includes near miss reports, hazard identifications, etc).<br>○ Safety walkthroughs over the year = 35 |

| | | |
|---|---|---|
| | • Immediately report injuries and suspected ergonomic symptoms to your manager * | • Immediately report injuries and suspected ergonomic symptoms to your manager* |

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

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 2023, Nordion continued the practice of monthly 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 CNSC 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

Throughout 2023 Nordion provided reporting to the CNSC for all Co-60 sealed source shipments and receipts.

In late 2023, there was one incident where sealed sources received by Nordion from a customer were not reported within the required 48 timeframe. The incident was investigated, and the process is being reviewed in 2024 to identify potential improvements.

2.3.4.2 Sealed Source Tracking Improvements

There were no significant changes or improvements made to the sealed source tracking program in 2023.

2.3.5 Non-production Sealed and Unsealed Source Inventory

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

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

The 2023 data on sealed source manufacturing is shown in Table 3.

**Table 3**
**Sealed Source Manufacturing**
**Activity in PBq (kCi)**

| Radioisotope | Total Processed in 2023 | Total Shipped in 2023 |
|---|---|---|
| Co-60 | [redacted] | [redacted] |

2.3.6.2 Processing >1 Petabecquerel (PBq)

Nordion has processed and shipped quantities of activity greater than 1 PBq of Co-60. In 2023, the quantities of Co-60 processed and shipped was [redacted] and [redacted] respectively.

2.3.6.3 Acquisitions of Finished Sealed Radioactive Sources

Sealed radioactive sources acquired by Nordion in 2023 included Co-60 double encapsulated sources that have been returned from customers [redacted]

2.3.6.4 Sealed Sources/Devices >50 Megabecquerels (MBq)

[redacted]

## 2.4 Safety Analysis

2.4.1 Validation and Maintenance of Overall Safety Case

The overall Nordion safety case for the facility is effectively maintained in the overall primary Final Safety Analysis Reports (FSARs) for 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 2023, there were no modifications that affected the facility's safety analysis.

In 2023, Nordion undertook a gap analysis of it's safety analysis program against REGDOC-2.4.4, "Safety Analysis for Class 1B Nuclear Facilities". Minor, administrative changes are being made to Nordion's program based on this gap 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 2023, there were no significant design issues identified through these reviews. Overall, Nordion's facility design has been maintained.

Construction work for a new hot cell in the COF was completed in 2023. This construction work did not impact the overall design basis for the facility. As of the end of 2023, commissioning of this new hot cell was ongoing.

The facility modifications and additions occurring in the leased areas (BWXT Medical) did not impact the ability of the facility structures, systems and components 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 2023, 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.

## 2.7 Radiation Protection

### 2.7.1 Dose Control Data

#### 2.7.1.1 Occupational External Dosimetry

Table 4 provides dosimetry data for employees grouped in various ranges of exposure. In 2023, a total of 157 employees were monitored. Only the Whole-Body and extremity doses are provided. The skin and lens of the eye doses are typically equivalent to the whole-body dose since Nordion processes Co-60, a high-energy gamma emitter. Of the 157 employees monitored, 51 were active area employees and 106 were non-active area employees. Of the 106 non-Active Area personnel, 8 support industrial irradiators (containing Co-60) work at customer sites. These individuals are included in the Class 1B licence dosimetry as they may also receive dose from work at the Nordion facility during the dosimetry year. In 2019 and 2020, the numbers of employees in the table included those employees now working under the BWXT Medical licence.

**Table 4**
**Personnel Dosimetry**

| Number of Employees | | | | | |
|---|---|---|---|---|---|
| Dose Range (mSv) | Whole Body | | | | |
| | 2019 | 2020 | 2021 | 2022 | 2023 |
| 0 | 47 | 70 | 18 | 44 | 10 |
| 0.01 - 1.00 | 190 | 219 | 61 | 52 | 107 |
| 1.01 - 5.00 | 41 | 35 | 28 | 35 | 40 |
| 5.01 - 10.00 | 0 | 0 | 0 | 0 | 0 |

| Number of Employees | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dose Range (mSv) | Right Hand | | | | | Left Hand | | | | |
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2019 | 2020 | 2021 | 2022 | 2023 |
| 0 | 50 | 61 | 14 | 10 | 14 | 52 | 93 | 13 | 10 | 12 |
| 0.01 - 1.00 | 35 | 50 | 7 | 12 | 12 | 40 | 23 | 7 | 10 | 14 |
| 1.01 - 5.00 | 39 | 38 | 15 | 19 | 22 | 33 | 33 | 16 | 21 | 21 |
| 5.01 - 10.00 | 5 | 3 | 2 | 0 | 0 | 4 | 3 | 2 | 0 | 1 |
| 10.01 - 20.00 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| >20 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Table 5
## Average, Maximum and Minimum Worker Effective Doses (mSv)

| | | 2019 | 2020 | 2021 | 2022 | 2023 | CNSC Regulatory Limit |
|---|---|---|---|---|---|---|---|
| NEWs | Average | 0.48 | 0.36 | 0.8 | 0.71 | 0.76 | n/a |
| | Average* | 0.57 | 0.46 | 0.96 | 1.07 | 0.81 | n/a |
| | Maximum | 4.79 | 4.92 | 4.3 | 4.29 | 4.58 | 50/yr 100/5yr |
| | Minimum | 0 | 0 | 0 | 0 | 0 | n/a |
| | Number of NEW monitored | 278 | 324 | 107 | 131 | 157 | |
| Contractors | Average | 0.03 | 0.01 | 0.04 | 0.03 | 0.02 | n/a |
| | Average* | 0.06 | 0.03 | 0.06 | 0.04 | 0.05 | n/a |
| | Maximum | 0.26 | 0.29 | 0.30 | 0.29 | 0.26 | 1/yr |
| | Minimum | 0 | 0 | 0 | 0 | 0 | n/a |
| | Number of NEW monitored | 123 | 381 | 53 | 40 | 51 | |

* This average is calculated excluding zero dose values.

## Table 6
## Minimum, Maximum and Average Worker Extremity Doses (mSv)

| | | 2019 | 2020 | 2021 | 2022 | 2023 | CNSC Regulatory Limit |
|---|---|---|---|---|---|---|---|
| NEWs | Average | 1.14 | 0.93 | 1.56 | 1.52 | 1.96 | n/a |
| | Maximum | 20.93 | 16.48 | 7.73 | 4.29 | 4.58 | 500/yr |
| | Minimum | 0 | 0 | 0 | 0 | 0 | n/a |
| | Number of NEW monitored | 130 | 153 | 38 | 58 | 51 | |

Table 5 and 6 provides maximum and average doses to NEWs. In 2023, dosimetry has remained consistent with previous years.

Contractor dosimeters and doses continue to be well managed and controlled. There was no significant change in average dose. The maximum doses to contractors slightly decreased from 2022.

In 2023, there was one exceedance of a Nordion action level related to NEW dose. This is discussed in section 2.7.4.

Table 5 and 6 shows continued good performance in maximum whole-body and extremity dose relative to the CNSC Regulatory Limit.

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

2.7.1.2 Internal Occupational Radiation Doses

Nordion's bioassay program includes whole-body counting if air contamination monitoring indicates a need. In 2023, Nordion had a non-reportable contamination event that had the potential for employee inhalation of Co-60. Two employees were sent for off-site whole-body monitoring. The employees had Co-60 inhalation doses of 1.1 µSv and 1.0 µSv. These doses are a fraction of the 100-300 µSv external dose these employees typically receive in a month.

2.7.2 Significance of Results for the Dose Control Data

The group with the highest average dose (2.2 mSv/employee) is the Cobalt Monitoring Decontamination and Shipping group. This is the group with the historic highest average. The 2023 average (2.2 ± 1.1 mSv) is consistent with the 2022 average (2.3 ±1.02 mSv).

The other group that drives Nordion's doses are the production technicians. The average dose in 2023 to production technicians was 2.69 ± 1.36 mSv. This is consistent with the 2022 value of 2.13 ± 1.08 mSv.

Non-active area personnel include [redacted] personnel that are part of Nordion's installation and services team that performs work at customer sites. This group has the highest average dose for non-active area personnel. In 2023, the installation group had an average dose of 1.1 mSv, with a max dose of [redacted]. Results overall demonstrate continued and consistent high performance of Nordion employees in accordance with ALARA.

2.7.3 Dose to the Public

Table 7 shows the doses to the public from 2019 - 2023. This dose represents the combined dose to the public from Nordion and BWXT Medical activities that occur on the site. The doses to the public from combined Nordion and BWXT Medical activities at the site remain well controlled and below the limit of 1 mSv/year.

**Table 7**

**Dose to Public**

| Year | (mSv) |
|---|---|
| 2019 | 0.00087 |
| 2020 | 0.00122 |
| 2021 | 0.00185 |
| 2022 | 0.00156 |
| 2023 | 0.00095 |

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 are monitored for contamination.

During 2023 operations, there were thirty-eight instances where contamination was found and subsequently contained within the Active Area. Of the thirty-eight contamination incidents, eleven were related to contamination found on clothing and twenty-seven were related to contamination found on equipment or floors. In 2023, there was one significant contamination event that resulted in a dose to a Nordion employee greater than the Nordion action level of 2 mSv per reporting period. Due to a contaminated object within an employee's lab coat pocket, an employee received a whole body (WB) dose of 2.05 mSv. Although this was still well within the regulatory limits, it reached the Nordion action level threshold of 2.0 mSv/Report. This incident was investigated, and corrective Actions were implemented to prevent reoccurrence of this incident.

The distribution of contamination incidents from 2019 to 2023 is shown in Table 8 and illustrated in Figure 1.

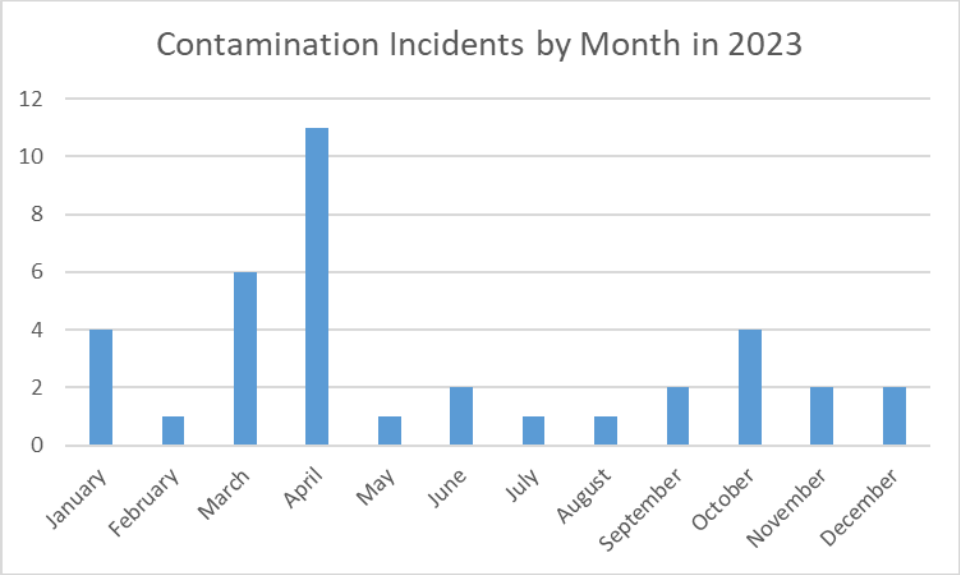
The main isotope identified during the contamination events is Co-60. Currently, Co-60 is the only isotope processed within the Cobalt Operations facility. The number of Co-60 contamination events in 2023 is higher than the Co-60 contamination events in previous years. All events were reviewed by surveyors and the increased number of events did not result in any increased doses to personnel. In 2024, Nordion will continue to monitor contamination events to assess areas for potential improvement.

Nordion's contamination control program continues to be well managed and meet the conditions of the licence.

**Table 8**
**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 | Total Co60 Contamination Incidents |
|---|---|---|---|---|---|---|---|---|
| 2019 | 1 | 1 | 6 | 6 | 4 | 0 | 18 | 4 |
| 2020 | 0 | 6 | 8 | 4 | 3 | 1 | 22 | 5 |
| 2021 | 0 | 0 | 3 | 4 | 1 | 1 | 9 | 9 |
| 2022 | 0 | 5 | 1 | 7 | 3 | 0 | 16 | 16 |
| 2023 | 1 | 2 | 5 | 16 | 10 | 4 | 38 | 38 |

**Figure 1**
**Contamination Incidents by Month in 2023**




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 building. 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, 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.

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 2023.

Breathing air was monitored at various locations in the facility. In addition to having the capability of alarming locally, Continuous Air Monitors (CAM) are monitored and logged at the Surveyor's control panel and on the building monitoring system.

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 2023, 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 2023. There were no fluctuations in 2023 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 2023, there was one exceedance of a Nordion actions limit. This event is discussed in 2.7.4.

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 2023.

2.7.8 Radiation Protection Program Improvements

There were no significant changes to the RP program in 2023. The RP program continued to operate effectively in 2023.

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 2023. 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 EMS and MSFS Review. See Section 3.2 Table 16 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. Maintenance is performed for any tests that are out of specification.

In 2023, the following testing was performed:

Nuclear Ventilation System (NVS) High Efficiency Particulate Air (HEPA) filters are required to be tested yearly. Testing at Nordion occurred twice annually, with the exception of one filter which was tested at the required annual frequency. HEPA specifications were met.

The emergency generators were tested monthly and confirmed to be operational.

The radiation evacuation alarm was tested weekly and confirmed to be fully functional.

The radiation alarms throughout the facility were tested on a weekly basis in 2023. The tests verified that the alarms sound at the pre-set alarm levels and that the alarms register on the Building Management System (BMS).

The sprinkler system fire system was tested monthly in 2023 and found to be operational. All dry systems were tested and verified in good operating condition in 2023 as required by the National Fire Protection Association.

The fire alarm panels were tested monthly and found to be fully functional.

Handheld contamination monitoring equipment was maintained twice a year. Hand & Foot and Whole-body area monitors are checked weekly. Area monitors are checked daily. Equipment continued to function properly in 2023.

Air sampling pumps were tested on a weekly basis.

Radiation survey instruments were tested on a monthly, bi-annual, or annual basis as required. Radiation instruments that do not meet the calibration check specifications are sent for repair and service. Nordion maintains an inventory of radiation survey instruments to ensure sufficient radiation instruments are available at all times.

There were no trends identified in 2023 relating to radiation instruments.

2.7.12 Radiation Protection Training Program and Effectiveness

See Section 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 or equal to one Medical Treatment Incidents and zero Lost Time incidents. In addition, Near Miss Reports and Hazard Identification Reports were tracked and reported monthly to senior management and are provided to the EHS Committee for review.

Process safety audits are conducted annually.

See Section 2.1.3 for a description of audits and inspections for 2023.

2.8.2 Conventional Health and Safety Committee

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

The Nordion Workplace Health and Safety (H&S) Committee met nine times in 2023. The 2023 accomplishments for these Committees were their continued review of new or changes to existing EHS policies and programs. In addition, the Workplace H&S Committee continued to review 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 2023 included the following:

- Continued to implement behavioural based safety awareness campaign
- Hosted a Safety Week in June 2023 to continue to raise safety awareness
- Developed a Hand Protection Policy

2.8.4 Conventional Health and Safety Occurrences

During 2023, there were two medical treatment incidents. 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.

Medical Treatment Incidents: Two

| Medical Treatment Injury | Actions Taken |
|---|---|
| Facilities Employee hurt back lifting/moving photocopy paper boxes. | 1) Implemented requirement that employees empty boxes off truck onto cart instead of trying to move a full box<br>2) Advised all applicable personnel to order half boxes (5 pack vs 10 pack) going forward<br>3) Updated JHA for the MPFO to provide more detail regarding lifting tasks<br>4) Investigated better ways for moving / Manual Material Handling copier paper |

| | |
|---|---|
| Employee called in sick stating not coming to work due to injury they associated with the work they did the day before. | 1) Introduced an Early Injury Intervention / Industrial Athlete Program<br>2) Replacement of worn bearing on manipulator<br>3) Enforce more frequent changing of tasks, particularly on more challenging cells and when doing non-routine work<br>4) Implementing stretching program to help minimize ergonomic strain |

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

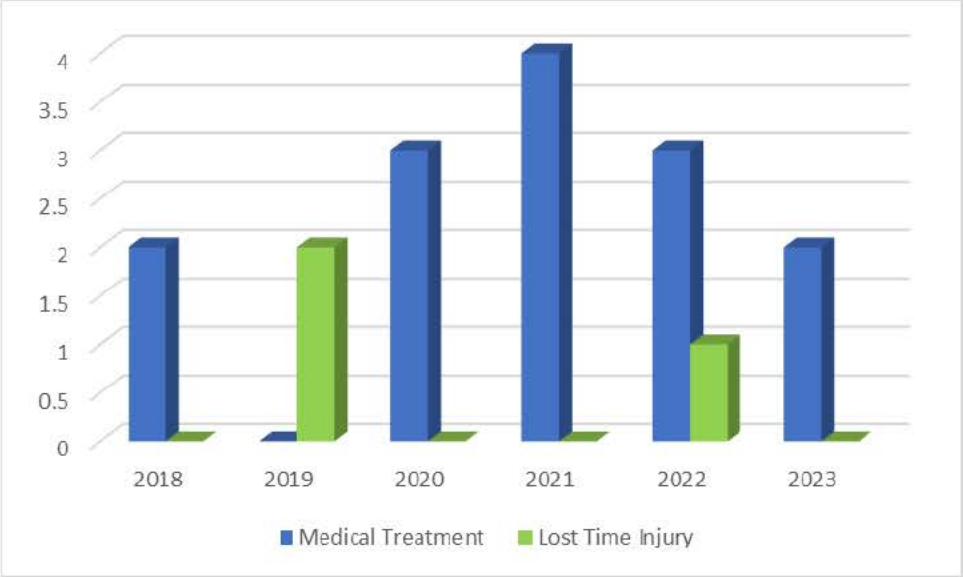
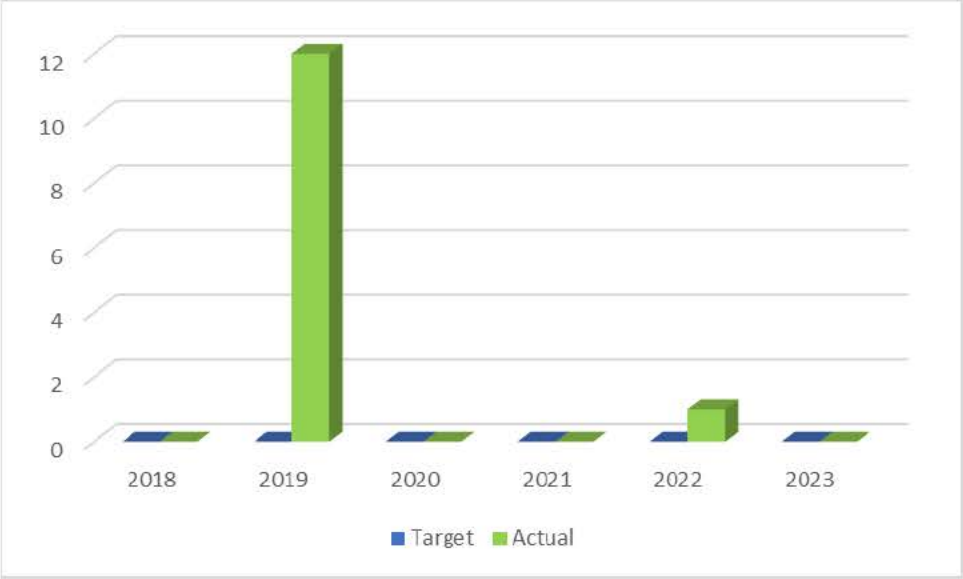


**Figure 3**
**Number of Lost Time Days by Year**




**Nordion Lost Time Injury Statistics for 2023**

| | |
|---|---|
| # Lost-Time Injuries[1] | 0 |
| Severity Rate[2] | 0 |
| Frequency Rate[3] | 0 |

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

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

## 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:

a) Continuous monitoring of process ventilation, exhausts ductwork, and stack emissions by use of in-situ detectors and samplers and computerized recording

b) Weekly air sampling and analyses for KOB exhaust stack emissions

c) Holding tanks for Active Area liquid effluent to allow sampling, analysis, and authorized release of liquid effluent

d) Environmental TLD program

e) Soil sampling

f) Groundwater sampling

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

All production operations are contained within cells 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 NVS has been designed and is maintained to prevent the unnecessary release of radioisotopes to the atmosphere.

2.9.1.1 Airborne Effluent

In 2023, there was air release of Co-60 material equal to 0.000004% of the DRL (see Table 9). No Action Levels were exceeded. There was no significant contribution to dose to public from air releases in 2023.

**Table 9**

**Airborne Releases**

| Year | Co-60 (GBq/yr) |
|---|---|
| 2019 | 0.00002 |
| 2020 | 0 |
| 2021 | 0.00004 |
| 2022 | 0.0003 |
| 2023 | 0.000001 |
| Action Levels (GBq/week) | 0.001 |

| | Co-60 |
|---|---|
| DRL (GBq/yr) | 250 |
| % DRL | 0.000004 |

2.9.1.2 Liquid Effluent

Allowable liquid effluent releases to the environment are also limited to values in SE-OP-013 “Water Effluent Monitoring”. The 5-year variation in activities released is listed in Table 10. Each release of liquid effluent in 2023 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 10.

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 ±10%.

Liquid releases are listed in Table 10 against both the DRL limits as well as the constraints Nordion places on every delay tank before it can be released from the building. In 2023, delay tanks were held on [redacted] occasions (versus [redacted] in 2022) for sampling, analysis and verification against the constraints in Nordion procedure SE-OP-013 "Water Effluent Monitoring" before release was permitted. The subsequent 22 discharges of the delays were measured for the 4 radionuclides show in Table 10.

If the critical receptor was the same group for all radionuclides potentially released by Nordion, the dose to public would be 0.000796 mSv. 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.

**Table 10**
**Liquid Releases (GBq/yr)**

| Year | Litres | Co-60 | Nb-95 | Zr-95 | Cs-137 |
|---|---|---|---|---|---|
| 2019 | 576800 | 0.020 | 0.002 | 0.0019 | 0.0007 |
| 2020 | 747902 | 0.031 | 0.0015 | 0.0013 | 0.00076 |
| 2021 | 152762 | 0.0046 | 0.002 | 0.002 | 0.001 |
| 2022 | 101337 | 0.038 | 0.002 | 0.001 | 0.001 |
| 2023 | 142560 | 0.026 | 0.0005 | 0.0009 | 0.0006 |

| Nordion SE-OP-013 (20) Constraints on each delay tank release (pH or GBq/Release) | | | | |
|---|---|---|---|---|
| **pH** | **Co-60** | **Nb-95** | **Zr-95** | **Cs-137** |
| 6-8.7 | <0.00058 | <0.000013 | <0.000014 | < 7.25E-06 |

| | Co-60 | Nb-95 | Zr-95 | Cs-137 |
|---|---|---|---|---|
| DRL (GBq/yr) | 35.4 | 3,250 | 2,060 | 24.8 |
| % DRL | 7.7E-02 | 2.0E-05 | 5.0E-05 | 2.5E-03 |

2.9.1.3 Environmental TLDs

The approximate locations of environmental TLDs are listed in Table 11. 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 2023 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 and between years is due to variations in natural background radiation at these different times and locations.

**Table 11**

## Environmental TLDs

| Location | 2019 (mSv) | 2020 (mSv) | 2021 (mSv) | 2022 (mSv) | 2023 (mSv) |
|---|---|---|---|---|---|
| 16 [redacted] | 0.096 | * | 0.2 | 0.135 | 0.08 |
| 17 [redacted] | 0.164 | 0.103 | 0.096 | 0.137 | 0.154 |
| 18 [redacted] | -0.086 | -0.092 | 0.04 | 0.358 | 0.159 |
| 19 [redacted] | 0.039 | -0.044 | 0.074 | 0.08 | 0.022 |
| 20 [redacted] | 0.093 | 0.081 | 0.065 | 0.088 | 0.085 |
| 32 [redacted] | -0.011 | -0.04 | -0.03 | 0.105 | -0.001 |
| 33 [redacted] | -0.004 | -0.083 | -0.04 | 0.044 | -0.038 |
| 38 [redacted] | 0.078 | 0.067 | 0.109 | -0.053 | -0.045 |
| 57 [redacted] | -0.018 | -0.061 | -0.037 | 0.07 | -0.026 |
| 58 [redacted] | 0.140 | 0.068 | -0.048 | 0.084 | 0.098 |

* Missing TLD

2.9.2 Significance of Air and Water Release Monitoring Results

As in previous years, air releases remain several orders of magnitude lower than liquid effluent releases.

Nordion's releases remain well below the allowed DRL and do not present a negative impact to people or the environment.

2.9.3 Exceeding Regulatory Limits or Action Levels

There were no instances of exceeding CNSC environmental regulatory limits or action levels in 2023.

2.9.4 Spills to the Environment

There were no spills to the environment in 2023.

2.9.5 Environmental Protection Program Effectiveness

A review of the performance related to the Environmental Protection Program and the EMS is conducted on an annual basis. In 2023, this review was held during the Annual EHS Program Review on June 16th, 2023.

See Section 2.1.3 for a description of audits and inspections for 2023.

2.9.6 Environmental Protection Program Activities

Activities which took place in 2023 included the following:

- Conducting a total of ten fire and environmental inspections to identify areas for improvement and/or concerns,
- 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 and three opportunities for improvement were identified during this audit.

2.9.7 Environmental Protection Program Improvements

In 2023, Nordion made the following improvements to the Environmental Protection Program.

- Third party quality control assessment of wastewater and air filter cartridges was conducted in 2023.

2.9.8 Environmental Protection Program Performance

A description of the Environmental Protection Program Initiatives is provided in Table 12, along with the results/outcomes.

A summary of initiatives and targets for 2024 is provided in Table 13.

**Table 12**
**2023 Environmental Objectives and Targets**

| Objective | Target | Status |
|---|---|---|
| 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 2023 | Audit of a supplier whose goods and/or services can have a significant impact on the environment was completed. |
| New - Investigate energy reduction opportunities | Estimated savings of 7,500 kWh per year | Complete, an estimated 16,450 kWh energy savings annually as a result of lighting retrofits. |

**Table 13**
**2024 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 the year |
| New – Investigate energy reduction opportunities | Estimated savings of 7,500 kWh per year |

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 2023. Samples were placed in plastic bags, labeled with the site location, and then analyzed on the multi-channel analyzer for eight hours as per Nordion's procedure. Background measurements (no sample, empty chamber) were also taken for reference but not subtracted from the measurements directly. The radioisotope primarily analyzed was Co-60. The MDA is determined for each sample individually. When accounting for background Co-60 fields present in the facility, all 19 samples were determined to be less than the MDA. No radionuclides attributable to licensed activities were detected in the soil samples.

2.9.9.2 Groundwater Sampling

2.9.9.2.1 Non-Radiological Sampling

Non-radiological groundwater samples were taken on June 21st, 2023. See details in Appendix C.

The results of this analysis demonstrated that there were no significant changes to groundwater when compared to previous 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 a year.

Samples were taken in August 2023 from the following boreholes (BH) 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 MDA for eight hours as per Nordion procedure. The radioisotope primarily analyzed was Co-60. The MDA was determined for each sample individually to be 1.1 Bq. When accounting for background Co-60 fields present in the facility, all five samples were determined to be less than the MDA. 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 all its scheduled activities for 2023.

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 2023, a number of Emergency Response exercises were conducted to test these emergency response plans and response personnel. In addition to these planned exercises, four additional incidents acted as "real-world" exercises.

In summary, the following activities took place in 2023:

- Onboarding several new employees to IMS positions, support groups and ERP roles.
- Continued to provide ongoing training and walkthroughs for ERP personnel.
- Provided tour and orientation for approximately 80 Ottawa Fire Services (OFS) personnel.
- Testing of the Fire Safety Plan in each of the RE Building and Heating Plant, including alarm activation and full evacuation.
- As a result of an error from our third-party monitoring company, OFS responded to site during unscheduled fire panel work on July 18th, 2023.
- A building evacuation of the KOB and KRMF buildings occurred on September 6th, 2023, as a result of Facilities personnel performing preventative maintenance on a heating system. This work created dust which

became airborne and trigger a smoke detector. A full evacuation and mobilization of our ICP was activated.

- As a result of an error from our third-party monitoring company, OFS responded to site during routine fire panel work on October 4th, 2023. No building evacuation occurred.
- A building evacuation of the KOB and KRMF occurred on November 22nd, 2023, as a result of a BWXT employee accidently activating a manual pull station in a document control room. A full evacuation and mobilization of our ICP was activated.

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 local 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.

2.10.4 Emergency Preparedness Program Improvements

In 2023, Nordion completed program enhancements to address minor areas for improvement identified in exercises and drills and other continuous improvements. As noted above, these included:

- Onboarding new staff
- Continued training with all IMs, IMS positions and subplan support groups
- Equipment upgrades, including additional Incident Command Post (ICP) vests
- Actioning program enhancements to address CNSC recommendations

2.10.5 Fire Protection Program Effectiveness

Fire exercises/evacuations were conducted in the Heating Plant, the RE Building and the KOB in 2023. 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 2023. An annual facility condition inspection was conducted by a third party in 2023.

2.10.6 Fire Protection Program Activities

The Fire Protection Program Activities that took place in 2023 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 ten fire and environmental inspections
- Conducting an annual facility condition inspection
- Nordion conducted a gap analysis against CSA N393-22, NBCC 2020 and NFCC 2020.

A fire protection program audit was conducted in 2022 and is conducted every three years as required by Canadian Standards Association (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 2023 included:

- Conducting a gap analysis against CSA N393-22, NBCC 2020 and NFCC 2020.
- Providing a tour/orientation to approximately 80 Ottawa Fire Services (OFS) personnel

There were no changes to training, methods, instrumentation, or equipment in 2023.

## 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 separate radioactive waste that is generated in Operations. Long term decay storage areas are located in the KOB active shipping/receiving facility. 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 2023 was 62%, down from 70.1% in 2022.

### 2.11.2 Identification and Characterization of Waste Streams

Due to the nature of radioisotope production that involves decay and contamination products, identification of individual isotopes and their respective quantities in waste material is difficult. Nordion has worked with a radioactive waste management facility to identify waste streams that are determined by the major isotope product in a given facility. Data for the actual waste activity levels are estimated from activity in the production volume and waste streams.

### 2.11.3 Waste Shipments

Table 14 provides a summary of solid waste material shipped to [redacted]. In 2023, there were no shipments to [redacted] of radioactive liquid waste from Nordion's Class 1B Facility.

Table 15 provides a summary of solid waste, shipped to [redacted] in 2023. Solid waste sent to [redacted] is no longer compacted, as compacted wastes are unfavourable for this disposal route, and the waste volumes shown in Table 15 represent uncompacted waste volumes.

Spent Co-60 sealed sources may be returned to Nordion from customers where [redacted] or included with other product material for disposal. In 2023, 33 low activity sources totalling [redacted] were disposed at [redacted] in routine waste shipments (included in the values shown in Table 14).

**Table 14**
**Radioactive Solid Waste Shipments to [redacted] for 2023**

| Isotope | Volume ($m^3$) | Bq | Ci |
|---|---|---|---|
| Co-60 | [redacted] | [redacted] | [redacted] |

**Table 15**
**Radioactive Solid and Low-level Liquid Waste Shipments to [redacted] for 2023**

| Isotope | Weight (kg) | Volume ($m^3$) | Bq | Ci |
|---|---|---|---|---|
| Co-60 | [redacted] | [redacted] | [redacted] | [redacted] |

2.11.4 Waste Management Program Performance

- Nordion diverted an estimated 62% of waste from landfill in 2023.

The waste management program was audited in late 2021 (finalized in 2022) 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).

2.11.5 Waste Management Program Improvements

Improvements to the Waste Management Program in 2023 included the following:

- [redacted] No sources shipped to [redacted] for disposal [redacted]

## 2.12 Nuclear Security

Details of Nordion security and any security improvements of 2023 were provided in the Nordion Physical Security Report and Security Plan for 2023, submitted in February 2023. 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 2023, Nordion performed accounting and reporting of nuclear material as required by REGDOC 2.13.1-Safeguards and Nuclear Material Accountancy. Nordion completed a Physical Inventory Taking of safeguarded material from which there were no findings.

Nordion was not selected for an International Atomic Energy Association (IAEA) Physical Inventory Verification in 2023.

There was no IAEA Complementary Access conducted at Nordion in 2023.

2.13.3 Safeguards Program Improvements

The request to exempt the final two depleted Uranium transport packages model 3300 remains outstanding since January 2022.

## 2.14 Packaging and Transport of Nuclear Substances

Nordion routinely ships nuclear substances and radioactive waste materials in Type B, Type A and Excepted packages. Shipments of Nordion's products are made via road, air, and sea. Shipments of waste are routinely made via road transport.

In 2023, Nordion shipped approximately [redacted] packages containing 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 2023, Nordion reported a non-conformance related to packaging and transport of nuclear substances. This reportable non-conformance was reported pursuant to subsection 26 (2), "Packages for transport – Activity or Mass Limits" of the Packaging and Transportation of Nuclear Substances Regulations. Details are provided in Appendix A.

## 2.15 Public Information Program

### 2.15.1 Indigenous Engagement Activities

In April of 2023, Nordion's senior leadership team traveled to Golden Lake to attended Cultural Awareness Training with the Algonquins of Pikwakanagan First Nation (AOPFN). In June 2023, Nordion and BWXT Medical hosted a delegation from the AOPFN at the 447 March Rd facility. Nordion presented an overview of our work and provided a tour of our operations. This was followed by a discussion on engagement with the AOPFN. In December 2023, Nordion hired a consultant to prepare a draft engagement plan that will be shared with the AOPFN for discussion in 2024.

### 2.15.2 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 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.

In 2023, Nordion published the following information in the "Public Disclosure" web page:

- July: There was a trouble alarm on the main fire panel due to a power supply issue. The Ottawa Fire Services was despatched to Nordion after receiving a call from the third-party monitoring company.
- January: on-site familiarization visits for Ottawa Fire Services Personnel.
- September and November: Two evacuation of the facility due to a fire alarm which proved to be false.
- October: Ottawa Fire Services was despatched to Nordion after receiving a call-in error from the third-party monitoring company.
- Q1, Q2, Q3, and Q4: 2023 Event reports.

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. In 2023, there were no questions pertaining to Nordion's public information program received through the general contact form.

Nordion issues news releases to inform the public of company initiatives, achievements, and issues that the business may be facing. In 2023, 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.

On December 21st, 2023, 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. 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.

2.15.3 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 2023.

2.15.4 Public Information Program Improvements

There were no significant changes to the Public Information Program in 2023. The Public Information Program remains effective.

## 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 31st 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 2023, Nordion submitted written notification of changes to programs and documents to the CNSC as required.

In 2023, there was one exceedance of an action level. Details of this is provided in section 2.7.4.

Nordion submitted its Annual Compliance Report to the CNSC on March 31st, 2023.

Nordion complied with all other site-specific reporting requirements. Throughout 2023, the Nordion decommissioning financial guarantee remained effective and compliant with CNSC requirements.

# 3 FUTURE PLANS AND CONCLUDING REMARKS

## 3.1 Improvement Plans and Future Outlook

In 2020, work was initiated for the installation of an additional cell (Cell 1) in Nordion's COF. This work was completed in 2023.

Nordion is planning to implement increased storage rack capacity within the Cobalt Operations Facility in 2024.

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

- Application to renew Nordion Operating licence.

## 3.2 Safety Performance Objectives for 2024

Nordion's 2024 EHS Program Objectives and Targets and Health and Safety Objectives are shown in Table 16.

## 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.

**Table 16**
**2024 EHS Program Objectives and Targets**

| Objective | Measure/Target * |
|---|---|
| Timely CAPA Closure | • Ensure timely closure of CAPAs (90% completed within 60 days)<br>• CAPAs greater than 180 days < 5<br>• No overdue compliance action items |
| EHS Management System Effectiveness | • Ensure timely closure of CAPAs (90% completed within 60 days)<br>• CAPAs greater than 180 days < 5<br>• No overdue compliance action items<br>• No EHS critical training overdue (0) |
| Minimize the number and extent of occupational injuries | • The number of Medical Treatment Incidents = 0<br>• Lost time Incidents = 0 |
| Minimize the use and release of hazardous materials to the environment and ensure adherence to permissible levels | • Radioactive materials emissions to < 2.0% of the Derived Release Limits (DRL) (Ottawa).<br>• No (0) reportable releases of radioactive and non-radioactive hazardous materials to the environment (sanitary or storm sewer, air, groundwater, land) |
| Actively limit radiation doses to employees as per ALARA principle | • Maximum employee dose rate < 6.5 mSv/yr |
| Maintain a healthy safety culture. * | • Actively participate in the behavioural based safety culture program (Sotera Health Culture Program, safety discussions and training as applicable)<br>o Target: 90% Manager participation rate |

| | |
|---|---|
| | • Immediately report, and where possible, take appropriate corrective action on near-misses and hazard identifications<br>o Target: Safety Improvement Rate – 100 (approximately 1 per employee) (includes near miss reports, hazard identifications, etc.).<br>o Target: 30 safety walkthroughs over the year<br>• IMMEDIATELY REPORT (within the same shift) work related injuries and suspected ergonomic symptoms (early onset pain) to your Manager |

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

# APPENDIX A
# 2023 Reportable Events

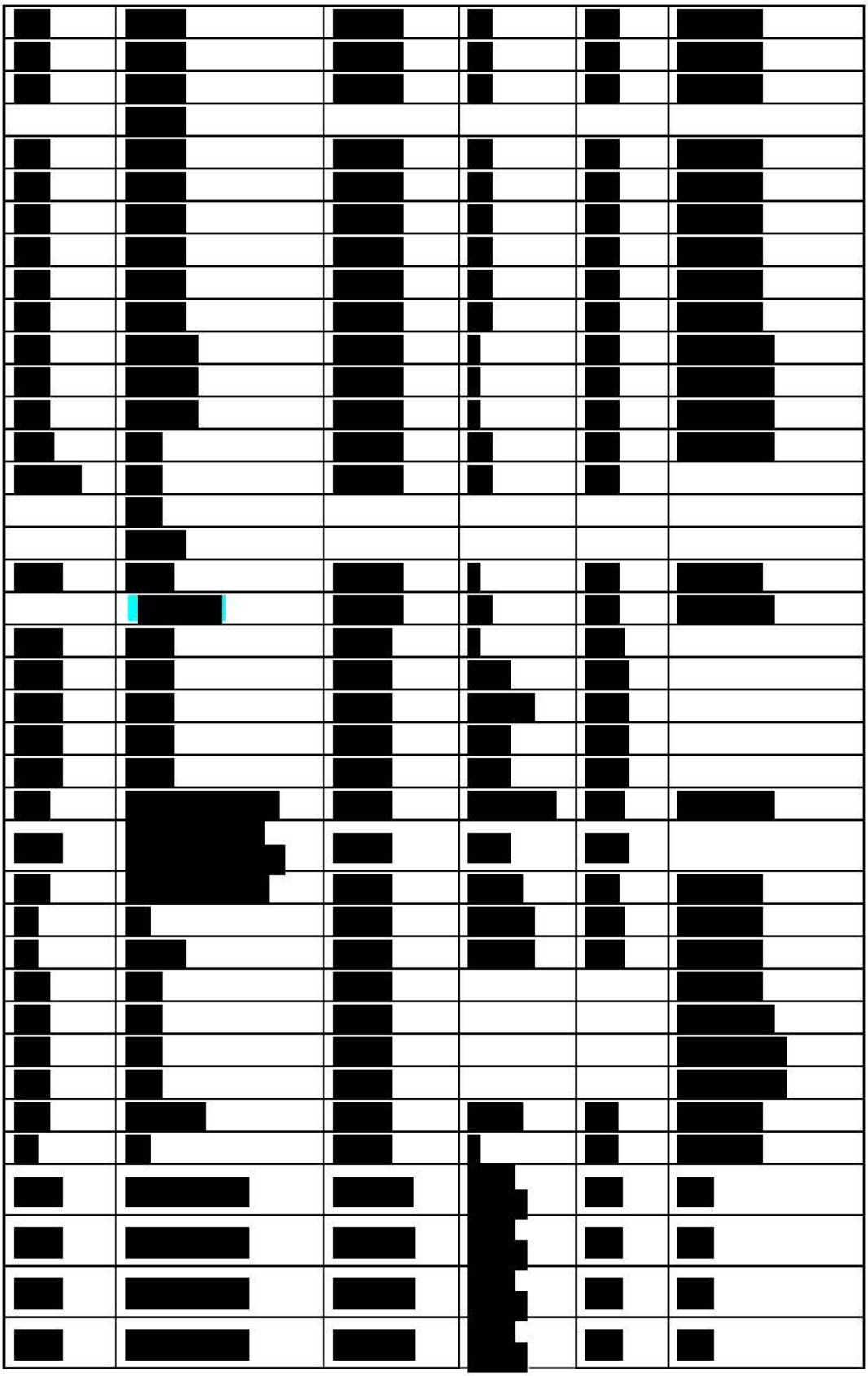
| Date of Occurrence | Description | Causes | Corrective Actions |
|---|---|---|---|
| February 27, 2023 | A supplier shipped to Nordion a quantity of radioactive material that the supplier had measured to be within the activity limits of the package. Upon receipt, Nordion measured the activity to be higher such that the activity limit of the package was exceeded by 5%. The radiation levels of the package were within the regulatory requirements and the package was shipped safely and posed no risk to the environment or the public. | The activity discrepancy was attributed to differences in measurement process. | Nordion has reduced the allowed activity allowed in this package for this supplier. |
| April 27, 2023 | An employee's monthly whole-body dose triggered Nordion's established action level. Action levels are conservatively established by Nordion well below regulatory limits and are used to continuously improve Nordion's strong safety programs. The employee's dose was well below the regulatory limits and the incident posed no risk to the environment or the public. | The observed dose level was caused by a slightly contaminated pen that was in the employee's lab coat pocket next to the TLD badge. | Procedures have been revised to include enhanced monitoring of employee lab coats for contamination. |

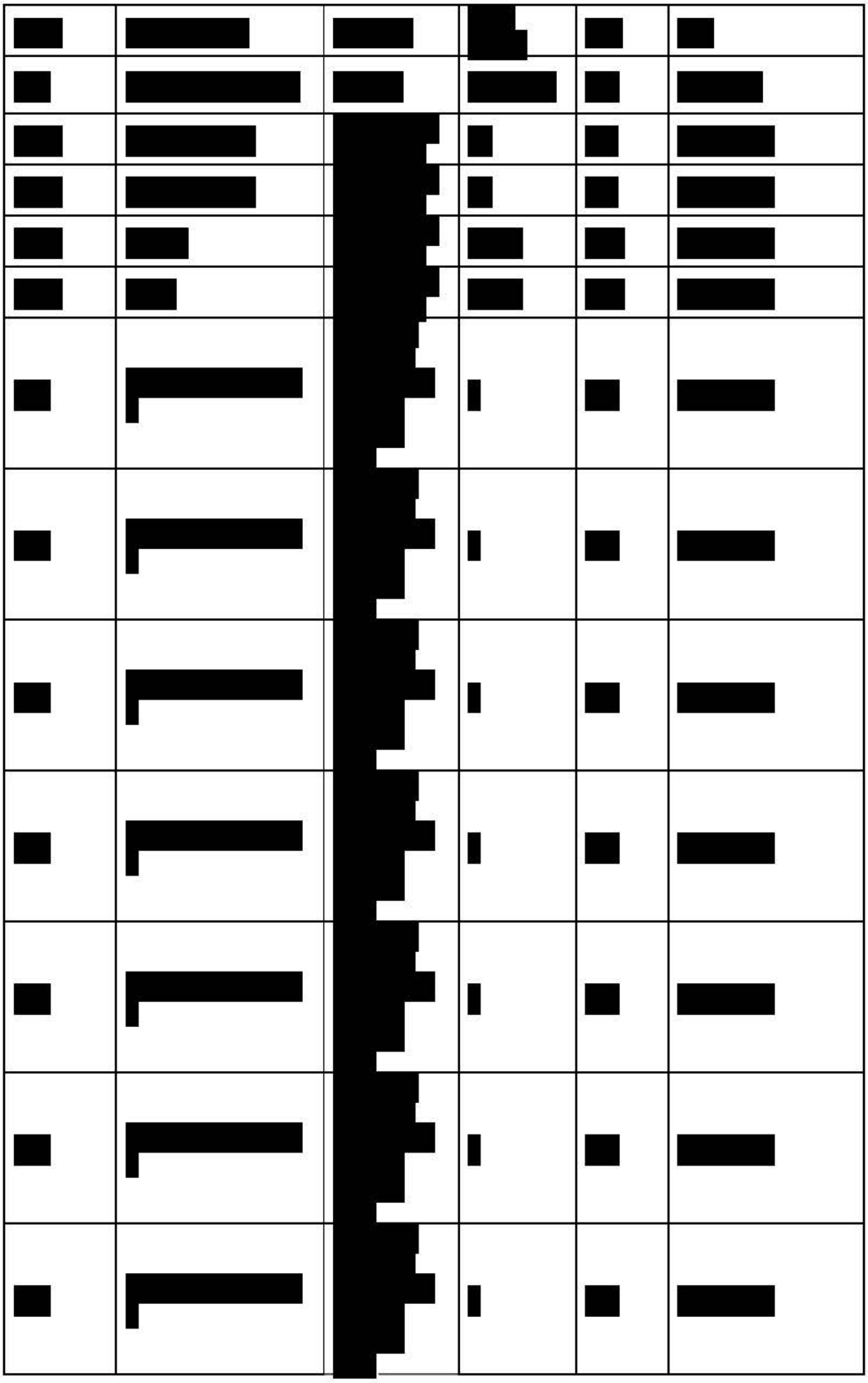
| Date of Occurrence | Description | Causes | Corrective Actions |
|---|---|---|---|
| July 18, 2023 | The Ottawa Fire Services (OFS) arrived at Nordion after receiving a call from Nordion's third-party monitoring company. The call was placed in error as Nordion was undertaking work to resolve a power supply issue on the panel. This event did not trigger an actual fire alarm, there was no evacuation, and the emergency response plan was not initiated. | The cause of the event was a miscommunication by the third-party monitoring company. | A formal communication process was developed with the third-party monitoring company. |
| September 6, 2023 | The smoke alarm went off and staff evacuated the building and fire department arrived on site. The Fire Department confirmed there was no fire. | An employee was blowing dust out of equipment coils and the combination of the dust and humidity cause the alarm. | Reviewed procedures and removed any conflicting information to handling compressed air. Employee was provided additional training on handling compressed air. |
| September 14, 2023 | The GC-220 sample chamber became temporarily stuck. The issue was resolved by cleaning the chamber assembly sliding mechanism. The GC-220 is designed such that the sealed source remain shielded at all times. As such, there were no health or safety impacts from this incident. | Increased dirt build-up in the sliding mechanism impacted the ability of the sample chamber to slide. | To avoid future reoccurrence, the frequency of regular inspection and maintenance has been increased. |
| September 28, 2023 | An elderly gentleman looking for assistance for directions to a local establishment near Nordion inadvertently accessed a secure door. | Proper security protocols had not been followed in securing a gate. | Supplementary checks of security points has been implemented with the security team. |

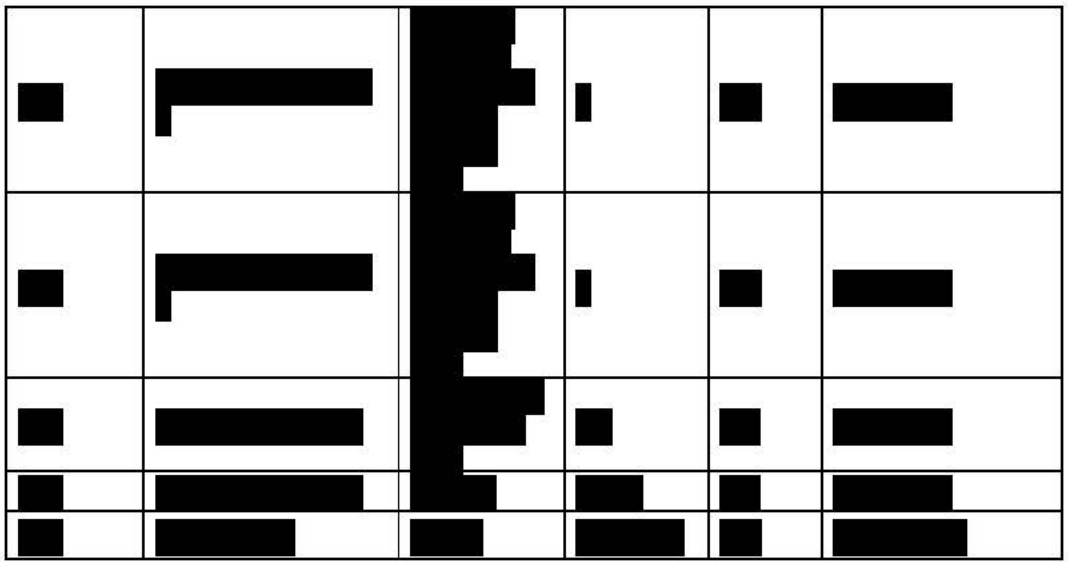
| Date of Occurrence | Description | Causes | Corrective Actions |
|---|---|---|---|
| October 4, 2023 | The Ottawa Fire Services (OFS) arrived at Nordion after receiving a call from Nordion's third-party monitoring company. The call was placed in error as Nordion was undertaking routine work on the fire alarm panel. This event did not trigger an actual fire alarm, there was no evacuation, and the emergency response plan was not initiated. | The cause of the event was a miscommunication by the third-party monitoring company. | The third-party monitoring company implemented additional controls within their system. |
| December 5, 2023 | A portion of the water main broke, causing some flooding of the outdoor shipping compound. To facilitate the repair, several fire systems were placed offline. Contingency plans were first implemented to ensure the safety of the facility.<br>There were no health or safety impacts. | The water main system is an older system. | The water main was repaired within the same day.<br>Nordion will be undertaking a systematic replacement of the water main system. |

# Appendix B
## Non-Production Sealed and Unsealed Source Inventory

| Unique ID | Serial # | Isotope | Activity | Unit | Activity Reference Date (M/D/Y) |
|---|---|---|---|---|---|
| [redacted] | | | | | |







**Nordion Depleted Uranium Transport Containers**

| SN | Activity (GBq) | SN | Activity (GBq) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

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

| | | Sample Date: | 6/21/2023 | 2022-06-08 | 2021-09-29 | 2020-10-05 | 2019-08-19 | 2005-04-07 (initial Sample) |
|---|---|---|---|---|---|---|---|---|
| | | **Sample ID:** | **2005-BH1** | **2005-BH1** | **2005-BH1** | **2005-BH1** | **2005-BH1** | **2005-BH1** |
| **Parameter** | **UNITS** | **MDL** | | | | | | |
| Alkalinity as CaCO3 | mg/L | 5 | 407 | 488 | 475 | 433 | 359 | 278 |
| Biochemical Oxygen Demand | mg/L | 1 | <3 | <3 | <3 | < 3 | <3 | <1 |
| Chemical Oxygen Demand | mg/L | 5 | 5 | 12 | 11 | < 5 | 13 | 7 |
| Chloride (Cl) | mg/L | 1 | 10.7 | 52 | 79.5 | 75 | 16.8 | 40 |
| Conductivity | µS/cm | 5 | 778 | 1110 | 1100 | 1120 | 766 | 676 |
| Dissolved Organic Carbon | mg/L | 0.5 | 1.2 | 3.1 | 3.5 | 3.1 | 2.6 | 1.6 |
| N-NH3 (Ammonia) | mg/L | 0.02 | <0.05 | 0.03 | 0.19 | 0.14 | 0.07 | 0.02 |
| N-NO3 (Nitrate) | mg/L | 0.1 | 0.09 | <0.05 | <0.05 | < 0.05 | 0.05 | 0.53 |
| pH | | | 7.93 | 7.89 | 8.02 | 7.96 | 8.04 | 7.71 |
| Sulphate (SO4) | mg/L | 1 | 16 | 73 | 51 | 51 | 28 | 22 |
| TDS (COND - CALC) | mg/L | 5 | 408 | 660 | 652 | 676 | 408 | 439 |
| Total Suspended Solids | mg/L | 2 | 132 | 456 | 1240 * | 570 | 286 | 1390 |
| Calcium (Ca) | mg/L | 1 | 89.4 | 113 | 113 | 150 | 66.3 | 80 |
| Magnesium (Mg) | mg/L | 1 | 30.9 | 50.5 | 53.1 | 63.7 | 30.0 | 29 |
| Sodium (Na) | mg/L | 2 | 55.1 | 69.6 | 58.2 | 59.6 | 45.1 | 18 |
| Barium (Ba) | mg/L | 0.01 | 0.09 | 0.122 | 0.146 | 0.217 | 0.053 | 0.02 |
| Boron (B) | mg/L | 0.01 | 0.031 | 0.047 | 0.086 | 0.086 | 0.016 | 0.07 |
| Iron (Fe) | mg/L | 0.03 | 1.27 | <0.005 | <0.005 | 3.13 | <0.005 | <0.01 |
| PHC F1 (C6-C10) | mg/L | 0.2 | <0.025 | <0.025 | <0.025 | <0.05 | <0.02 | <0.2 |
| PHC F2 (C10-C16) | mg/L | 0.2 | <0.050 | <0.050 | <0.050 | <0.05 | <0.05 | <0.2 |
| PHC F3 (C16-C34) | mg/L | 0.5 | < 0.4 | < 0.4 | < 0.4 | <0.4 | <0.4 | <0.2 |
| PHC F4 (C34-C50) | mg/L | 0.5 | < 0.4 | < 0.4 | < 0.4 | <0.4 | <0.4 | <0.2 |

* TSS were found to be high in BH 2005-BH1 in 2021. A third party was brought in to assess and conduct additional purging of the well. Additional samples were taken on 2021/11/02 and 2021/12/20 which brought levels down to 4 mg/L.

# Borehole #2 (2005-BH2)
# (Background Well)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Sample Date: | 6/21/2023 | 2022-06-08 | 2021-09-29 | 2020-10-05 | 2019-08-19 | 2005-04-07 (initial Sample) |
| | | Sample ID: | 2005-BH2 | 2005-BH2 | 2005-BH2 | 2005-BH2 | 2005-BH2 | 2005-BH2 |
| Parameter | UNITS | MDL | | | | | | |
| Alkalinity as CaCO3 | mg/L | 5 | 328 | 323 | 325 | 286 | 285 | 278 |
| Biochemical Oxygen Demand | mg/L | 1 | <3 | <3 | <3 | <3 | <3 | <1 |
| Chemical Oxygen Demand | mg/L | 5 | 8 | <5 | 9 | <5 | 5 | 7 |
| Chloride (Cl) | mg/L | 1 | 158 | 142 | 161 | 166 | 215 | 40 |
| Conductivity | µS/cm | 5 | 1130 | 1060 | 1070 | 1100 | 1250 | 676 |
| Dissolved Organic Carbon | mg/L | 0.5 | <0.2 | 1.3 | 1.8 | 0.8 | 1.4 | 1.6 |
| N-NH3 (Ammonia) | mg/L | 0.02 | <0.05 | <0.01 | 0.02 | 0.020 | 0.03 | 0.02 |
| N-NO3 (Nitrate) | mg/L | 0.1 | 0.83 | 0.860 | 0 | < 0.05 | 1.410 | 0.53 |
| pH | | | 7.87 | 8.02 | 7.88 | 8.07 | 8.01 | 7.71 |
| Sulphate (SO4) | mg/L | 1 | 28 | 26 | 27 | 26 | 26 | 22 |
| TDS (COND - CALC) | mg/L | 5 | 608 | 572 | 599 | 599 | 635 | 439 |
| Total Suspended Solids | mg/L | 2 | 250 | 33 | 37 | 620 | 140 | 1390 |
| Calcium (Ca) | mg/L | 1 | 115 | 109 | 117 | 130 | 121 | 80 |
| Magnesium (Mg) | mg/L | 1 | 41.6 | 40 | 40 | 46 | 47 | 29 |
| Sodium (Na) | mg/L | 2 | 56.3 | 56 | 53 | 50 | 48 | 18 |
| Barium (Ba) | mg/L | 0.01 | 0.053 | 0.02 | 0.024 | 0.05 | 0.01 | 0.02 |
| Boron (B) | mg/L | 0.01 | 0.023 | 0.02 | 0.02 | 0.03 | 0.01 | 0.07 |
| Iron (Fe) | mg/L | 0.03 | 2.77 | <0.005 | 0.18 | 1.45 | <0.005 | <0.01 |
| PHC F1 (C6-C10) | mg/L | 0.2 | <0.025 | <0.02 | <0.02 | <0.05 | <0.02 | <0.2 |
| PHC F2 (C10-C16) | mg/L | 0.2 | <0.050 | <0.05 | <0.05 | <0.05 | <0.05 | <0.2 |
| PHC F3 (C16-C34) | mg/L | 0.5 | < 0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.2 |
| PHC F4 (C34-C50) | mg/L | 0.5 | < 0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.2 |

# Borehole #3 (2005-BH3)

| Sample Date: | | | 6/21/2023 | 2022-06-08 | 2021-09-29 | 020-10-05 | 2019-08-19 | 2005-04-07 (initial Sample) |
|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | 2005-BH3 | 2005-BH3 | 2005-BH3 | 2005-BH3 | 2005-BH3 | 2005-BH3 |
| **Parameter** | **UNITS** | **MDL** | | | | | | |
| Alkalinity as CaCO3 | mg/L | 5 | 468 | 459 | 468 | 420 | 433 | 471 |
| Biochemical Oxygen Demand | mg/L | 1 | <3 | <3 | <3 | <3 | <3 | <1 |
| Chemical Oxygen Demand | mg/L | 5 | 6 | 6 | <5 | <5 | 12 | 10 |
| Chloride (Cl) | mg/L | 1 | 67.1 | 66 | 76 | 62 | 67 | 64 |
| Conductivity | µS/cm | 5 | 1110 | 1080 | 1100 | 1080 | 1110 | 1170 |
| Dissolved Organic Carbon | mg/L | 0.5 | 0.9 | 2.5 | 3.1 | 1.9 | 3.4 | 3.3 |
| N-NH3 (Ammonia) | mg/L | 0.02 | <0.05 | 0.01 | 0.09 | 0.06 | 0.04 | 0.09 |
| N-NO3 (Nitrate) | mg/L | 0.1 | 0.22 | 0.41 | 0.14 | 0.08 | 0.42 | <0.10 |
| pH | | | 8.1 | 8.05 | 8.03 | 8.08 | 8.05 | 7.49 |
| Sulphate (SO4) | mg/L | 1 | 57 | 56 | 63 | 61 | 61 | 81 |
| TDS (COND - CALC) | mg/L | 5 | 594 | 634 | 667 | 620 | 608 | 761 |
| Total Suspended Solids | mg/L | 2 | 83 | 94 | 59 | 75 | 7 | 496 |
| Calcium (Ca) | mg/L | 1 | 93.8 | 101 | 110 | 105 | 89 | 121 |
| Magnesium (Mg) | mg/L | 1 | 44.5 | 47 | 47 | 47 | 46 | 51 |
| Sodium (Na) | mg/L | 2 | 80.5 | 80 | 80 | 81.6 | 77 | 63 |
| Barium (Ba) | mg/L | 0.01 | 0.075 | 0.06 | 0.08 | 0.0820 | 0.05 | 0.06 |
| Boron (B) | mg/L | 0.01 | 0.257 | 0.22 | 0.25 | 0.2650 | 0.198 | 0.14 |
| Iron (Fe) | mg/L | 0.03 | 0.577 | <0.005 | 0.243 | 0.402 | <0.005 | <0.01 |
| PHC F1 (C6-C10) | mg/L | 0.2 | <0.02 | <0.02 | <0.02 | <0.05 | <0.02 | <0.2 |
| PHC F2 (C10-C16) | mg/L | 0.2 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.2 |
| PHC F3 (C16-C34) | mg/L | 0.5 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.2 |
| PHC F4 (C34-C50) | mg/L | 0.5 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.2 |

# Borehole #4 (2005-BH4)

| Sample Date: | | | 6/21/2023 | 2022-06-08 | 2021-09-29 | 2020-10-05 | 2019-08-19 | 2005-04-07 (initial Sample) |
|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | 2005-BH4 | 2005-BH4 | 2005-BH4 | 2005-BH4 | 2005-BH4 | 2005-BH4 |
| **Parameter** | **UNITS** | **MDL** | | | | | | |
| Alkalinity as CaCO3 | mg/L | 5 | 293 | 276 | 265 | 237 | 243 | 279 |
| Biochemical Oxygen Demand | mg/L | 1 | <3 | <3 | <3 | < 3 | <3 | <1 |
| Chemical Oxygen Demand | mg/L | 5 | <5 | <5 | <5 | 8 | <5 | 6 |
| Chloride (Cl) | mg/L | 1 | 32.2 | 30 | 35 | 22 | 22 | 15 |
| Conductivity | µS/cm | 5 | 716 | 682 | 681 | 625 | 641 | 646 |
| Dissolved Organic Carbon | mg/L | 0.5 | 1.8 | 2.1 | 3.4 | 3.3 | 3.0 | 2.1 |
| N-NH3 (Ammonia) | mg/L | 0.02 | 0.15 | 0.11 | 0.11 | 0.13 | 0.18 | 0.17 |
| N-NO3 (Nitrate) | mg/L | 0.1 | 0.09 | <0.05 | <0.05 | < 0.05 | 0.080 | <0.10 |
| pH | | | 8.09 | 8.00 | 7.90 | 8.07 | 8.08 | 7.84 |
| Sulphate (SO4) | mg/L | 1 | 51 | 46 | 62 | 48 | 52 | 41 |
| TDS (COND - CALC) | mg/L | 5 | 372 | 393 | 409 | 353 | 354 | 420 |
| Total Suspended Solids | mg/L | 2 | 5 | 3 | <3 | 6 | 3 | 175 |
| Calcium (Ca) | mg/L | 1 | 47.8 | 50 | 62 | 51 | 27 | 39 |
| Magnesium (Mg) | mg/L | 1 | 19.8 | 21 | 22 | 20 | 14 | 18 |
| Sodium (Na) | mg/L | 2 | 74.8 | 73 | 60 | 61 | 84 | 76 |
| Barium (Ba) | mg/L | 0.01 | 0.085 | 0.08 | 0.10 | 0.08 | 0.04 | 0.07 |
| Boron (B) | mg/L | 0.01 | 0.221 | 0.194 | 0.189 | 0.187 | 0.222 | 0.19 |
| Iron (Fe) | mg/L | 0.03 | 0.738 | 0.006 | 0.544 | 0.513 | <0.005 | 0.16 |
| PHC F1 (C6-C10) | mg/L | 0.2 | <0.025 | <0.02 | <0.02 | <0.05 | <0.02 | <0.2 |
| PHC F2 (C10-C16) | mg/L | 0.2 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.2 |
| PHC F3 (C16-C34) | mg/L | 0.5 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.2 |
| PHC F4 (C34-C50) | mg/L | 0.5 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.2 |