CONFIDENTIAL – PRESCRIBED INFORMATION

nordion
SCIENCE ADVANCING HEALTH

Nordion Class 1B Facility

License Number: NSPFOL-11A.00/2025

447 March Road
Ottawa, ON, Canada K2K 1X8

Annual Compliance and Operational Performance Report – Amendment #2 to the Canadian Nuclear Safety Commission for the period JANUARY to DECEMBER 2016

Signatures

Prepared by:	[redacted]	Date:	yy/mm/dd
Reviewed by:	[redacted]	Date:	yy/mm/dd
Approved by:	[redacted]	Date:	yy/mm/dd

ABSTRACT

This Annual Compliance and Operational Performance Report (ACOPR) provides performance and operational information for Nordion's Class 1B Facility. It reports annual performance against the Nuclear Safety and Control (NSC) Act, applicable regulations, relevant safety and operational programs and the license conditions of the Nuclear Processing Facility Operating License issued by the Canadian Nuclear Safety Commission (CNSC) (License NSFPOL-11A.00/2025) and demonstrates that Nordion is operating in a safe and responsible manner.

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

- 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 2017 Environmental, Health and Safety Objectives

The key points of this report are as follows:

- The implementation of measures to ensure compliance with Nordion's Licence Conditions Handbook (LCH).
- Implementation of new EHS Compliance management software to track regulatory items and report near miss situations and identified hazards.
- The completion of Nordion's Systematic Approach to Training (SAT).
- Various improvements made to the Radiation Protection, Conventional Health and Safety, Environmental Protection and Fire Protection Programs. These programs fall within the scope of the Quality Assurance (QA) Program for Safety and all changes made were within the licensing basis as outlined in the LCH.
- Nordion's Full Scale Emergency Drill was conducted on June 24, 2016.
- All measurable radiation doses received by personnel and the public were within the regulatory limits of 50 mSv/yr for NEW personnel and 1 mSv/yr for non-NEW personnel and public, and no internal dose levels or limits were exceeded.
- There were no instances in which there was potential to exceed a regulatory limit or to reach or exceed an action level.
- Three lost time injuries and three medical treatment injuries occurred.
- There were four reportable exceedances of an environmental regulatory limit or action level in 2016 involving non-radiological releases to the sanitary sewer which resulted in by-law limit exceedances. They were identified by Nordion during routine sampling and self-reported to the City of Ottawa (Refer to Section 1.1.6).
- Feedback from community residents at Nordion's October 2016 Community Café Open House indicate that the majority (90%) of attendees felt their questions were sufficiently answered and 86% were extremely confident that Nordion's safety processes were protecting employees, community, and environment (Refer to Appendix D.2).

- Results from a Public Opinion Survey taken from the community after the Open House indicate that the majority of the sample regard Nordion favourably and regard Nordion as being safe to the community.

In 2016, Nordion's Class 1B Facility operated within the requirements of the Nuclear Safety and Control (NSC) Act, the applicable regulations and the conditions of the operating license issued by the CNSC with the exception of 32 non-compliances with the NSC Act, the regulations or with Nordion's site license NSPFOL-11A.00/2025. Eleven (11) of these instances were reportable to the CNSC (refer to Appendix A). .

TABLE OF CONTENTS

GLOSSARY

ACOPR	Annual Compliance and Operational Performance Report
AHU	Air Handling Unit
ALARA	As Low As Reasonably Achievable
AMMS	Advanced Maintenance Monitoring System
AMP	Administrative Monetary Penalty
BH	Borehole
BMS	Building Monitoring System
CAD	Charcoal Adsorber
CAM	Continuous Air Monitor
CAPA	Corrective Action Preventative Action
CBRNE	Chemical Biological Radionuclear Explosive
CNSC	Canadian Nuclear Safety Commission
COF	Cobalt Operations Facility
[redacted]	
CSA	Canadian Standards Association
DRD	Direct Reading Dosimeter
DRL	Derived Release Limit
EC	Environment Canada
EHS	Environment, Health and Safety
EMS	Environmental Management System
EMU	Emergency Measures Unit
EOC	Emergency On Call
EPD	Electronic Personal Dosimeters
EQMS	Electronic Quality Management System
ER	Emergency Response
ESDC	Employment and Social Development Canada
FAQ	Frequently Asked Questions
FSAR	Final Safety Analysis Reports
GDP	Good Documentation Practices
HEPA	High Efficiency Particulate Air
HEPCO	Hospital Emergency Planning Committee of Ottawa
HPGe	High Purity Germanium
HRSDC	Human Resource Skills Development Centre
HVAC	Heating, Ventilation and Air Conditioning
IAEA	International Atomic Energy Association
ICP	Incident Command Post
IMS	Incident Management System
IPPAS	International Physical Protection Advisory Service
KRMF	Kanata Radiopharmaceutical Manufacturing Facility
KOB	Kanata Operations Building
LCH	Licence Conditions Handbook
LLLW	Low Level Liquid Waste
MDA	Minimum Detectable Activity
MSDS	Material Safety Data Sheet
NCSP	Nuclear Critical Safety Program
NEW	Nuclear Energy Worker
NFPA	National Fire Protection Association
NMPF	Nuclear Medicine Production Facility
NPRMI	Non-production Radioactive Material Inventory
NSC	Nuclear Safety and Control
NVS	Nuclear Ventilation System
OMIS	Obligated Material Inventory Summary
OSL	Optically Stimulated Luminescent
PIP	Public Information Program

PIT	Physical Inventory Taking
PIT-E	Physical Inventory Taking – Evaluation
PPE	Personal Protective Equipment
PTNSR	Packaging and Transport of Nuclear Substances Regulations
QA	Quality Assurance
R&D	Research & Development
RE	Roy Errington
RP	Radiation Protection
SAT	Systematic Approach to Training
SCBA	Self Contained Breathing Apparatus
SOP	Standard Operating Procedures
SSTS	Sealed Source Tracking System
SSC	Structures, Systems, and Components
TDG	Transportation of Dangerous Goods
TKN	Total Kjeldahl Nitrogen
TLD	Thermo-luminescent Dosimeter
UPS	Uninterruptible Power Supply
US DOT	United States Department of Transportation
WSIB	Workplace Safety Insurance Board

1. INTRODUCTION

1.1 General Introduction

Nordion is a business unit of Sterigenics International, a recognized global leader in contract sterilization services for medical device and pharmaceutical industries. Nordion continues to operate as a stand-alone company and is a major global supplier of radioisotopes used in nuclear medicine for diagnostic and therapeutic purposes, industrial applications, and research and development activities. The Class 1B Facility is comprised of two major production operations, one involving the processing of radioisotopes used in nuclear medicine (Medical Isotopes) and the other involving sealed sources used in cancer therapy and irradiation technologies (Gamma Technologies).

Sterigenics International LLC and Nordion announced entering into an agreement to purchase REVISS Services (UK) Limited and its US subsidiary REVISS Services Inc. on August 16, 2016. The transaction closed and the completion of the acquisition took place on October 25, 2016. Also, effective October 31, 2016, Nordion ceased production and sale of Iodine-125, Iodine-131, and Xenon-133.

Throughout this report, environmental, health and safety (EHS) significance is applied to incidents using the following definitions:

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.

1.1.1 Summary of Production and Operational Limits

Nordion's license NSPFOL-11A.00/2025 does not include any production and operational limits. Operational limits for cells, gloveboxes, and fume-hoods are specified in a Nordion internal procedure.

1.1.2 Summary of Performance

In 2016, Nordion's operations were in compliance with the Nuclear Safety and Control (NSC) Act, regulations, and conditions of its site license NSPFOL-11A.00/2025, with the exception of 32 noncompliances, 10 of which were reportable.

The 11 reportable incidents (refer to Appendix A) were related to:

- Transport (Seven incidents each assessed as low risk)
- A wipe test of a sealed source with results greater than 200 Bq (One incident assessed as low risk)
- Dosimeters that inadvertently received readings that reached action levels (One incident assessed as medium risk)
- A small fire in a power supply unit (One incident assessed as medium risk)

In 2016, occupational incidents were divided into two separate categories of Medical Treatment Injuries and Lost Time Injuries. The targets for these measures were ≤ 6 and 0 respectively. There were three Medical Treatment Injuries and three Lost Time Injuries in 2016. The details of these incidents can be found in Section 2.8.4. The concept of Hazard Identifications and a method by which employees could report them was also introduced. A Hazard Identification is a situation where an unsafe condition, act, behaviour, or other operational deficiency that does not fall under the Near Miss definition is observed. There continues to be focus on promoting ergonomics, safety awareness, Near Miss reporting and Hazard Identifications.

There has been an increase in the reporting by personnel of Near Miss situations and the identification of hazards which is attributed to the continued growth in safety culture as well as the implementation of a new EHS compliance management tool that makes this reporting easier to perform.

The EHS program performance objectives are reviewed at the Annual Joint Environmental Management System (EMS) and Quality Assurance (QA) Program for Safety Review. Refer to Section 2.3.1 for a summary of the EHS Objectives and Targets for 2016.

1.1.3 Summary of Activities

A number of facility modifications took place in 2016. Refer to Section 1.2.3.

In April 2016, Nordion posted on our external website the Annual Compliance and Operational Performance Report to the CNSC for the reporting period of January to December 2015.

By the end of 2016, all required employees completed training on new EHS compliance management software. The software is now being used to track and manage regulatory commitments and related action items, incidents, near misses and hazard identifications.

In December 2016, the implementation was completed of Nordion's Systematic Approach to Training (SAT) program which built on Nordion's previous systematic training program and introduced a formal process for conducting a training needs analysis.

On June 24 2016, Nordion performed a full scale emergency drill which incorporated several unanticipated incidents including, fire, injury, radiation contamination, trespassers, etc. Nordion emergency response participants worked in conjunction with first responders ensuring the success of the activity. CNSC was present as observers.

In 2016, significant improvements were made to the Emergency Response Plan to incorporate required elements of the REGDOC 2.10.1 "Nuclear Emergency Preparedness and Response".

1.1.4 Issues and Corrective Actions

There were no major incidents in 2016. Refer to Appendix A.

1.1.5 Reportable Incidents

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

1.1.6 Compliance with Other Regulatory Agencies

During 2016, Nordion reported four exceedances of the City of Ottawa Sewer Use by-law (2003-514). The following parameters were identified:

- petroleum hydrocarbons
- formaldehyde
- nonylphenols and nonylphenol ethoxylates
- phosphorous
- total kjeldahl nitrogen (TKN)

The source of the minor amounts of petroleum hydrocarbons was identified and quickly corrected. This was resolved by installing oil/grease interceptors in shipping/receiving areas within the building. The phosphorous was determined to likely be a result of cleaning activities conducted at the time of sampling. At the time this sample was taken it was noted

that there was low flow in the sanitary system. With regards to the total kjeldahl nitrogen (TKN), it was suspected that this may have also been a result of low flow in the sanitary system at the time samples were taken, leading to samples consisting of sitting water from the drainage system. In discussions with the City of Ottawa with regards to the parameters nonylphenols, nonylphenol ethoxylates and formaldehyde, they indicated they are in the processes of reviewing the current by-law limits for these parameters and changing the limits for these parameters. The City of Ottawa had indicated they were not concerned with these releases.

Nordion reports to the Workplace Safety Insurance Board (WSIB) whenever a reportable occupational injury or illness occurs. In 2016, there were four medical treatments and two lost-time incidents reported to the WSIB. WSIB may inspect Nordion's Occupational Health and Safety programs at any time; however, no inspections were held in 2016.

In compliance with Part II of the Canadian Labour Code, six disabling injuries were reported to Employment and Social Development Canada (ESDC). Details of the six injuries are provided in Section 2.1.4.

1.2 Facility Operation

1.2.1 Facility Operation

The facility operated according to applicable design criteria in 2016. There were no investigations in 2016 related to facility design.

1.2.2 Personnel Performance

The number and significance of corrective actions preventative actions (CAPAs) related to training and human error is an indication of how effectively personnel performed compared to their duties and how well personnel followed procedures. CAPAs typically arise from internal audits, investigations, or external regulatory compliance inspections. During 2016, there were 37 EHS CAPAs with none were related to human error and four related to training.

Three of the training related CAPAs were assessed as having low risk and one was assessed as having medium risk. The medium risk CAPA involved implementing mandatory pre-operation "Circle Checks" for all motorized lifting devices. The other three low risk CAPAs related to the addition of legacy non-production radioactive material inventory (NPRMI) and leak test schedule, an error in Sealed Source Tracking System (SSTS) reporting caused by a delay in shipment, and improper documentation practices on daily contamination survey records.

1.2.3 Summary of Modifications and Repairs

Modifications and repairs that were carried out in 2016 included:

- Replacement of a medium voltage load breaker switch in the Kanata Operations Building (KOB) electrical room
- Upgrade motor controls on plant chillers to variable frequency speed control
- Installation of reheat coil for air handling unit (AHU) #40
- Installation of recirculation pumps(glycol) at AHU #1 and #3
- New Autoclaves in Rooms 1561 and 1228A in the KOB
- Chiller Upgrade; refurbishment project as part of necessary maintenance

1.2.4 Internal and External Audits

As part of the QA Program for Safety and the Environmental Management System (EMS), Nordion annually conducts internal audits to identify and correct environmental, health and safety related issues. In 2016, Nordion conducted a total of 20 internal EHS audits. These audits included an audit of production areas and supporting functions as well as policy and program audits. In addition, as part of its inspection program, Nordion conducted a total of 11 health and safety inspections, and 16 environmental and fire inspections.

In 2016, there were a total of 20 internal audits, three external audits, and two external audit conducted by Nordion. Out of a total of 37 EHS related CAPAs initiated in 2016, 14 CAPAs were a result of minor findings from internal audits and six CAPAs were a result of external audits. The remaining CAPAs resulted from investigations or to address observed deficiencies. A list of the internal audits and associated EHS CAPAs are provided and tabulated in Section 1.2.4.1.

1.2.4.1 Internal Audits

The following internal audits were conducted in 2016:

1. Process Audit of Facilities.
2. EMS Program.
3. Safety Program.
4. Internal EHS Audit Program.
5. Design Control and Change Control.
6. Safeguarded Physical Inventory Taking (PIT).
7. Non-production Radioactive Material Inventory (NPRMI).
8. Radiation protection program for servicing work conducted in New York State.
9. Advance Shipping Notice (ASN) Quote and PO.
10. Access Authorization Program.
11. Import/Export Controls Program.
12. Source Return Statement.
13. Transport.
14. Radiation Safety Program.
15. Conventional Health and Safety Program.
16. Fire Protection Program.
17. Sealed Source Security (Transport Security Plans).
18. Document Control and Records.
19. Procurement.
20. Process Safety Audit for C-188 Production.

Below is a summary of the CAPAs associated with the internal audits conducted in 2016:

Audit Title	# of CAPAS	CAPA #	Finding	Corrective Action	Status
Non-Production Radioactive Material Inventory (NPRMI)	4	170109	Low activity source in Cobalt Operations not located.	Create work instruction on how to package check sources.	In-progress
		170110	Three sources were incorrectly listed in inventory.	Implement monthly inventory reviews and electronic notification of changes within the tracking system.	In-progress
		170111	Count put into the tracking system for sources in one department was not performed in 2016.	Clarify responsibility for the entry in the tracking system.	In-progress
		170112	Count input into the tracking system for sources in one department not performed since June 2016.	Revised procedures to detail how the sources in this one department are managed.	Completed
Transport	1	160502	F168 Container Inspection Form was not reviewed by the Technical Design Authority (TDA) prior to releasing the package.	Create new document for inspection of transport packages with enhanced responsibilities section with respect to approvals.	In-progress
Radiation Protection Program	1	161011	Contractor was observed working in High Caution Area without wearing Personal Protective Equipment (PPE).	TBD	In-progress
Conventional Health & Safety Program Audit	5	170104	Requirement of Biosafety Risk Assessment for common pathogens has not been met.	TBD	In-progress
		170105	Delayed near miss reporting by two weeks after the occurrence.	Revised reporting timeframe in investigation procedure with a more reasonable reporting requirement.	Closed
Conventional					

Audit Title	# of CAPAS	CAPA #	Finding	Corrective Action	Status
Health & Safety Program Audit (Con't)		170106	Floor drill press was not securely anchored to the floor.	Installed a stabilization platform on the drill press in the Carpentry Shop.	Closed
		170107	Annual calibrations were not performed on some pressure reducing regulators in non-active area.	TBD	In-progress
		170108	Daily safety inspection log books for cranes were not up to date.	TBD	In-progress
Sealed Source Security	1	160702	Requirements of REGDOC 2.12.3 with regards to repairing locks, maintenance of security alarms and password protection and secure storage of transport security plans are not being met.	Revised Security procedures to address discrepancies.	Closed
Document Control and Records	2	161002	Daily Contamination Survey records were not filled out according to Good Documentation Practices (GDP).	Ensure all staff completes Good Documentation Practices (GDP) training and revise applicable procedures.	In-progress
		161004	A document periodic review was not completed by due date.	Review all Emergency Response documents to ensure that ownership is current and correctly assigned.	In-progress

1.2.4.2 External Audits of Nordion

The following external audits of Nordion were conducted in 2016:

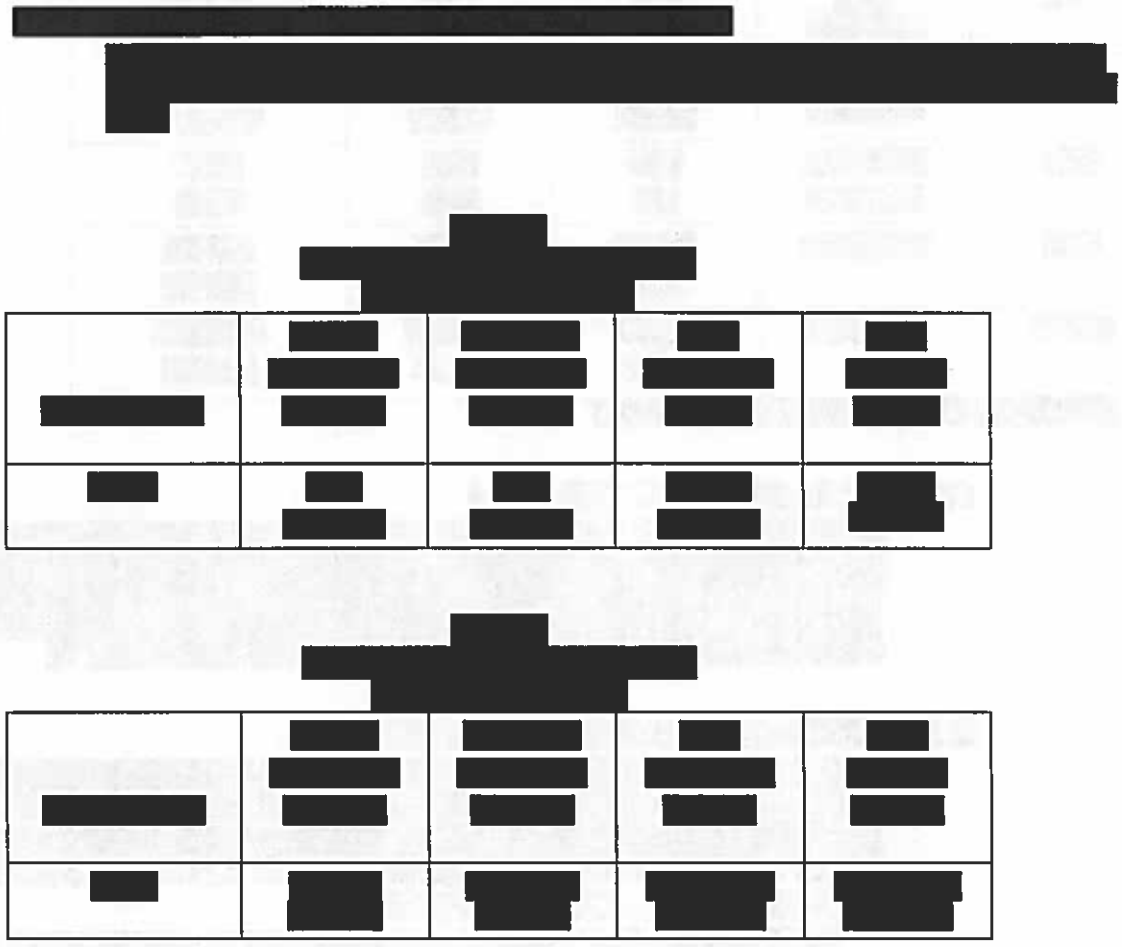
1. On May 25-30, 2016 a third party conducted a continuing assessment (surveillance) audit against the requirements from the ISO 14001:2004 standard. There were two findings identified.
2. On September 7-9, 2016 the CNSC conducted a Management System inspection of several safety and control areas. The inspection resulted in four action notices and one recommendation.
3. On October 24-25, 2016 the CNSC conducted an inspection of Nordion's Export Licensing requirements. The inspection resulted in three directives and three recommendations.

1.2.4.3 External Audits Conducted by Nordion

Nordion conducted two EHS audits of suppliers in 2016. There were four corrective actions identified during these audits.

1.3 Production or Utilization

Activities conducted in the Kanata Operations Building (KOB) relating to the procurement, possession, processing and shipping of radioactive materials are conducted under Nuclear Substance Processing Facility Operating Licence, NSPFOL-11A.00/2025. The facility is comprised of the KOB, which houses the Nuclear Medicine Production Facility (NMPF) the Cobalt Operations Facility (COF), and the Kanata Radiopharmaceutical Manufacturing Facility (KRMF).



[redacted]

[redacted]

1.4 Facility Modifications

1.4.1 Changes to the Facility Buildings, Processes and Equipment

1.4.1.1 Changes to Designated Active Area

In 2016, Nordion made no changes to designated Active Areas.

1.4.1.2 Structural/Functional Changes Affecting Emissions

In 2016, Nordion made no structural/functional changes that affected the emissions of the facility.

1.4.1.3 Structural/Functional Changes Affecting Active Area Ventilation

In 2016, there were no structural or functional changes that would have affected active area ventilation.

1.4.1.4 Structural/Functional Changes Affecting the Active Liquid Waste System

In 2016, Nordion made no changes that affected the active Liquid Waste System.

1.4.2 Changes to Procedures Related to Operations Safety and Control

In 2016, the following changes were made to procedures related to operational safety and control:

- SE-EHS-007 "Fire Protection Program – Nordion Ottawa Site"
  Addition of fire barrier inspections to reflect current practice
- P-310 "Supplier Qualification Program"
  Addition of an EHS assessment when onboarding new approved suppliers
- SE-LIC-016 "Management of Safeguarded Material"
  Addition of a warning to ensure Non-Production Radioactive Material Inventory (NPRMI) sources are not deselected in the inventory tracking system when conducting a cycle count
- SE-LIC-013 "Physical Inventory Taking and Verification of Safeguarded Material"
  Addition of instructions for managing non-Nordion owned DU transport packages and labeling of safeguarded material
- QAP-AP-45 "Change Control Procedure"
  Revised to implement a written notifications process for Licensing Documents
- SE-ERP-001 "Fire Safety Plan"
  Updated to reflect the "General Nuclear Safety and Control Regulations"
- SE-ERP-011 "Radiation Safety Response Plan"
  Revised to align with new Emergency Response Incident Management System
- SE-LIC-001 "Quality Assurance Program for Safety"
  Revised to align with CSA Standard N286-12,"Management System Requirement for Nuclear Facilities"

1.4.3 Changes to the Organizational Structure and Key Personnel

In March of 2016, the position of Safety Manager was eliminated and the related responsibilities transferred to the Manager, EHS and Documents & Corporate Records. In September of 2016, the President of Nordion (Canada) Inc. retired and was replaced with an interim President until a successor is determined.

In 2016, EHS personnel were organized into a Gamma Technologies – EHS Compliance Group and a Medical Isotopes – EHS Compliance Group. The personnel of these two groups are outlined below. All of the positions for Gamma Technologies - Compliance are corporate wide functions supporting both businesses, with the exception of the Administrative Assistant. A full list of key EHS personnel is included below:

Gamma Technologies – EHS Compliance

- Director, QA EHS Compliance
- Administrative Assistant
- Manager, Corporate Security & Emergency Management
- Contract Security Supervisor
- Contract Security Officers (16)
- Senior Manager, Facility Nuclear Compliance
- EHS Assistant
- Senior Manager, Transportation Licensing & Gamma Radiation Safety
- Nuclear Transportation Specialist
- Senior EHS Compliance Specialist
- Senior Licensing Coordinator
- EHS Compliance Specialist (3)
- EHS Compliance Specialist Term Position (1)
- Training Specialist
- Manager, EHS and Documents & Corporate Records
- Occupational Health & Safety Specialist
- Safety Specialist Term Position (1)

Medical Isotopes – EHS Compliance

- Vice-President, QA Regulatory & EHS Compliance
- Senior Manager, Radiation Safety & Compliance
- Senior Radiation Surveyor (2)
- Radiation Surveyor (4)
- Senior Radiation & Contamination Monitor (3)
- Radiation and Contamination Monitor (3)

1.4.4 Changes to the Training Programs

In 2016, Nordion completed the transition to and implementation of a Systematic Approach to Training (SAT). The completion of this transition is in accordance with Nordion's License Conditions Handbook which requires that Nordion be in compliance with CNSC Regulatory Document 2.2.2, Personnel training, by December 31st, 2016.

To meet this requirement, Nordion finalized the following SAT items in 2016:

- Revision of one key EHS training course (Contractor EHS Training Level 1)
- 11 Job Task Analysis and revision to existing training programs, for roles that have embedded safety related tasks, but core role is not a safety function
- Creation and implementation of two compliance awareness courses for personnel with roles related to reporting to the CNSC Sealed Source Tracking System (SSTS)

Separate from the implementation of SAT, Nordion released one new EHS self-directed training course on Fire Prevention & Safety for all new employees.

2. SAFETY AND CONTROL AREA

2.1 Management System

2.1.1 Review of Quality Assurance/Management Program Activities

In 2016, Nordion conducted a total of twenty (20) internal EHS audits at the Ottawa site. A summary of these audits and their findings can be found in Section 1.2.4.1.

2.1.2 Review of Quality Assurance/Management Program Effectiveness

The annual management review of the Environmental Management System and the QA Program for Safety was conducted June 27, 2016.

The management review involves the evaluation of actions from the previous meeting, the Environment, Health & Safety Policy (CPM-6-06), adequacy of resources, environmental health and safety objectives and targets, changing circumstances and recommendations for improvement.

Results of the 2016 Annual Review:

1. Six out of the ten outstanding actions from the previous meetings were completed and closed. The remaining four items included:
    a. holding a discussion regarding measurement of Human Performance,
    b. reviewing non-conformance processes to ensure there is an appropriate level of EHS involvement,
    c. reviewing with the Facilities department how EHS can be engaged when safety related structures, systems, or components are unexpectedly removed from service, and
    d. creating a complete listing of standards that Nordion is responsible for complying with.
2. The Environment, Health and Safety Policy (CPM-6-06) was reviewed and it was determined that the policy did not require further review and update.
3. The 2015 EHS Performance Report was reviewed and discussed. This report assesses the performance related to the 14 Safety and Control Areas over the past three years where this information was available. The findings that contributed to these trends have been addressed with CAPAs being initiated as a result.
4. The 2016 EHS Objectives and Targets were reviewed by the Committee. At the time, the environmental objective to investigate ways to reduce energy was still in progress, but the remainder of the objectives were on track.
5. It was mentioned that the 2017 EHS Objectives and Targets were to be discussed closer to the end of the year in December.
6. Resource requirements for the Environmental Management System and QA Program for Safety were discussed. The Committee agreed that the programs are resourced adequately to ensure that critical issues are being addressed. Financial and specialized skills resources were felt to be adequate.

There were 13 recommendations during the meeting. The EHS Committee made five recommendations for improvement with regards to the Performance Report. The Committee concluded that the EHS management system (the Environmental Management System and the QA Program for Safety) is effective.

2.1.3 Summary of Quality Assurance/Management Program Improvements

In 2016, the Quality Assurance Program for Safety was revised to align with the new CSA Standard N286-12, "Management System Requirement for Nuclear Facilities".

All other changes or revisions made to the Radiation Protection Program, Conventional Health and Safety Program, and the Environmental Protection Program as discussed in Sections 2.7.7, 2.7.9, 2.8.3 and 2.9.6, respectively.

2.1.4 Manager Self-Assessments

All managers who are responsible for processes under Nordion's nuclear licensed activities are required to regularly assess the effectiveness of the management processes for which they are responsible. They are also responsible for assessing their effectiveness at establishing, promoting and achieving safety objectives and targets (nuclear safety, Occupational Health & Safety, and environmental).

In 2016, all 25 managers completed the twice yearly self-assessments for a total of 50 assessments submitted. All issues identified by managers in the self-assessments were addressed appropriately.

2.2 Human Performance Management

The internal performance indicators for Human Performance Management are attendance rate and evaluation of training effectiveness.

2.2.1 Training Program Effectiveness

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 Health, Safety and Environment, Level I, which provides information on the facilities, emergency response procedures and alarms, and basic procedures to follow for safety in the workplace. Nuclear Energy Workers receive a NEW Indoctrination Course. To be authorized to enter the Active Area unescorted, the employee must complete and pass a written test, as evidence of understanding the principles of radiation protection and Nordion safe work practices. NEW retraining and retesting are conducted on a three year frequency. In addition, NEWs are provided with a half day Radiation Instrumentation Workshop, dealing specifically with the selection and use of radiation survey and contamination meters for the Active Area. In 2016, there were no radiation safety incidents nor were there any anomalous TLD readings 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 such topics as "Working with Radioiodines", 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 Transportation of Dangerous Goods (TDG) requirements. The training program includes a one day classroom training course that is required once on employment or upon job change. Retraining is conducted on a 2-year frequency and is accomplished through self-study. The self-study program is separated into three levels.

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

Additional EHS 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 such topics as "Working with Radioiodines", emergency response awareness, care and use of respirators, material handling training, and working safely with fume-hoods. A summary of the key training programs is provided in Table 4.

Table 4
2016 Safety Training Programs

Program	Duration	# of Participants Requiring Training in 2016	# of Participants who Completed Training in 2016	# Participants with Overdue Refresher Training at the End of 2016
Nuclear Energy Worker (NEW) Indoctrination[3]	6 Hours	18	18	-
NEW Refresher[3]	Self Study	79	79	0
Radiation Instrumentation Workshop[3]	3 Hours	64	64	0
Radiation Safety Review for Operators[3]	Half Day	14	12	2[2]
Radioiodine Handling[3]	2 Hours	31	29	2[1]
Transport of Dangerous Goods Level I[3]	Self Study	1	1	0
Transport of Dangerous Goods Level II[3]	Self Study	9	9	0
Transport of Dangerous Goods Level III[3]	All Day In-Class	26	26	0
TDG for Contractors[3]	Full Day	21	21	0
Working with BETA[3]	1 Hour	50	50	0
Crane	Half Day	46	44	2[1]
Pallet	Half Day	55	54	1[1]
Forklift	Half Day	36	35	1[1]
Contractor Radiation Safety Protection Training[3]	Half Day	12	12	0
Contractor Radiation Safety Protection Refresher[3]	2 Hours	25	24	1[1]
Contractor EHS Training Level I[3]	2 Hours	38	38	0
HEGS Safety Training	2 Hours	4	4	0
In-Depth Security Awareness[3]	2 Hours	2	2	0
Emergency Response Part 1[3]	2 Hours	42	42	0
Emergency Response Part 2[3]	2 Hours	37	37	0
Emergency Response Part 3[3]	2 Hours	7	7	0
Emergency Response: Security[3]	1 Hour	18	18	0
Emergency Response: Site Security Volunteer[3]	1 Hour	14	14	0
Emergency Response: Monitors[3]	1 Hour	11	11	0
SCBA Part 1[3] & 2[3]	1 Hour	57	57	0
TOTAL		**717**	**708**	**9**

[1] On leave
[2] Refresher training completed in January 2017
[3] Key EHS course

In 2016, the number of scheduled participants that required safety training was 717, and by the end of the year, 708 of the scheduled participants completed the training, which included refresher training. Therefore, the attendance completion rate in 2016 was 99% with details shown in Table 4.

2.2.2 Evaluation of Training Effectiveness

Training effectiveness assessment criteria are based on three levels of evaluation: trainee reaction, trainee learning and training results.

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 options: 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.).

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.

Training results is the degree to which targeted outcomes occur as a result of the training. The effectiveness of training results are measured by the EHS significance (high, medium, low) and the frequency of unplanned events documented through processes such as the deviation process, the nonconformance 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.

Nordion's training program was effective in 2016 as:

- 100% of courses had an overall rating of good, very good or excellent. 0% of courses had an overall rating of poor or very poor. Therefore, overall trainee satisfaction is high.
- Training courses were perceived by trainees as engaging and relevant.
- 100% of trainees passed the assessment test for all key EHS training courses and there were no rescheduled tests due to failed attempts.
- There were only nine unplanned events in 2016 for which the root cause was determined to be related to human error or training (seven low and two medium significance)
- There was no trend for recurrence (three or more) of the same unplanned event with the same human error or training root cause.

2.2.3 Verification of Minimum Number of Responsible Personnel During Operations and Similar Activities

Nordion has ensured that the minimum number of responsible personnel is available to provide safety during overnight operations and during emergency situations.

Nordion Security is on site at all times. Radiation Surveyors are always on site when production involving radioactive materials is occurring. Nordion has key emergency response, Facilities and Production Managers on-call at all times. The Incident Manager, or the person in charge of the response, can initiate a call-in of both on-call and regular emergency response personnel. Currently there are approximately 80 Fire Wardens and Marshalls and over 80 other emergency response personnel.

Nordion routinely assesses the availability of qualified staff as part of the Emergency Response Program and through drills and exercises. Nordion tests its emergency call list annually and the results have demonstrated year over year that within one hour of the onset of an emergency, adequate emergency response personnel and at least one representative from each of the key emergency response groups would be available on-site (refer to Section 2.10.4).

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

2.3 Operating Performance

2.3.1 Effectiveness of Licensed Activities

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

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

The 2016 EHS program objectives are shown in Table 5. All of the EHS objectives listed in Table 5 were met in 2016 with the exception of Lost Time Incidents, Lost Time Rate, Severity Rate, Non-Radiological Releases, thyroid attendance rate and timely closure of EHS CAPAs for Medical Isotopes. The number of Medical Treatment Incidents (three) was met and less than the target of ≤6, but the number of Lost Time Incidents (three) was more than the target of 0. The details of these incidents can be found in Section 2.8.4.

In 2016, most of the hazardous occurrences involved repetitive strain injuries from performing routine work as well as slipping and falling. Nordion continues to provide increased focus on ergonomic assessments, proper mechanics training, and awareness to Operations groups. Managers engage in regular safety talks with their teams and continue to emphasize the importance of taking regular breaks to rest muscles and joints and rotating duties, as required, in an effort to avoid repetitive strain injuries.

Severity rate was at 12.17 and Lost Time rate was at 0.61, both of which increased from the previous year and is calculated using lost time over the last three years.

Radioactive materials emissions (0.32% DRL) continue to be well below the target of ≤ 5% DRL, but Non-Radiological releases were above the target of 0 for a total of four in 2016. The details of these releases are found in Section 1.1.6.

The thyroid attendance (89%) was less than the target of 90%. The target is conservative as it is based on meeting all scheduled bioassays, which as biweekly or weekly depending on the role, and not the minimum required thyroid bioassay frequency which is monthly. The majority of weekly and biweekly bioassays were attended in 2016. A drop in attendance could also be attributed with the cease in production of iodine. Nordion continues to monitor attendance rate, but has removed this leading indicator as a target with the decrease in population base.

The target of 80% of generated CAPAs closed within 1 year was not met for Medical Isotopes as there were three historical low risk CAPAs initiated in previous years that continued to be open throughout 2016 (one open greater than one year and two open greater than 2 years) out of a small total number of CAPAs open in 2016. The three CAPAs were closed in 2016.

The remainder of the EHS Targets and Objectives were met for 2016 and Nordion reported diverting 76% of waste from landfills, maximum employee dose rates well under the target of ≤ 7.5 mSv/yr and completing a supplier audit by the end of 2016.

Table 6 shows Health and Safety Objectives that Directors and Managers and employees of high risk areas are expected to meet. A system is in place to ensure that the performance reviews are completed. CAPAs greater than twelve months are reviewed in the QA CAPA Review Board meetings as well as the EHS Committee meetings. They are also reviewed monthly by senior management.

Manager self-assessments are performed twice a year and the completion of which are audited annually. Deviations, Change Forms and complaints are reviewed yearly at the Annual Joint Environmental Management System and QA Program for Safety review.

Table 5
2016 EHS Program Objectives and Results

Applicable Nordion Job Function	Objective	Measures and Targets	Result
All Directors and Managers All Directors and Managers of Operations, Facilities, or Nuclear Energy Worker employees	Minimize the number and extent of occupational injuries, environmental and radiation incidents.	• Number of Medical Treatment Incidents ≤ 6 • Number of Lost Time Incidents = 0 • Lost Time Accident Rate ≤ 0.5 per 200,000 hours worked (3-yr rolling) • Severity Rate ≤ 4 days per 200,000 hours worked (3-yr rolling)	3 Incidents 3 Incidents 0.61 12.17
	Minimize the use and release of hazardous materials to the environment.	• Radioactive materials emissions to ≤ 5.0% of the Derived Release Limits (DRL) • No Noncompliant Releases (Radiological or Non-Radiological) • Reduce non-hazardous waste to landfill • Audit one supplier whose goods/services could impact the environment • Reduce particulate matter air emissions from glass blowing process.	0.32 % DRL 3 Noncompliant releases (Non-radiological) 76% Waste was diverted from landfill Audited supplier on Dec 20, 2016 Target moved to end of 2017 due to a significant reduction in production in this area
	Maintain radiation doses to employees as per ALARA principle.	• Maximum employee dose rate ≤ 7.5 mSv/yr (12 mo. rolling) • Thyroid testing attendance >90% (Medical Isotopes)	2.32 mSv/yr (Medical Isotopes) 4.9 mSv/yr (Gamma Technologies) 89%*
	Timely closure of EHS CAPAs.	• Target of 80% of generated CAPAs are closed within 1 year	57%* (Medical Isotopes) 80%* (Gamma Technologies)

*Average taken over the year.

Table 6
2016 Health and Safety Objectives

Applicable Nordion Job Function	Objective	Measures and Targets
All Directors and Managers All Directors and Managers of Operations, Facilities, or Nuclear Energy Worker employees	Timely closure of EHS CAPAs.	• Meet all CAPA target dates. • Ensure timely closure of EHS CAPAs.
	Ensure all managers of high risk areas conduct / document regular self-assessments of their management processes and safety performance.	• Mid-Year and Year-End performance reviews. • Ensure the departmental job hazard analysis is kept up-to-date.
	Ensure that all managers actively consider the impacts to the environment and health and safety	• Environment, health and safety impacts are assessed as part of product realization planning and risks are mitigated through application of ALARA and pro-active planning. • Identify opportunities for minimizing waste (hazardous and non-hazardous) are assessed and implemented whenever possible. • Ensure all near-misses are reported in a timely manner and appropriate corrective action(s) are taken. • Maintain control of non-production radioactive material.
	Communicate monthly with teams about environment, health and safety performance and impacts. Openly evaluate employee environment, health safety concerns and encourage reporting of near misses.	• Environment, health & safety information and concerns are discussed regularly at team meetings. • Health and safety concerns are assessed with the results of the evaluation communicated to the employee(s). • Deviations, CF's, Non-conformances and Complaints are assessed for EHS risks against targets and reported accordingly. • Routinely invite EHS Representatives to team meetings to discuss EHS topics and/or concerns.
All High Risk Employees	Prioritize working safely at all times.	• It is unacceptable to take risks in order to get the job done. Personal safety is ever employee's highest responsibility. • Work must follow Nordion's EHS training, standards and procedures, and is performed with care and attention to safety principles and policies. • Wear all applicable personal protective equipment (PPE) as necessary. • Bring all safety concerns or questions to the attention of the direct Supervisor or EHS. • Submit all dosimeter(s) and rings for monitoring on time (no later than one month) following end of monitoring period.

Applicable Nordion Job Function	Objective	Measures and Targets
All High Risk Employees	Report all workplace injuries, unsafe conditions and near misses.	• All workplace injuries, suspected injuries, observed unsafe conditions and near misses are reported immediately to the direct Supervisor. • Report any suspected symptoms to your Supervisor or identify problems before they become injuries.
	Encourage and assist co-workers in adopting safe work practices.	• Following Nordion values and safety policies, coach co-workers who are observed to be working unsafely.
	Safety Talks	• Full participation and engagement during team safety talks by asking questions and voicing concerns.
	Reduce environmental impacts.	• Identify opportunities for reducing waste, and using less harmful materials wherever possible. • Ensure EHS reviews and approves all new hazardous or environmentally harmful materials prior to ordering as well as any equipment designed to contain these materials. • Zero reportable releases of radioactive or non-radioactive hazardous materials to the environment.
	Timely closure of EHS CAPAs.	• Target 80% of generated CAPAs are closed within 1 year • Meet all CAPA target dates. • Prioritize high risk EHS CAPAs.

2.3.2 Effectiveness in Implementing Operational Controls

EHS operational controls are documented in a specific series of documents (SE-OP 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.

2.3.3 Summary of Safety Inspections and Audits

Refer to Section 1.2.4 for a summary of the safety inspections and audits.

2.3.4 Radiation Devices and Instruments Maintenance

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

2.3.4.1 Ventilation

Duplex fan tests are conducted every 6 months. This involves testing of more than 100 fans which form part of the Nuclear Ventilation System (NVS). During 2016, all High Efficiency Particulate Air (HEPA) filters were tested at the required frequency. CAD filters were tested once, which meets the minimum testing frequency of once annually.

Table 7 details the results of the Nuclear Ventilation System Filter testing and replacement. The filters summarized in Table 7 are credited with mitigating releases in Nordion's Safety Analysis reports.

Table 7
NVS Filter Efficiency Testing/Replacements

	Q1/Q2 HEPA	Q1/Q2 CAD	Q3/Q4 HEPA	Q3/Q4 CAD
Filters in fleet	239	73	239	73
Number tested	237	67	237	67
Filters which met specification	237	67	237	63
Filters out of specification*	0	0	0	4
Out of specification filters replaced during test cycle	0	0	0	4
Not tested	2	6	2	6
Total replaced during this cycle	0	4	0	5
Filters (systems) removed from service	0	0	0	0
New Filters (systems) Added	0	0	0	0

* The four CAD filters that were out of specification were on System 13. The failures did not result in any apparent increase to releases.

Comments Q1/Q2 HEPA: Two filters were not tested as one of them is not in service and the other is inaccessible.

Comments Q1/Q2 CAD: Six trench filters were not tested, but are changed every three years. Due to their inaccessibility and potential radiation hazard, these trench filters are replaced every three years in lieu of testing as per procedure. Four CAD filters were changed out due to their shelf life expiration. An in-situ lab test was performed prior to and after installation of the four new filters. The filters passed the testing. Since there was no radioiodine processing and storage in the KRMF/Radiopharmaceutical facilities, 21 CADs servicing those areas have had their pass criteria removed. These filters remain in-situ and are tested regularly to research the filter performance.

Comments Q3/Q4 HEPA: Two filters were not tested as one of them is not in service and the other is inaccessible.

Comments Q3/Q4 CAD: Six trench filters were not tested, but are changed every three years as per procedure. One CAD filter was changed out due to its shelf life expiration and four failed. An in-situ lab test was performed prior to and after installation of the five new filters. The filters passed the testing. Due to lack of radioiodine processing and storage in the KRMF/Radiopharmaceutical facilities, 21 CADs servicing those areas have had their pass criteria removed, but continue to be tested regularly to research the filter performance.

Nuclear Medicine in-cell charcoal roughing filters are on a preventative maintenance schedule and replaced typically every six months. These filters are not credited with mitigating releases in Nordion's Safety Analysis reports.

2.3.4.2 Back-up Power Facilities

The emergency generators, which supply emergency power to the KOB, KRMF and the Heating Plant are tested monthly. Testing in 2016 was performed at the required frequency.

2.3.4.3 Radiation Evacuation Alarms

Radiation evacuation alarms are tested weekly and quarterly by the Radiation Surveyors. They are additionally tested annually by Facilities. Testing in 2016 was performed at the required frequency and results were satisfactory.

2.3.4.4 Radiation Alarms

The radiation alarms are scheduled for testing on a weekly basis and were tested every week in 2016. The tests verify that the alarms sound at the pre-set alarm levels and that the alarms register on the Metasys monitoring system. If the alarms do not function as required, adjustments to the alarm levels and/or the Metasys are conducted immediately by Facilities. The results were satisfactory.

2.3.4.5 Sprinkler System Fire Alarms

The sprinkler system fire alarms in KOB, KRMF and the Heating Plant are tested every month. Testing in 2016 was performed at the required frequency and results were satisfactory. All dry systems were tested and verified in good operating condition in 2016 as required by the National Fire Protection Association (NFPA).

2.3.4.6 Fire Alarm Panels

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

The fire alarm panels that monitor the KOB, KRMF and the Heating Plant are tested monthly. Testing in 2016 was performed at the required frequency and results were satisfactory.

2.3.4.7 Contamination Monitoring Equipment

Handheld contamination monitoring equipment is maintained twice a year. Area monitors are checked on a daily basis. Testing in 2016 was performed at the required frequency and results were satisfactory.

2.3.4.8 Contamination Control Equipment

The hand and foot monitors are calibrated twice a year, tested weekly and serviced on a routine basis. They are also repaired as required, which is typically two to three times a year. Testing in 2016 was performed at the required frequency and the results were satisfactory.

2.3.4.9 Environmental Monitoring Equipment

Environmental monitoring equipment is tested on a weekly basis. If required, repairs to equipment are carried out immediately after the testing by Facilities personnel or in some instances the Surveyor. In 2016, a total of 27 work orders were generated for issues that were identified during weekly equipment testing.

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

Six work orders involved issues with air sampling pumps; however, these issues were at locations considered to be of secondary importance and alarms on the Building Management System (BMS) are not triggered for failure of these pumps. In several instances, the air sampling pumps were replaced immediately.

Five work orders were generated for an alarm signal not registering at the BMS. These five issues may have occurred as a result of a lag between the device alarming in the field and the alarm registering on the BMS which requires the Surveyor to hold the radioactive check source for a few seconds longer then it takes to alarm the device locally. The Surveyor has since been informed of the correct method.

Four work orders were generated due to meter or probe faults. As probes begin to fail the number of counts detected will begin to decrease over time. The weekly testing helps identify failing probes so they can be changed prior to complete failure.

The three remaining items were general hardware related issues.

Overall the results were very good. Device failures found on weekly testing were at locations where the likelihood of a real alarm is low and there is no necessity, based on safety, to have these devices on the BMS. Examples of these low priority device failures include pump failures in the South fresh air intake and rooms where traditionally there is never or extremely rarely airborne contamination.

2.3.4.10 Radiation Survey Instruments

Radiation Survey Instruments are tested on a monthly, bi-annual, or annual basis as required. In 2016, for all of the 814 calibrations performed, the "As Found" results did not constitute a safety or regulatory concern. Testing in 2016 was performed at the required frequency and the results were satisfactory. At the end of 2016, there were six out of 814 survey meters past due for the internal frequency requirements, some due to them requiring repair. These past-due meters were not in use. The majority of meters are calibrated every six months. The regulatory requirement for calibration frequency is 12 months, and though Nordion employees do not use meters past the calibration due date (typically six months), none of the six meters were past due for longer than 12 months. All of the six meters have since been calibrated.

2.3.4.11 Trends

There were no trends identified. Some equipment did have repeated unscheduled maintenance on up to three occasions during the year, but for each of them, the maintenance occurrences were unrelated, and as such, did not require further remedial action.

2.3.5 Non-Production Sealed and Un-Sealed Source Inventory

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

2.3.6 Effectiveness of the Nuclear Criticality Safety Program (NCSP)

Not applicable.

2.3.7 Emergency Drills Related to Nuclear Criticality

Not applicable.

2.4 Safety Analysis

Nordion has an established EHS Committee comprised of senior management and technical professionals and is chaired by the Director, Quality Assurance Environment Health and Safety Compliance, or designate. The EHS Committee reviews new/amended processes which might have an impact on health, safety, and environment. Activities that relate specifically to CNSC licensing and the radiation protection of workers, the public and the environment, are addressed in the EHS Committee meetings which are typically held on a bi-monthly basis with ad hoc meetings arranged as required. Typical agendas include Safety Analysis Reports, Operational Experience (OPEX) significant changes (repairs/modifications) to existing facilities, Radiation Incident Report reviews, safety procedures, and review of CNSC licensing requirements (radiation monitoring, As Low As Reasonable Achievable (ALARA) program, emissions, dosimetry, project approval, etc.).

In 2016, the EHS Committee met on nine occasions (six regular meetings and three ad hoc meetings).

Final Safety Analysis Reports (FSARs) are prepared by EHS and/or project leaders to encompass risk analysis and safety and environment reviews. FSARs must be approved by the EHS Committee before a new process goes into full production. Primary focus is placed on the Nuclear Medicine Production Facility (NMPF) FSAR, the Cobalt Operations FSAR, and the Cobalt Pools FSAR since these are three main documents covering the production operations. Revisions to these documents are reviewed and approved internally, and submitted to the CNSC for acceptance. Secondary FSARs (for each individual production process and operational support areas) are reviewed and approved internally as per an established review schedule.

[redacted]

Summaries of the activities and modifications and repairs are provided in Sections 1.1.3 and 1.2.3 respectively.

[redacted]

2.5 Physical Design

In 2016, Nordion did not make any modifications to the 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 2016, there were no significant design issues identified through these reviews. Overall, Nordion's facility design has been maintained and continues to be effective with no planned changes or upgrades in the future.

2.6 Fitness for Service

The management of Nordion's Preventative Maintenance Program was not altered in 2016. Nordion continues to use an "Advanced Maintenance Management System" (AMMS) to control Nordion's maintenance activities. Maintenance performance is reviewed monthly for outstanding activities and is acted on by team leaders. This continues to prove effective as during 2016, there were no major equipment failures.

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 takes into account three criteria: safety of the facility, regulatory requirements and site improvements. Projects are prioritized into three categories and funds are allocated as required to approved projects. 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.

The work identified during the 2016 review included the following:

- Upgrade of the computerized Building Management System (BMS)
- Continuation of the KOB roof replacement program
- Installation of an additional Miura Boiler to service the Cobalt Operations area
- Securing of external institutional waste bins
- Installation of additional fire suppression for the Information Technology Rooms
- Resurfacing of Active Area floors
- Seismic upgrade of Nuclear Ventilation System (NVS) as part of continuous improvement project
- Replace condenser pumps motor controls with variable frequency speed control

When approved, the work identified during the aging equipment review is executed as a project. In 2016, the required equipment was available to perform its intended design function when needed. Refer to Section 2.3.4.1 to 2.3.4.11

2.7 Radiation Protection

2.7.1 Dose Control Data

2.7.1.1 Occupational External Dosimetry

Tables 8 and 9 provide dosimetry data to the public and with employees grouped in various ranges of exposure. Data on the minimum, maximum and average doses for all employees are shown in Tables 10, 11 and 12. In 2016 there were 140 Active Area personnel monitored, 127 non-Active Area personnel in these tables. Of the 127 non-Active Area personnel 13 support industrial irradiators (containing Co-60) at customer sites, these are included in the Class 1B licence dosimetry as they may also receive dose from work at KOB during the dosimetry year.

Table 8
Personnel Dosimetry

Number of Employees										
Dose Range (mSv)	Whole Body					Skin				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
< 0.2	187	197	175	170	141	186	184	173	171	127
0.2 - < 0.5	41	25	34	40	62	40	37	30	37	59
0.5 - < 1.0	28	24	21	19	27	30	25	24	21	32
1.0 - < 5.0	36	36	37	34	37	36	36	40	34	48
5.0 - < 20.0	1	2	2	1	0	1	2	2	1	1
20.0 - < 50.0	0	0	0	0	0	0	0	0	0	0
> 50	0	0	0	0	0	0	0	0	0	0
Number of Employees										
Dose Range (mSv)	Right Hand					Left Hand				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
< 0.2	105	103	98	108	59	106	102	100	105	53
0.2 - < 0.5	15	6	5	8	20	15	7	2	9	21
0.5 - < 1.0	5	10	10	2	18	4	7	5	3	25
1.0 - < 5.0	16	17	15	18	27	15	19	22	18	24
5.0 - < 20.0	5	4	7	2	3	4	3	5	2	4
20.0 - < 50.0	0	0	0	0	0	0	0	0	0	0
> 50	0	0	0	0	0	0	0	0	0	0

Table 9
Breakdown of Whole Body Radiation Doses 5.0 to < 20 mSv

Year	Dose Range			
	5<8 mSv	8<10mSv	10<15 mSv	15<20 mSv
2012	1	0	0	0
2013	2	0	0	0
2014	2	0	0	0
2015	1	0	0	0
2016	0	0	0	0

Table 10
Minimum, Maximum and Average Worker Effective Doses (mSv)

		Active Area Personnel (NEWs)	Non-Active Area Personnel (NEWs)	Non-NEWs (Contractors)
Minimum	2012	0	0	0
	2013	0	0	0
	2014	0	0	0
	2015	0	0	0
	2016	0	0	0
Average	2012	0.56	0.13	0.03
	2013	0.59	0.12	0.03
	2014	0.65	0.14	0.09
	2015	0.56	0.16	0.03
	2016	0.75	0.2	0.08
Maximum	2012	5.19	1.36	0.21
	2013	6.39	1.48	0.27
	2014	6.03	1.73	0.31
	2015	5.24	1.88	0.13
	2016	4.9	2.06	0.36
CNSC Regulatory Limits		**50/yr; 100/5yr**	**50/yr; 100/5yr**	**1/yr**

Table 11

Minimum, Maximum and Average Skin Exposure Doses (mSv)

		Active Area Personnel (NEWs)	Non-Active Area Personnel (NEWs)	Non-NEWs (Contractors)
Minimum	2012	0	0	0
	2013	0	0	0
	2014	0	0	0
	2015	0	0	0
	2016	0	0	0
Average	2012	0.61	0.12	0.04
	2013	0.6	0.15	0.03
	2014	0.69	0.15	0.07
	2015	0.58	0.16	0.03
	2016	0.92	0.22	0.07
Maximum	2012	5.19	1.41	0.23
	2013	6.39	2.89	0.28
	2014	6.11	1.78	0.31
	2015	5.21	1.9	0.12
	2016	5.2	2.09	0.39
CNSC Regulatory Limits		**500/yr**	**500/yr**	**50/yr**

Table 12
Minimum, Maximum and Average Extremity Doses (mSv)

		Active Area Personnel (NEWs)	Non-Active Area Personnel (NEWs)	Non-NEWs (Contractors)
Minimum	2012	0	0	N/A
	2013	0	0	
	2014	0	0	
	2015	0	0	
	2016	0	0	
Average	2012	0.54	0	
	2013	0.54	0	
	2014	0.73	0	
	2015	0.48	0	
	2016	0.86	0.24	
Maximum	2012	10.3	0	
	2013	7.4	0	
	2014	9.5	0	
	2015	9.3	0	
	2016	8.3	0.8	
CNSC Regulatory Limits		500/yr	500/yr	

Table 10 shows a decrease in maximum effective dose to Active Area personnel in 2016 compared to 2015. Contractor dosimeters and doses continue to be well managed and controlled. [redacted]

The workers that install Co-60 in off-site irradiators are included in the breakdown for effective, extremity and skin dose. One set of dosimetry data is used for those individuals working under both the Class IB processing facilities license and Nordion's Class II licence.

At times, the dosimeters of Nordion employees who travel are inadvertently x-rayed in the airport security scanning system and results in doses that are inconsistent with the Direct Reading Dosimeter results for these employees. These dose results are not the subject of requests for revision at the National Dose Registry. If the thermo-luminescent dosimeter (TLD) results for Nordion employees who travel are inconsistent with their direct reading dosimeter (DRD) results, the dose results are not considered for revision if the difference between the TLD results and the DRD are minimal and Nordion cannot be certain that the results are personal or non-personal; and therefore, considers them as personal. Also, the amount of work to provide the justification for the request for revision is not considered an effective use of time and resources. In addition, it is reasonable to conclude that omitting the revision does not negatively affect the national dose registration database.

Table 11 shows similar results to Table 10 in 2016.

Table 12 shows continued good performance in maximum extremity dose. [redacted] The continued low extremity doses speak to the strong safety culture at Nordion.

The above analysis of trends demonstrates continuously improving performance at Nordion and adherence to the ALARA principle in the execution of duties by Nordion personnel.

2.7.1.2 Internal Occupational Radiation Doses

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

During 2016, there were no cases of employees exceeding Nordion's administrative investigation level of 1000 Bq I-125 or I-131.

Whole body counting was performed once in 2016. No urinalysis was required in 2016.

There were no employees who recorded internal doses exceeding any of the dose limits in Sections 13 and 14 of the Radiation Protection Regulations.

2.7.2 Significance of Results for the Dose Control Data

A further breakdown of dose trends by group, for the last five years is provided in Figures 1 to 19 at the end of this report. The graphical trends show group average, individual maximum and group cumulative doses. This trend data is reviewed yearly at the EHS Committee and the Annual Joint Environmental Management System and QA Program for Safety Review. There are a few general observations in the trend data: Maximum individual dose is down slightly (from Figure 2, includes Cobalt Shippers) though increases in Cobalt personnel is observed and illustrated in Figures 1 & 2. [redacted] Facility support groups have had consistently low doses over the last five years where most employees TLDs read under 1 mSv. A detailed analysis, by group, is provided in Table 13.

[redacted]

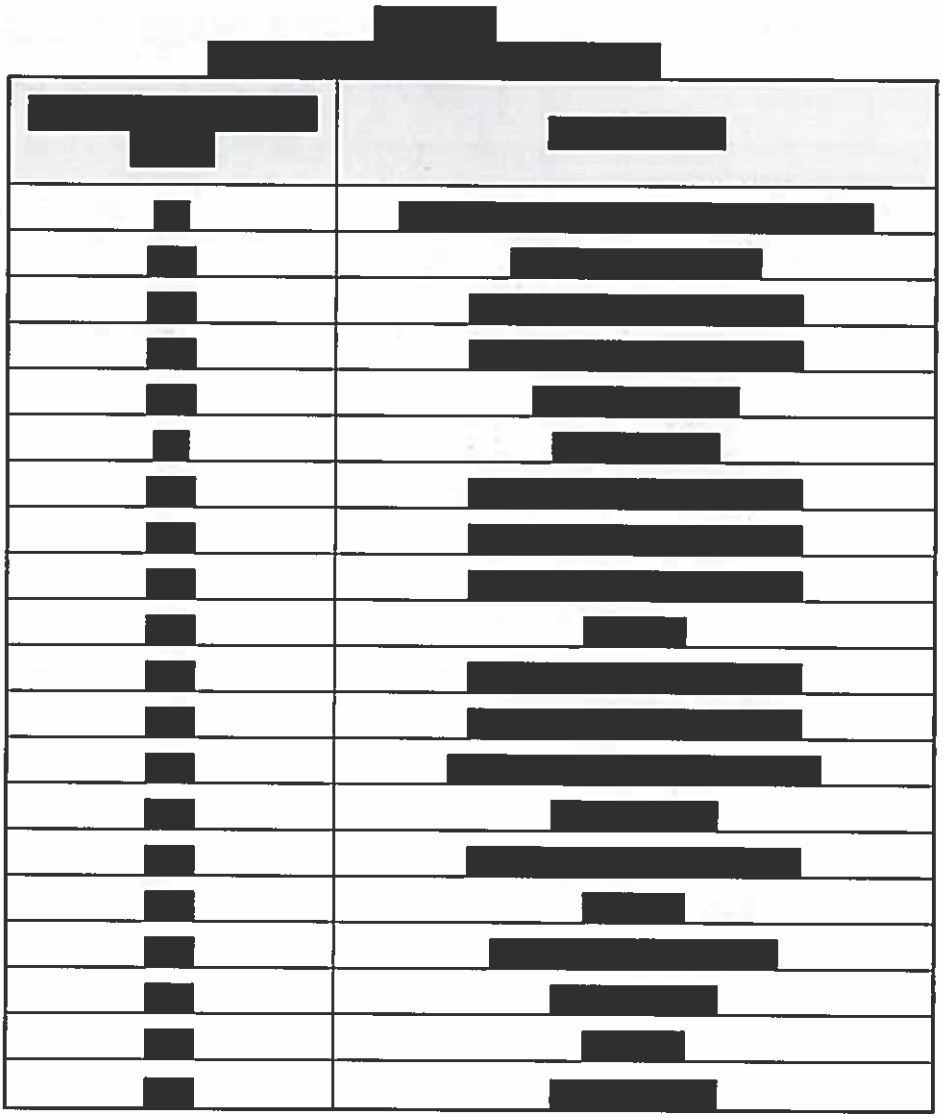
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]
		[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

[redacted] It is significant to note that because of ALARA investments put in place in 2014 there was a decrease in doses to Shipping and Monitoring and Decontamination personnel in 2015 and continuing into 2016.

Another very significant performance indicator is that Monitoring and Decontamination personnel in Medical Isotopes have maintained extremity doses year over year to the same level [redacted]. Nordion personnel working with [redacted] are re-trained every two years on the safety aspects of how to work with this high energy beta emitter, including the correct orientation of ring dosimeters. Radiopharmaceutical QC Technicians have likewise maintained low extremity (ring) doses.

Results overall demonstrate continued and consistent high performance of Nordion employees in accordance with ALARA, [redacted] The highest effective doses received in 2016 by employee role are listed below in Table 14. This demonstrates that the higher dose work at Nordion mainly involves personnel dedicated to Co-60 production activities. The 20 employees with the highest effective doses account for 53.9% of the cumulative dose at Nordion in 2016.



2.7.3 Dose to the Public

Two sets of DRL values, which are listed in Table 18 and in the License Conditions Handbook (LCH), are used to calculate the dose to the public. Refer to Section 2.9.1.1 for further information. Table 15 shows the doses to the public from 2012-2016.

Table 15
Dose to Public

Year	(mSv)
2012	0.020
2013	0.022
2014	0.010
2015	0.0057
2016	0.0021

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, glove-boxes, 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 leaving the Active Area is monitored by wipe test and/or direct measurement to provide assurance that it meets administrative and regulatory requirements.

During 2016 operations, there were 26 instances where contamination (above "clean on swipe") was found and subsequently contained within the Active Area. Most were due to routine operations. Of the 26 contamination incidents, 21 were related to contamination found on clothing, three to contamination found on clothing and subsequently in limited areas of the facility (i.e. floors or other structures and equipment), and two were related to contamination found directly on personnel. No increased dose to personnel was received as a result of any of these incidents.

The distribution of contamination incidents from 2012 to 2016 is shown in Table 16 and 17 and is illustrated in Graph 1.

There does not appear to be a discernible trend in the contamination incidents by month. The number of contamination events in 2016 was less than in each of the previous four years. However, there is no specific trend upward or downward over the past five years. When reviewing the data based on contamination level, there does not appear to be any trend year-over-year.

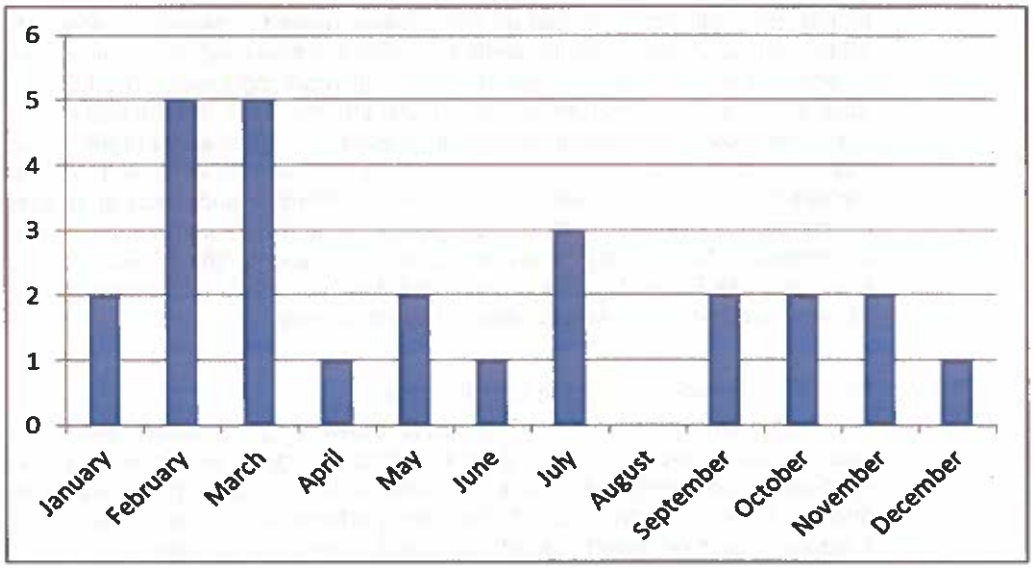
Table 16
Contamination Incidents by Contamination Level

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
2012	1	1	7	13	6	4	32
2013	0	1	12	8	6	5	32
2014	1	2	16	12	12	4	47
2015	1	2	15	12	6	7	43
2016	0	2	10	8	4	2	26

Table 17
Contamination Incidents by Radionuclide

Radionuclide	2012	2013	2014	2015	2016
Not recorded	1	1	0	2	1
C-14	0	0	2	1	0
C-60	5	9	12	12	6
I-125	2	1	3	1	2
I-131	7	10	5	5	6
Mo-99	10	5	13	8	2
Y-90	5	4	7	5	0
Decayed Mo-99	0	0	2	2	5
Ir-192	1	1	0	1	1
In-111	0	0	0	0	0
Lu-177	0	0	0	0	0
Xe-133	0	1	2	4	0
Sr-82	0	0	1	0	0
I-123	1	0	0	0	0
Eu-152	0	0	0	0	0
Y-88	0	0	0	0	1
Radon	0	0	0	0	1
Se-75	0	0	0	0	1
Total	32	32	47	43	26

Graph 1: Contamination Incidents by Month in 2016



2.7.5 Facility Radiological Conditions

The radiation survey program involves radiation measurements within the Active Area, and on the perimeter and exterior of the KOB. Within the Active Area, radiation surveys are conducted on a daily basis, throughout all the labs and rooms. Areas where radiation fields are above 2.5 mrem/hr (0.025 mSv/hr) are posted with radiation warning signs, indicating the radiation fields. In addition, surveys are conducted at employee work areas, at cells, glove-boxes, and fume-hoods, during production and test operations, to ensure radiation fields during processing are within acceptable levels. Special surveys are conducted on new processes/equipment to provide information on the safety performance of new operations. Detailed surveys are conducted on each of the Cobalt Operations cells every three years, to check for integrity of the cells and ensure radiation levels are within acceptable levels.

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 2016.

Breathing air was monitored at 12 Continuous Air Monitor (CAM) stations and at over 50 locations with 24 hour air filters. In addition to having the capability of alarming locally, CAMs are monitored and logged at the Surveyor's control panel and on the building monitoring system. The 24 hour air filters are measured at the end of the day shift on a daily basis.

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 2016, all breathing air sampling was performed in accordance with procedures and results indicated that processes were in control.

2.7.6 Exceeding Regulatory Limits or Action Levels

In July 2016, Nordion reported an exceedance related to personnel dosimetry. A total of 16 personnel whose doses exceeded Nordion's action level of 2 mSv per reporting quarter, for the Q2 quarterly and June monthly reporting period. The highest reported dose was 4.6 mSv. An investigation (16-21) into the issue determined that the package of personnel dosimeters was inadvertently placed near radioactive materials during shipment to the external third-party dosimetry provider. As such, all personnel dosimetry badges for this reporting period were incorrect. Nordion undertook an assessment of estimated dose values for all affected personnel and determined that there were no true exceedances for dose action levels. Nordion worked with the CNSC and updated the National Dose Registry with the estimated dose values for all personnel, in addition to the 16 personnel whose doses exceeded the action level.

2.7.7 Radiation Protection Program Effectiveness

The Radiation Protection (RP) Program is reviewed by conducting process audits and process safety audits. The Radiation Protection Program was found to be compliant with Nordion requirements following a dedicated audit in 2016, with the exception of one finding. Refer to Section 1.2.4.1. Data and performance of the Radiation Protection Program is also reviewed regularly at EHS Committee meetings.

2.7.8 Radiation Protection Program Improvements

Improvements to the RP Program in 2016 included the following:

- Performing a study on the real world effectiveness of activated charcoal stack cartridges6 in correctly quantifying radioiodine releases. Although the study concluded air release activities were underestimated for I-125, it also determined that, coupled with conservative historical practices, they were overestimated for I-131 air releases. Previous annual reports do not warrant adjustment to dose to the public, as the range of adjustment is -0.28% to +0.39%, with an average of +0.12% of reported values from 2011-2015.
- A new source was purchased for the radiation survey meter calibrations (SN 3007GG). The new higher activity source ensures compliance with precision in distance requirements.
- A number of alarms were purchased and installed on fume hoods in the Active Area to alert personnel in the event of a loss in ventilation.

2.7.9 Radiation Protection Program Performance

The objectives, goals and targets of the Radiation Protection Program are shown in Table 5 of Section 2.3.1. The targets average and maximum NEW dose and environmental releases were met in 2016. These targets are tracked as key performance indicators at EHS Committee meetings and in Monthly Operational reports. The targets are reviewed yearly at the Annual Joint Environmental Management System and QA Program for Safety Review. Refer to Section 3.2 Table 26 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 an internal procedure called "Keeping Radiation Exposures and Doses as Low as Reasonably Achievable" (SE-RP-002). This procedure was followed in 2016 and there were no revisions made to the program. Performance is measured against targets and demonstrated in Table 5 of Section 2.3.1.

2.7.11 Radiation Protection Training Program and Effectiveness

Refer to Section 2.2.1 and 2.2.2.

2.8 Conventional Health and Safety

2.8.1 Conventional Health and Safety Program Effectiveness

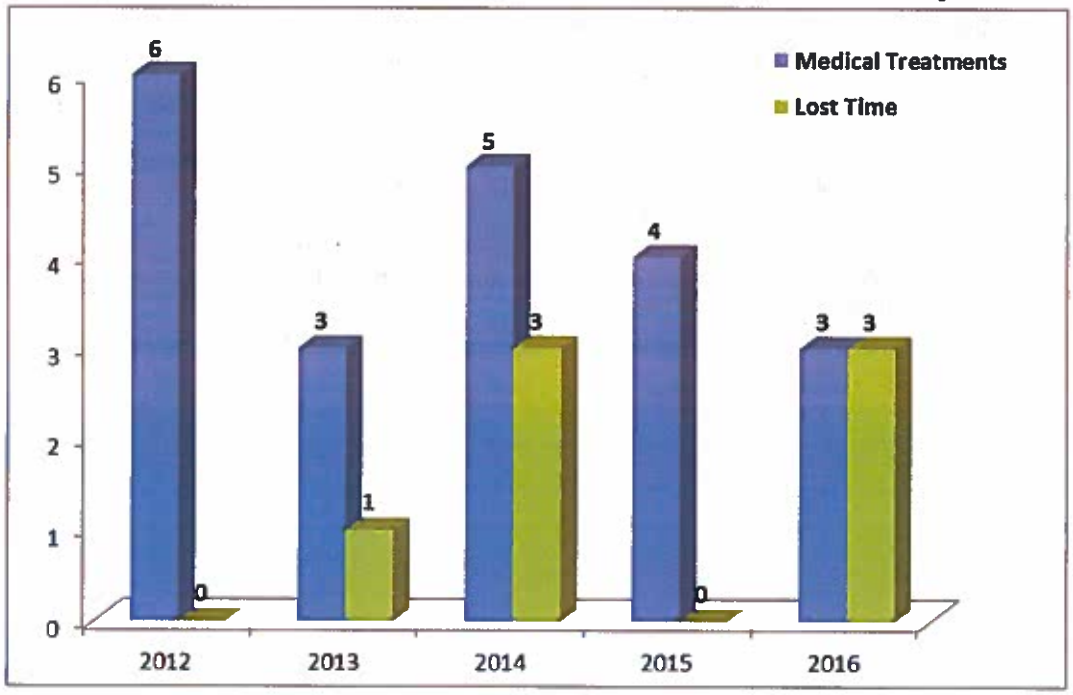
The Conventional Health & Safety Program is reviewed by conducting program audits, process audits, regular inspections by both employees and management, and a review of revised safety programs is performed by the Policy Health & Safety Committee. The Policy Health & Safety Committee is also responsible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

In 2016, the incident targets were divided into two categories and the targets set for both were the following: Medical Treatment incidents with a target of ≤ 6 and Lost Time incidents with a target of zero.

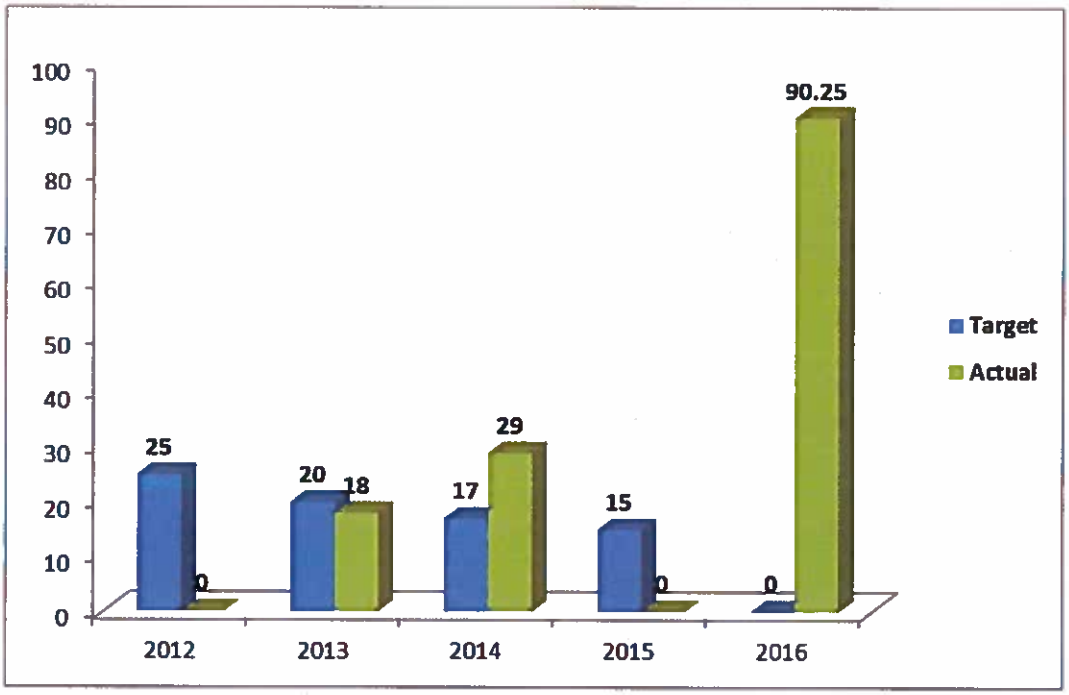
Graphs 2 and 3 illustrate the number of Incidents by year and the Number of Days Lost by year respectively.

Refer to Sections 1.2.4.1 and 1.2.4.2 for a description of audits and inspections for 2016.

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



Graph 3: Number of Lost Time Days by Year



2.8.2 Conventional Health and Safety Committee Performance

The Kanata Operations Building (KOB) Workplace Health and Safety Committee is represented by union and management and typically meets on a monthly basis. The KOB Health & Safety Policy Committee is represented by union and management and typically meets on a quarterly basis.

The KOB Workplace Health and Safety Committee met ten times in 2016. The KOB Health & Safety Policy Committee met on three occasions in 2016. The accomplishments for 2016 were that the Policy Committee continued to review applicable policies and programs (e.g. the Hazard Prevention Program, Occupational Health and Safety Manual, etc.). In addition, the Policy Committee continued to review operational ergonomics as a standing agenda item for each meeting.

2.8.3 Conventional Health and Safety Program Improvements

Improvements to the Conventional Health and Safety Program in 2016 included the following:

- Quarterly "Safety Focus Talks" were created for managers to provide to their teams. Themes included:
  - "Near Miss Reporting – Report Don't Repent"
  - "Helping Hands - Benefits of Massage"
  - "WHMIS 2015"
  - "Two Minute Safety Check"
- An EHS compliance management software was implemented for incident, near miss and hazard identification reporting; all employees were trained on its use
- A formal site-wide reassessment was completed related to designated substances and materials containing asbestos
- A formal occupational health and safety manual was developed
- A formal pre-start health and safety review procedure was established

2.8.4 Hazardous Occurrences

During 2016, there were three medical treatment incidents and three lost time incidents. The details are summarized below.

Medical Treatment Incidents:

1) An employee required sutures to forehead when his ladder slipped and he fell from the third rung of the ladder.
2) An employee sustained a small fracture to right foot when she slipped on the floor. An air cast and modified duties were required.
3) An employee required physiotherapy and modified duties for a right elbow strain attributed to working with manipulators around the Cobalt pool.

Lost Time Incidents:

1) An employee sustained a severe allergic reaction from multiple wasp stings. (1.25 days)
2) An employee slipped while wearing clean room booties that were not fitted properly. They sustained a low back injury and were assigned modified duties upon returning. (18 days)
3) An employee sustained a right shoulder injury after using an Allen key to loosen a socket head cap screw. Modified duties were assigned. They later required surgery. The employee was on modified duties from the date of the injury until the date of surgery. (71 days).

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. Radioiodine sampling involves the use of activated charcoal filter cartridges, and analyses by gamma measurement. Particulates are sampled by use of cellulose filter papers and analyzed by gamma measurement.

All production operations are contained within cells, glove-boxes 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

Two sets of DRL values are listed in Table 18, the values in the License Conditions Handbook (LCH) are used to calculate dose to public. Also included for comparison are the DRL values from the Nordion report submitted to CNSC in 2016 using Impact software and the most current version of the CSA standard N288.1-14 – "Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities". Action levels are listed in the LCH and were not exceeded in 2016. A summary of airborne releases is provided in Table 18.

In 2016, the maximum annual release of airborne from any one radionuclide was from Xe-135m at 0.118% of the Derived Release Limit (DRL). The total air release was 0.21% of the DRL. No Action Levels were exceeded in 2016. Dose to public using LCH DRL values is 2.1 µSv (compare with 0.9 µSv using the Impact derived DRL values).

Releases of radioxenons have lowered in 2016, commensurate with a reduction in Mo-99 and Xe-133 production. Calibration factors used in 2012 and 2013 were more conservative, indicating higher releases. In 2014 and 2015, new calibration equipment was used to calibrate radioxenon monitors which resulted in slower releases with dead times in the same range as releases from Xe-133 and Mo-99 production. The previously used calibration apparatus could allow for sudden, rapid release with significant dead times and the calibration values were not corrected for dead time.

[redacted]

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

Table 18
Airborne Releases

Year	C14 (GBq/yr)	Co-60 (GBq/yr)	I-125 (GBq/yr)	I-131 (GBq/yr)	Xe-133 (GBq/yr)	Xe-135 (GBq/yr)	Xe-135m (GBq/yr)
2012	15.7	0.006	0.46	0.40	36,153	23,943	39,498
2013	N/A*	0.005	0.23	0.39	30,735	28,193	43,383
2014	N/A*	0.005	0.14	0.46	15,018	13,075	18,170
2015	N/A*	0.005	0.12	0.15	11,916	8,237	10,758
2016	N/A*	0.006	0.21	0.35	7,277	4,299	5,421
Action Levels (GBq/week)		0.001	0.10	0.20	3,000	N/A	N/A

	C14	Co-60	I-125	I-131	Xe-133	Xe-135	Xe-135m
DRL (GBq/yr) From LCH	N/A	70.1	4,880	3,790	61,200,000	7,660,000	4,600,000
% DRL (2016-LCH)	-	0.009	0.004	0.009	0.012	0.056	0.118

	C14	Co-60	I-125	I-131	Xe-133	Xe-135	Xe-135m
DRL (GBq/yr) Submitted 2016	1,580,000	250	952	686	677,000,000	102,000,000	69,000,000
% DRL (2016-Impact)	-	0.002	0.022	0.051	0.001	0.004	0.008

* C-14 production stopped toward the end of 2008, and measurement of C-14 was stopped in 2012.

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 five year variation in activities released is listed in Table 19. Each release of liquid effluent in 2016 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 19.

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.

In 2014, the Minimum Detectable Activity (MDA) for I-125 was raised, due to the replacement of an aging NaI(Tl) (sodium iodide activated with thallium) detector with a new low energy window HPGe (high purity germanium) detector. The low energy window HPGe detector has lower efficiency than the obsolete NaI(Tl) detector.

Note that liquid release activity measurements have an uncertainty of ±10%.

Table 19
Liquid Releases (GBq/yr)

Year	Litres	β<1MeV	β>1MeV	I-125	I-131	Mo-99	Co-60	Nb-95	Zr-95	Cs-137
2012	720821	0.261	0.06	0.005	0.009	0.075	0.017	0.0002	0.0003	0.0004
2013	782848	0.288	0.065	0.005	0.009	0.077	0.022	0.0006	0.0006	0.0005
2014	600162	0.209	0.05	0.051	0.006	0.055	0.018	0.0007	0.0005	0.0004
2015	590570	0.191	0.044	0.111	0.006	0.06	0.019	0.001	0.001	0.0004
2016	680559	0.222	0.051	0.144	0.006	0.052	0.026	0.001	0.0015	0.0007

	β<1MeV*	β>1MeV*	I-125	I-131	Mo-99	Co-60	Nb-95	Zr-95	Cs-137
LCH-DRL (GBq/yr)	66,000	210,000	73,600	23,300	1,120,000	155,000	558,000	749,000	137,000
% DRL (2016)	3.36E-04	2.43E-05	1.96E-04	2.58E-05	4.64E-06	1.68E-05	1.79E-07	2.00E-07	5.11E-07

*β<1MeV Ni-63 DRL value used, β>1MeV Y-90 DRL used

Releases in Table 19 are compared against the values in the License Conditions Handbook (LCH). If the critical receptor was the same group for all radionuclides the dose to public would be 6 nSv. This value is a conservative over estimate because the critical receptor has been overlooked and the MDA values are used.

The majority of the recorded releases are the minimum detectable activities being conservatively reported as real values instead of using zero. [redacted]

The increase is actually due to a change in measurement technique, as mentioned previously. The low energy window HPGe detector has lower efficiency than the obsolete NaI(Tl) detector. This change accounts for the increase in the I-125 liquid release from 2013 to 2014 and in subsequent years.

Nordion continues to report liquid releases as equal to the MDA even when it is suspected that nothing was released. This change accounts for the increase in the I-125 liquid release from 2013 onward. Nominal increases in the reported values for Nb/Zr-95 and Cs-137 are also noted, however even assuming these releases are real they only represent nSvs of dose to the public which is several orders of magnitude lower than published de Minimis values.

2.9.1.3 Environmental TLDs

The locations of environmental TLDs are shown on Figures 20 and 21 and listed in Table 20. The Environmental TLD results are shown in Table 20 and presented in Graph 4. 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.

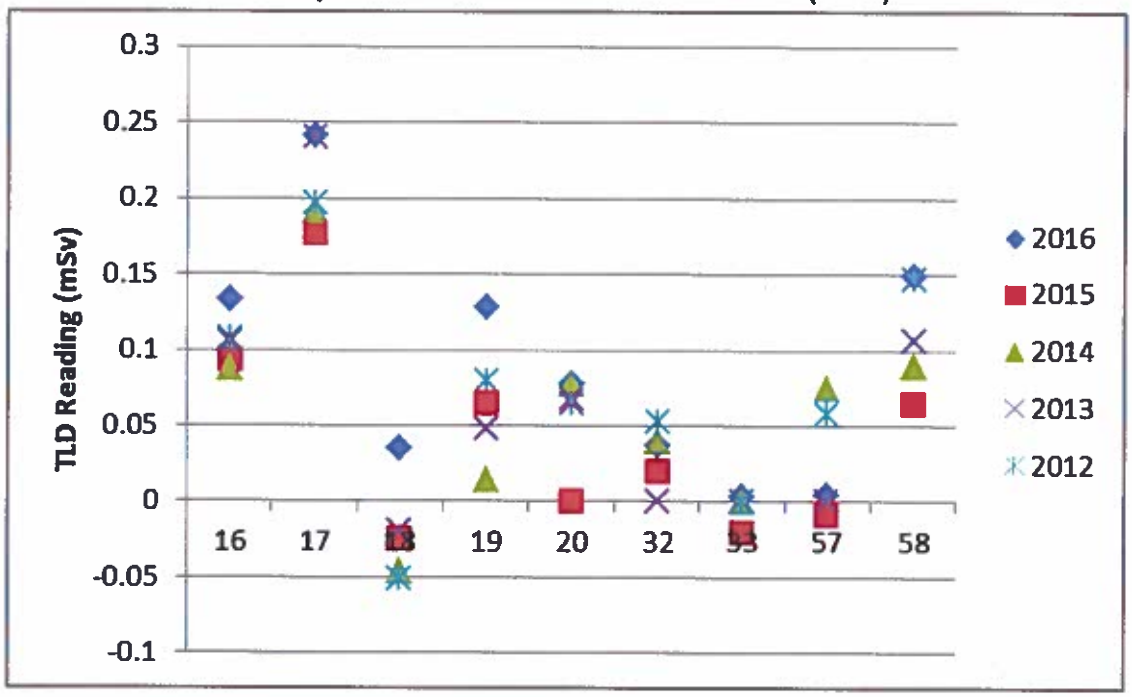
All environmental TLD readings for 2016 were well below the public limit of 1 mSv. Soil samples at these locations have not shown any radionuclides attributable to Nordion's licensed activities. The similarity in the recorded dose in these locations year over year, taken with the absence of any contamination found in soil illustrates that the variation between locations is due to variations in natural background radiation at these different times and locations.

Table 20
Environmental TLD Results

Location		Totals				
		2012 (mSv)	2013 (mSv)	2014 (mSv)	2015 (mSv)	2016 (mSv)
16	[redacted]	0.107	0.105	0.088	0.094	0.133
17	[redacted]	0.197	0.240	0.192	0.177	0.241
18	[redacted]	-0.051	-0.019	-0.046	-0.024	0.035
19	[redacted]	0.08	0.048	0.014	0.065	0.128
20	[redacted]	0.065	0.068	0.078	*	0.078
32	[redacted]	0.053	0.017	0.04	0.02	0.037
33	[redacted]	ND	0.025	*	-0.02	0.003
57	[redacted]	0.058	0.070	0.075	-0.008	0.004
58	[redacted]	0.147	0.106	0.09	0.065	0.149

* missing TLD
* TLDs that cannot be located
ND = not deployed

Graph 4: Environmental TLD Results (mSv)



2.9.2 Significance of Air and Water Release Monitoring Results

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

Trends in changes in volumes of water released from the facility continue to be generally proportional to activities released. Nordion employs a conservative practice of assuming the MDA is always released. This explains why the year over year trend very closely follows the number of litres released. In August 2014, Nordion switched from a NaI(Tl) detector to a low energy window HPGe detector with slightly less efficiency in the I-125 range, which on paper will contributed to higher releases being reported in 2014 and subsequent years although no I-125 was actually detected. The next largest factor is variation in the MDA between the Cobalt Operations Facility and the Nuclear Medicine Production Facility. Every year only a small percentage of the release reported is activity detected over the MDA.

2.9.3 Exceeding Regulatory Limits or Action Levels

There were no instances of exceeding CNSC environmental regulatory limits or action levels in 2016.

2.9.4 Environmental Protection Program Effectiveness

A review of the performance related to the Environmental Protection Program and the Environmental Management System is conducted on an annual basis. In 2016, this review was held during the Annual Joint Environmental Management System and QA Program for Safety Review on June 27, 2016. The results of the review are summarized in Section 2.1.2 items 3, 4, 5 and 6.

Refer to Section 1.2.4 for a summary of internal and external inspections, audits and reviews.

2.9.5 Environmental Protection Program Activities

Activities which took place in 2016 included the following:

- Conducting a total of 16 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 a maintenance audit of Nordion's ISO 14001 certification One minor nonconformance and two opportunities for improvement were identified during the course of this audit

2.9.6 Environmental Protection Program Improvements

In 2016, Nordion made the following improvements to the Environmental Protection Program:

- Implementation of the CSA standards N288.4, N288.5, and N288.6 which included developing a formal Environmental Risk Assessment (ERA), revising Nordion's Derived Release Limits (DRLs) and developing Nordion's Environmental Monitoring Program.

2.9.7 Environmental Protection Program Performance

A description of the Environmental Protection Program Initiatives is provided in Table 21, along with the results/outcomes.

A summary of initiatives and targets for the upcoming year is provided in Table 22.

Table 21
2016 Environmental Objectives

Objective	Result / Outcome
Reduce non-hazardous waste to landfill (target of 68% by the end of 2017)	The diversion rate from the 2015/2016 audit was 76%.
Audit one Supplier whose goods and/or services could have a significant impact on the environment	Completed one supplier audit in accordance with SE-ENV-019 "External Supplier Environmental Audits
Reduce Energy	Nordion has upgraded controls on chillers to variable frequency drives and has replaced some facility lighting to LED lighting. These were recommendations from the energy audit conducted by a Third Party in 2015.
Reduce particulate matter air emissions	Currently in-progress. Investigating ventilation/filtration options.

Table 22
2017 Environmental Objectives and Targets

Objective	Target
Reduce non-hazardous waste to landfill (target of 68% by the end of 2017).	Increase waste diversion rate to 68% by the end of 2017 (baseline year – 2015 waste audit results).
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 2017.
Reduce Energy	Investigate opportunities for reducing energy
Reduce particulate matter air emissions (continued from 2016)	Reduce particulate matter air emissions from the glass blowing process

2.9.8 Well and Soil Sampling and Measuring/Monitoring

2.9.8.1 Soil Sampling

Soil sampling was conducted every two years to determine the presence or absence of radioactive materials in the soil. It was last performed in 2016. No radionuclides attributable to licensed activities were detected in the soil samples. Soil sampling will henceforth be conducted annually.

2.9.8.2 Groundwater Sampling

Figure 22 shows current groundwater well locations.

2.9.8.2.1 Non-Radiological Sampling

Since 2005, Nordion has been monitoring the groundwater at least once a year for non-radioactive contaminants. Holes are bored into the ground at varying depths, in various locations, until the ground water has been reached. The locations of these boreholes are illustrated in Figure 22.

After samples have been taken from each borehole, they are sent to an accredited laboratory for analysis and parameters for analysis are chosen with consideration to past sampling.

The results are monitored to ensure there are no significant shifts or trends in the sample results that could indicate a change to the groundwater. Results are also compared to the background well which represents the water quality as it enters the property. As a conservative reference, results are compared against limits from the following requirements:

- Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act
- Ontario Drinking Water Standards, Objectives and Guidelines

Non-radiological groundwater samples were taken in November 2, 2016. Results, including those from the recent analysis, from five years previous and from the original sampling in 2005 are provided in Appendix C by borehole, with borehole two (2005-BH2) representing background conditions.

The results of this analysis demonstrated that there were no significant changes in the groundwater in 2016 compared to past years. This indicates that Nordion's operations have not had a significant impact on the groundwater.

2.9.8.2.2 Radiological Sampling

Since 2013, Nordion has been monitoring groundwater at least once a year for radiological contaminants.

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

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

It was determined that only naturally occurring radionuclides which are not processed at this site were detected.

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. However, continuous improvement opportunities have been identified based on internal and external feedback to exercises and discussion with Ottawa first responders. As a result, Nordion management chose to re-develop the program.

This included the complete revision of the Emergency Response Plan and all sub-plans. These changes are to align the plan with Incident Management Systems (IMS) and to incorporate other continuous improvements identified.

Objectives for 2016 included:

- Maintaining baseline preparedness under the current program until implementation of the new program
- Finalizing all new program documentation
- Developing and rolling out training of the new program to all responders
- Developing and executing a full-scale, emergency exercise
- Holding emergency response exercises and drills (refer to 2.10.2)

Nordion completed all of its scheduled activities for 2016.

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 2016, a number of Emergency Response (ER) exercises were conducted to test these emergency response plans and response personnel.

Activities which took place in 2016 included:

- Emergency response training for all Nordion responders on the new program (refer to Section 2.10.3 for additional information)
- Successful completion of a full-scale emergency exercise with Ottawa Fire Services participation
- Testing of the Fire Safety Plan in each of the three buildings (KOB, Roy Errington (RE) Building, and Heating Plant), including alarm activation and full evacuation
- Testing of the Emergency Response Contact List to ensure accuracy of telephone numbers listed, to determine availability of personnel, and to estimate response times

2.10.3 Emergency Preparedness Program Improvements

In 2016, Nordion completed the creation of new documents and the revision of existing emergency management program documents to reflect the updated program and incorporation of IMS.

These documents and the revised sub-plans were submitted to the CNSC for review in December 2014. These revisions incorporated comments received by the CNSC on a previous draft submission. In June, 2015, the CNSC noted that the revised program documentation incorporates the elements of REGDOC 2.10,1 "Nuclear Emergency Preparedness and Response".

2.10.4 Emergency Preparedness Program Performance

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

In 2016, equipment checks and work conducted to ensure optimal performance and readiness related to the Emergency Management Program included the following:

Equipment	Minimum Frequency
Emergency Response Kit Inspections	Quarterly
Emergency Generators Test	Monthly
Communications Emergency On Call (EOC) Test	Quarterly
Radiation Evacuation Test	Annual
Self-Contained Breathing Apparatus (SCBAs) Hydrostatic Testing	Every 5 years
SCBA Air Replacement	Once/year
SCBA Annual Inspection	Once/year

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

There were no deficiencies with the Emergency Management Program systems or equipment in 2016.

2.10.5 Emergency Preparedness Training Program Effectiveness

All new employees and contractors are provided with emergency response training prior to being issued a security badge.

During 2016, the following emergency response training was provided to employees and those working on behalf of Nordion:

- Fire Warden and Marshall Training – 82 Participants
- New Employee/Contractors Emergency Alarm and Response Training – 51 Participants
- Emergency Alarms & Response Training – 22 Participants
- Fire Watch Training – 51 Participants
- Incident Management System (IMS) - Emergency Response – 163 Participants

2.10.6 Fire Protection Program Effectiveness

Nordion has completed the review of all emergency response plans, including the fire safety plans with the goal of aligning these plans with an Incident Management System model.

Fire drills/evacuations were conducted in the Heating Plant, the RE Building and the KOB in 2016. There were no significant findings identified as a result of these drills.

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 2015.

2.10.7 Fire Protection Program Activities

Activities that took place in 2016 included:

- Testing of the fire safety plans. This test involved evacuation of the three buildings (KOB, RE Building and Heating Plant) by activation of the building fire alarm system
- Conducting 16 fire and environmental inspections
- Providing Fire Prevention and Safety training to all employees
- Implementing a Transient Combustible Materials Management Program
- Completing a Fire Protection Program Audit (third party report in progress)
- Conducting a Fire Needs Analysis (third party report in progress)

2.10.8 Fire Protection Program Improvements

Improvements to the Fire Protection Program in 2016 included:

- Revising Nordion's Fire Safety Plan (SE-ERP-001) to align with Incident Management System protocols
- Completing project to replace halon fire suppression in hot cells with argon, or in some instances, removing in cell fire suppression as for some cells, combustible loading is minimal
- Revising the Fire Protection Program and associated documents to meet requirements of CSA standard N393, "Fire protection for facilities that process, handle, or store nuclear substances"
- Implementing Fire Watch and Fire Extinguisher Training for applicable staff
- Updating Nordion's Work Permit Authorization procedure to enhance the fire prevention process and to include guidelines for conducting inspections

There were no changes to training, methods, instrumentation, or equipment in 2016.

2.10.9 Fire Protection Program Performance

In 2016, equipment checks and work conducted to ensure readiness related to the Fire Protection Program included:

Equipment	Frequency
Fire Pump Test	Monthly
Sprinklers Inspection	Monthly
Fire Extinguishers Inspection	Monthly
Fire Protection System Verification (Third Party)	Annual

Overall, compliance with the Fire Protection Program and results from equipment checks was satisfactory

Fire suppression in cells containing CO_2 systems were impaired (locked-out) for the first part of 2016 as a result of a third party compliance review against NFPA 12 requirements. Some deficiencies were identified in these systems. In 2016, Nordion received third party approval to remove the CO_2 systems or have them modified to use a different agent for fire suppression. All work on in-cell fire suppression is now complete.

2.11 Waste Management

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 was generated through the production operations was collected and sent to a CNSC approved radioactive waste management facility.

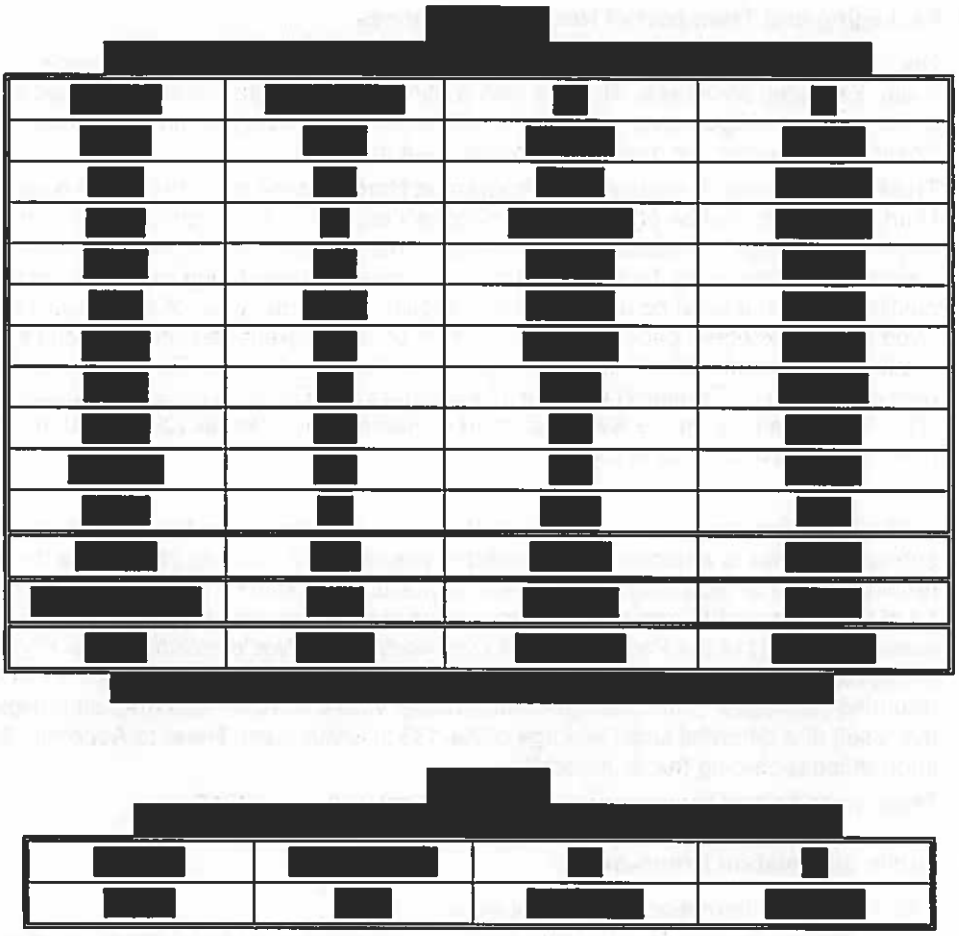
Nordion has designated space and processes to store and segregate radioactive waste that is generated in Operations. [redacted]. Additional space for long term storage of divertible waste, (i.e. waste generated within the Active Area at Nordion that has been deemed safe to divert and dispose of by conventional waste disposal methods, such as landfill), exists in the [redacted], if needed. These areas are segregated rooms or bays that are designated for this purpose. Space is also designated for storage of containers and management of waste being prepared for shipment to the external waste management facilities.

[redacted]

In 2016, [redacted] of waste that met CNSC unconditional clearance levels was disposed of to landfill as part of the waste diversion program. Nordion frequently reviews the waste diversion program to increase opportunities for reducing waste sent for active waste disposal.

In 2016, there were no shipments to [redacted] of radioactive liquid waste by Nordion. In 2016, approximately [redacted] of solid and liquid hazardous (chemical) waste was disposed of by Nordion via a licensed waste disposal company.

[redacted]



2.12 Nuclear Security

Details of Nordion security and all of the security improvements of 2015 were provided in the Nordion Physical Security Report and Security Plan for 2015, submitted in March 2016. These safeguards and improvements are prescribed information and were reviewed and accepted by CNSC Security as part of the 2015 Type II Security Inspection. Additional enhancements were made in 2015 following the inspection that will be reviewed by CNSC Security.

2.13 Safeguards and Non-proliferation

Nordion has a program in place for the management of safeguarded material at the Nordion Ottawa site. The program meets the safeguards requirements of specified license conditions, CNSC regulatory document RD-336, "Accounting and Reporting of Nuclear Material", CNSC *Nuclear Non-Proliferation Import and Export Control Regulations*, the *Nuclear Safety and Control Act* and *General Nuclear Safety and Control Regulations*.

In 2016, Nordion performed accounting and reporting of nuclear material as required by RD-336. Nordion completed a Physical Inventory Taking (PIT) of safeguarded material from which there were no findings.

In 2016, one safeguards inspection was conducted by the CNSC. This safeguards inspection was the Physical Inventory Taking - Evaluation (PIT-E) conducted on October 27, 2016. There were no findings or follow-up items required as a result of this inspection.

2.14 Packaging and Transport of Nuclear Substances

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

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 (2012 Edition), US DOT 49 CFR, and US NRC 10 CFR part 71.

In 2016, Nordion reported seven non-conformances related to packaging and transport of nuclear substances. This is a decrease compared to previous years due to changes in the reporting requirements that resulted from the implementation of Nordion's License Condition Handbook. All of these reportable non-conformances were reported as "dangerous occurrences" pursuant to subsection *37(1) of the Packaging and Transportation of Nuclear Substances Regulations*. Six of the seven non-conformances were the result of other parties (suppliers, carriers or customers) returning packages. The one non-conformance, where Nordion was the responsible party, was the result of a potential small leakage of Xe-133 in a shipment. Refer to Appendix A for further information regarding these incidents.

There were no non-compliances with the TDG regulations in 2016.

2.15 Public Information Program

2.15.1 Public Information Program Activities

Nordion is committed to fully disclosing its activities to the public in an effort to maintain transparency to the surrounding community and to the City of Ottawa. Nordion's website is the primary communications vehicle. In 2016, 69,803 unique users visited Nordion.com 93,186 times looking at a total of 222,387 pages.

In 2016, Nordion published the following public disclosures:

- February: Q4 2015 Event Report.
- April 13: False alarm reported – At approximately 11:19 am, a false fire alarm was reported at the Heating Plant Building in Kanata. This resulted in a brief evacuation of the facility in line with the company's standard procedures for dealing with such situations.
- May: Q1 2016 Event Report.
- June 3: False alarm reported – At approximately 3:02 pm, a false fire alarm was reported at the Operations Building in Kanata. This resulted in a brief evacuation of the facility in line with the company's standard procedures for dealing with such situations.
- June 14: Nordion announced it would hold a training exercise of its Emergency Response Plan. At the conclusion of the exercise, Nordion announced the training exercise was a success.
- June 29: Nordion announced that the CNSC would be conducting independent Environmental Monitoring around the Kanata site, and that the CNSC would publish the results to the CNSC website.

- July 13: Nordion announced that production would cease in Kanata of the following products effective October 31: Iodine-125, Iodine-131 and Xenon-133, and that there would be no impact to Nordion's environment, health and safety programs as a result of this change.
- November: Q3 2016 Event Report.

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 gather how the public would like the program to evolve. Seventy five (75) unique users visited the survey. Zero surveys were completed. A copy of the feedback survey form is provided in Appendix D.

Nordion regularly issues news releases to inform the public of company initiatives, achievements, and issues that the business may be facing. In 2016, there were no media articles related to Nordion environment, health and safety issues or topics. As the context of media coverage referring to Nordion was business-oriented, there was no media analysis of public opinion.

Nordion uses social media such as Facebook, Twitter, and LinkedIn to inform the public of the company's initiatives. In 2016, there were neither negative comments pertaining to events nor questions related to environment, health and safety.

On October 5, Nordion hosted the Kanata general public, Kanata Community Leaders and Kanata Area Community Associations at an information session called Nordion's Community Café. There were several goals:

- To build public awareness about Nordion's business products, services, operations and facility through timely and ongoing clear, consistent and transparent communications
- To proactively engage identified stakeholders and utilize available communications tools and channels to foster ongoing public awareness and outreach

  To obtain stakeholder feedback and continuously improve Nordion's Program

The 90-minute Community Café included 30 minutes of networking, a 30-minute information session, and 30-minute Q&A.

Nordion used the following vehicles to promote the Community Café to these stakeholders:

- Nordion.com
- KanataNorthBIA.ca
- Social Media
- *EMC Kanata Kourier*
- Canada Post Unaddressed Mail
- Email

A sample of the promotional material and survey results from the Community Café is provided in Appendix E

2.15.2 Public Information Program Improvements

During the December 2014 Nordion Community Café, the public requested that Nordion add a Virtual Tour to its website. A comprehensive Virtual Tour was published to Nordion.com in June 2016.

2.16 Site Specific Information

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

- Nordion shall prepare and submit to the Commission an Annual Compliance Report by March 31st of each year.
- Nordion shall make and submit reports to the Commission regarding safeguarded material in accordance with RD-336, "Accounting and Reporting of Nuclear Material".
- Nordion shall annually update and submit the Annual Physical Security Report by March 31, of the following calendar 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 submit a written notification of changes to programs and documents to the CNSC either prior to or at the time of implementation of the change depending on the impact on the licensing basis and/or the document affected.

In 2016, there were three events with regard to sealed source reporting:

- Nordion did not report the import of three Co-60 sealed sources to the CNSC Sealed Source Tracking System (SSTS) within the required timeframe. The root cause was communication as the Forecasting & Planning group was not notified of the import arrival. Email distribution lists were created and the appropriate procedure revised to address the issue.
- The revised ship date for the export of Co-60 sealed sources was not reported to the CNSC SSTS prior to shipment. The root causes were procedure, training and work direction. Nordion implemented a final verification of sealed source reporting prior to the shipment leaving the site. Also, on-the-job training was developed and completed, and the procedure as enhanced.
- The revised ship date for the domestic transfer of sealed sources was not reported to the CNSC SSTS prior to shipment. The root causes were human engineering and work direction. A verification step was implemented to check revisions to ship date and back-up personnel were trained.

These instances were not reportable to the CNSC. As a result of the number and nature of the incidents related to sealed source reporting in previous years, and as a result of a trend identified in the 2013 Nordion performance review, a process review was conducted to identify additional corrective actions. This process review concluded in 2016 and the CAPAs initiated are currently in effectiveness verification. Although no trend was identified with regard to the SSTS-related events in 2016, Nordion will be repeating the process review incorporating a different analysis method to ensure all avenues for error are identified. Nordion complied with all other site-specific reporting requirements.

The Financial Guarantee, as approved by the Commission and based on the Facility's Decommissioning Plan, is still valid.

3. FUTURE PLANS AND CONCLUDING REMARKS

3.1 Improvement Plans and Future Outlook

Nordion does not have any development plans for 2017, but will continue to focus on the new Molybdenum-99 program to resume supplying key customers with products and customer service.

[redacted]

3.2 Safety Performance Objectives for Following Year

Nordion's 2017 EHS Program Objectives and Targets and Health and Safety Objectives are shown in Tables 26 and 27. The thyroid attendance leading indicator was removed as a target for 2017 with the decrease in population base due to the shutdown of the iodine process. Nordion continues to monitor the attendance rate. The remainder of the objectives and targets have not changed since the previous year.

Table 26
2017 EHS Program Objectives and Targets

Applicable Nordion Job Function	Objective	Measures and Targets
All Directors and Managers All Directors and Managers of Operations, Facilities, or Nuclear Energy Worker employees	Minimize the number and extent of occupational injuries, environmental and radiation incidents.	• The number of Medical Treatment Incidents ≤ 6 • Lost time Incidents = 0
	Safety Meeting Attendance	• Attendance at Safety Meetings = 100% (Quorum)
	Minimize the use and release of hazardous materials to the environment.	• Radioactive materials emissions to ≤ 5.0% of the Derived Release Limits (DRL) • No non-compliant releases of radioactive or non-radioactive hazardous materials to the environment (sewer, air, etc.) • Reduction in the use of hazardous materials and the generation of waste (hazardous and non-hazardous)
	Maintain radiation doses to employees as per ALARA principle.	• Maximum employee dose rate ≤ 7.5 mSv/yr
	Manage EHS CAPAs and ensure timely closure of CAPAs	• Target 80% of generated CAPAs within your areas are closed (Actions complete, excluding CAPA verifications) within 1 year • Meet all CAPA target dates • Prioritize high risk EHS CAPAs

Table 27
2016 Health and Safety Objectives

Applicable Nordion Job Function	Objective	Measures and Targets
All Directors and Managers All Directors and Managers of Operations, Facilities, or Nuclear Energy Worker employees	Ensure all managers of high risk areas conduct / document regular self-assessments of their management processes and safety performance.	• Mid-Year and Year-End performance reviews (semi-annually) • Ensure the departmental job hazard analysis is kept up-to-date.
	Ensure all managers actively consider impacts to the environment and health and safety.	• Environment, health and safety impacts are assessed as part of product realization planning and risks are mitigated through application of ALARA and pro-active planning. • Opportunities for minimizing waste (hazardous and non-hazardous) are assessed and implemented whenever possible. • Ensure all near misses are reported in a timely manner and appropriate corrective actions(s) are taken. • Maintain control of non-production radioactive material.
	Communicate monthly with teams about environment, health and safety performance and impacts. Openly evaluate employee environment, health safety concerns and encourage reporting of near misses.	• Environment, health & safety information and concerns are discussed regularly at team meetings. • Health and safety concerns are assessed with the results of the evaluation communicated to the employee(s). • Deviations, CFs, Non-conformances and Complaints are assessed for EHS risks against targets and reported accordingly. • Routinely invite EHS Representatives to team meetings to discuss EHS topics and/or concerns.
All High Risk Employees	Prioritize working safely at all times	• It is unacceptable to take risks in order to get the job done. Personal safety is every employee's highest responsibility. • Work must follow Nordion EHS training, standards and procedures, and is performed with care and attention to safety principles and policies. • Wear all personal protective equipment (PPE) as necessary. • Submit all dosimeter(s) and rings for monitoring on time (i.e. no later than one month) following end of monitoring period
	Report the occurrence of workplace injuries, unsafe conditions and near misses.	• All workplace injuries, suspected injuries, observed unsafe conditions and near misses are reported immediately to the direct Supervisor. • Report any suspected symptoms to your Supervisor or identify problems before they become injuries.

Applicable Nordion Job Function	Objective	Measures and Targets
	Encourage and assist co-workers in adopting safe work practices	• Following Nordion values and safety policies, coach co-workers who are observed to be working unsafely.
	Safety Talks	• Full participation and engagement during team safety talks by asking questions and voicing concerns
	Reduce environmental impacts	• Identify opportunities for reducing waste, and using less harmful material wherever possible. • Ensure EHS review and approves all new hazardous or environmentally harmful materials prior to ordering as well as any equipment designed to contain these materials
	Timely closure of EHS CAPAs	• Target 80% of generated CAPAs within your areas are closed (Actions complete, excluding CAPA verifications) within 1 year • Meet all CAPA target dates • Prioritize high risk EHS CAPAs

3.3 Concluding Remarks

On December 23, 2015, the CNSC provided Nordion with a Licence Conditions Handbook (LCH) which identifies the regulatory requirements and other relevant parts to ensure that Nordion maintains facility operations in accordance with the licensing basis for the facility as well as Nordion's Nuclear Substance Processing Facility Operating Licence. The LCH did not introduce new requirements, but rather, provided an explanation of how Nordion is expected to meet licence conditions and regulatory requirements.

Immediately following the receipt of the LCH, Nordion worked continuously throughout 2016 to introduce and roll out the License Conditions Handbook which included the following:

- A review of the LCH and assessment for any potential gaps
- An introduction of the LCH and training for all employees
- Updating all Licensing Documents identified in the LCH with Caution Notes that prompt Change Leaders to send Written Notification when changes are being made
- The creation of a document that lists Safety Control Measures and safety related Structures, Systems and Components

In 2016, an EHS compliance management software was rolled out to employees at the Ottawa site. This introduced a method to report and track near misses and hazard identifications. The new reporting method, along with regular team safety talks where near miss reporting continued to be encouraged, resulted in a 488% increase in near miss reporting from 8 in 2015 to 39 in 2016. Actions that result from near misses and hazard identifications are also tracked by the same software tool and are trended, discussed, and reported in the EHS Performance Report.

Nordion also continues to see an improvement in EHS CAPA closures as actions can now be tracked and monitored through the EHS software tool. Continued EHS and manager oversight address and highlight any CAPAs that may benefit from further management discussion. At the end of 2015 EHS CAPA closures within one year of initiation were below the target of 80% at 56% (Medical Isotopes) and 72% (Gamma Technologies). By the end of 2016, CAPA closures saw improvement at 57% (Medical Isotopes) and 80% (Gamma Technologies).

Effectiveness of the Emergency Response and Preparedness programs was demonstrated on June 14, 2016 during the Full Scale Emergency Response drill. Despite the favourable result and positive feedback from collaborative Emergency First Responders and the CNSC, Nordion continues to work towards the improvement of these programs.

Nordion also hosted a Community Café Open House on October 5, 2016 inviting community members and public stakeholders to attend an information session and engage in meaningful discussion. The event was considered a success based on the survey results (Refer to Appendix E). Nordion continues to develop its Public Information Program to ensure transparency and cultivate open dialogue between Nordion and community. Results from a public opinion survey conducted by a third party research company indicate that the majority of the public have a favourable opinion of Nordion and feel confident that control measures are in place keeping the community safe.

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.

FIGURES

Figure 1: Cobalt Production Technicians

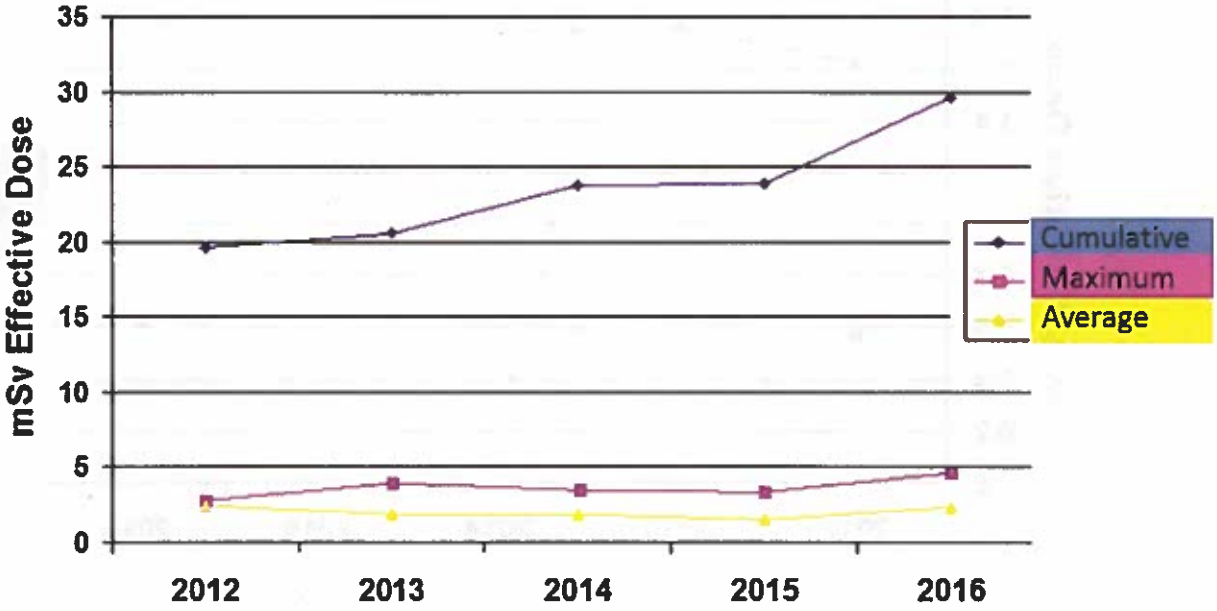


Figure 2: Cobalt Monitoring, Decontam and Shipping

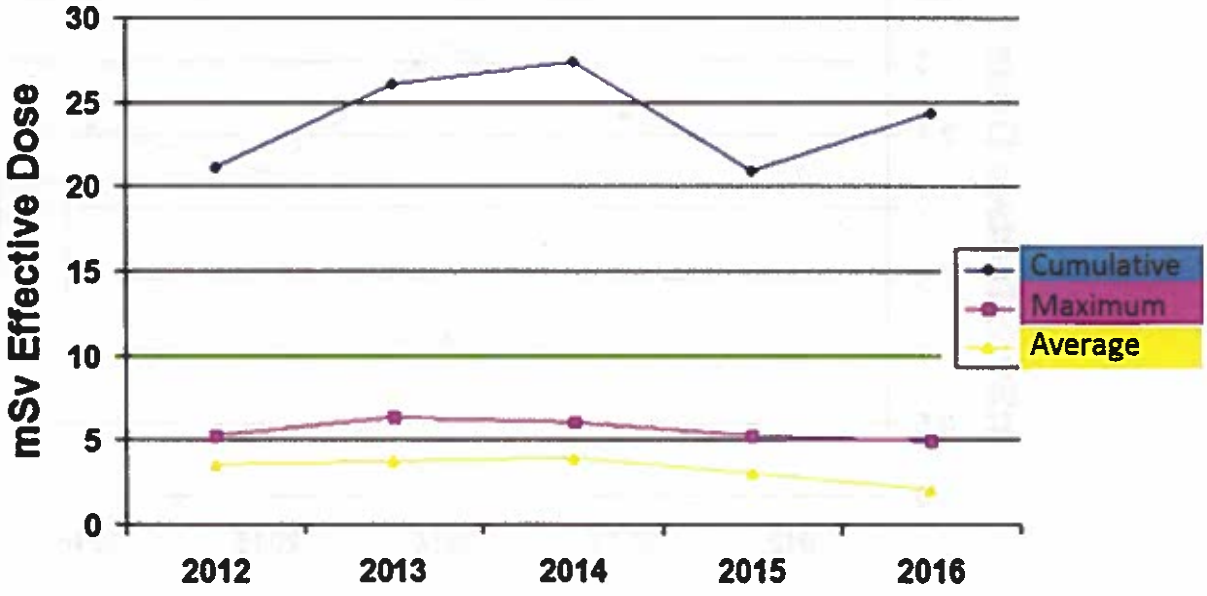


Figure 3: Cobalt Development

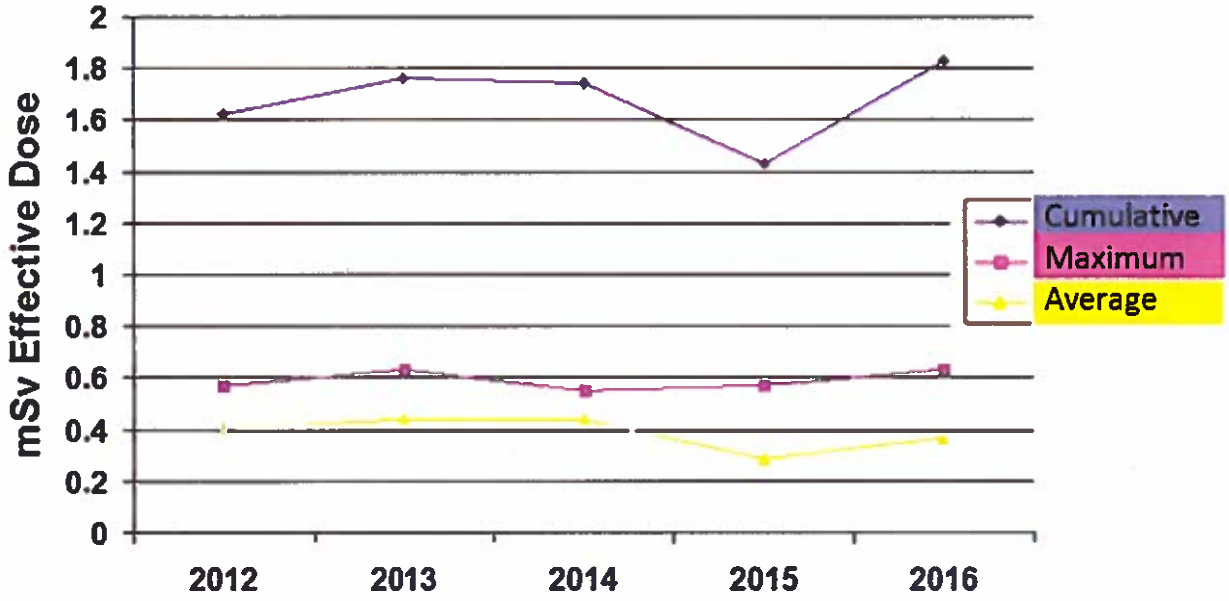


Figure 4: QC Cobalt

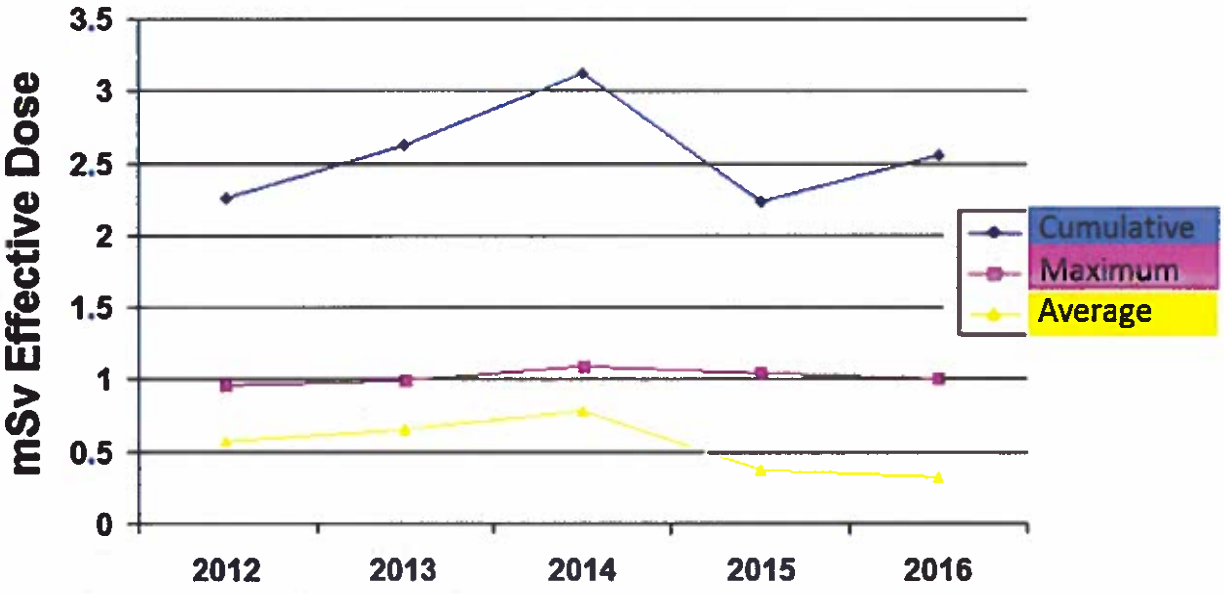


Figure 5: Radiopharm Development

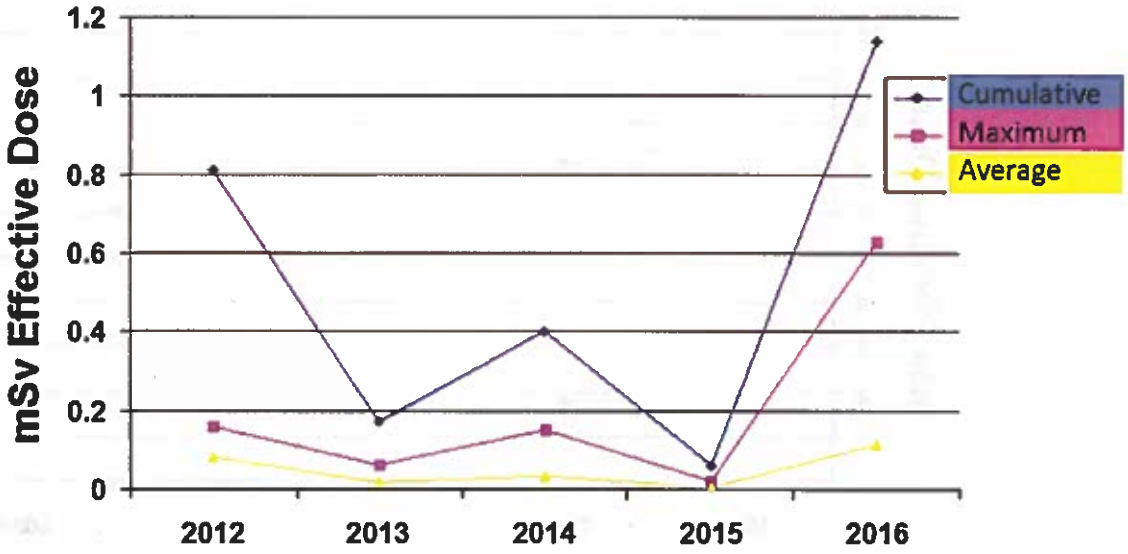


Figure 6: Technical Support

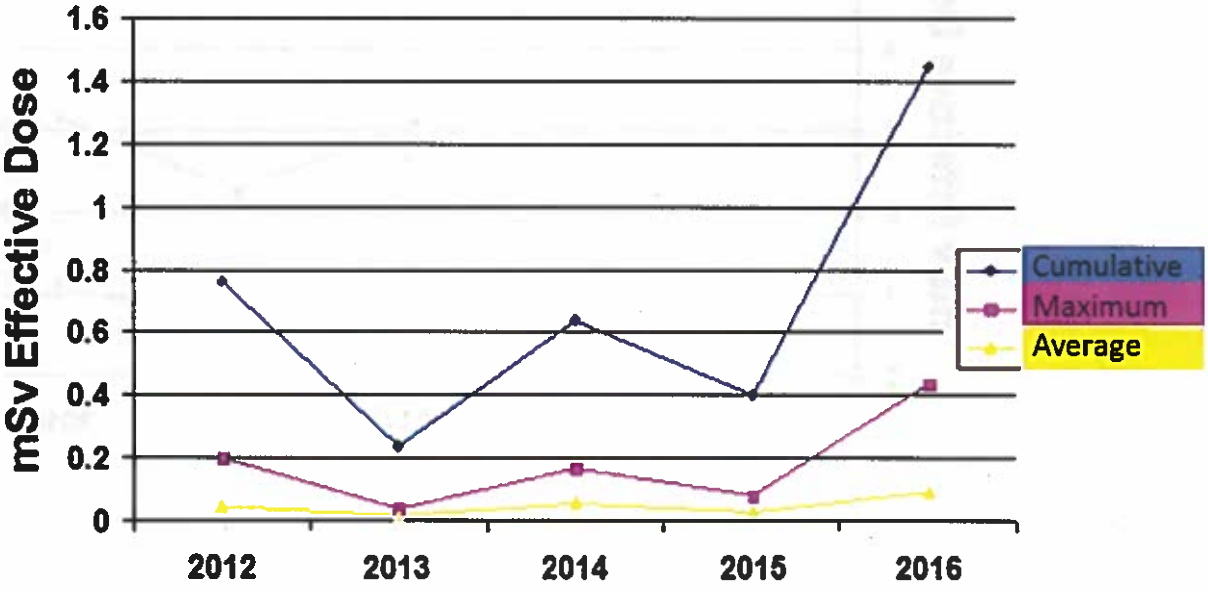


Figure 7: Nuclear Medicine Shippers, Waste, Containers

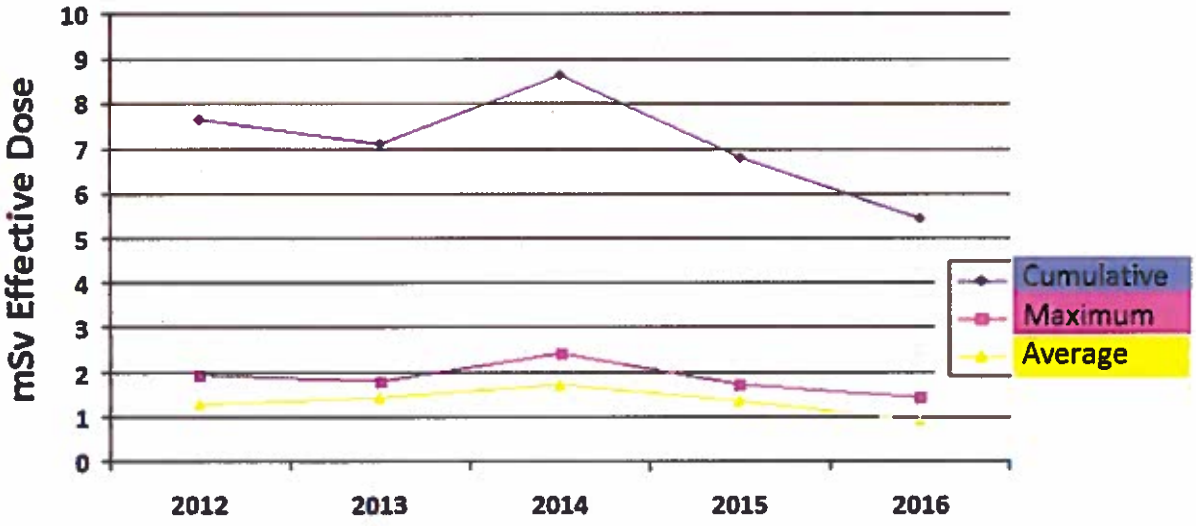


Figure 8: I-125, I-131 & Ir-192 Production Technicians

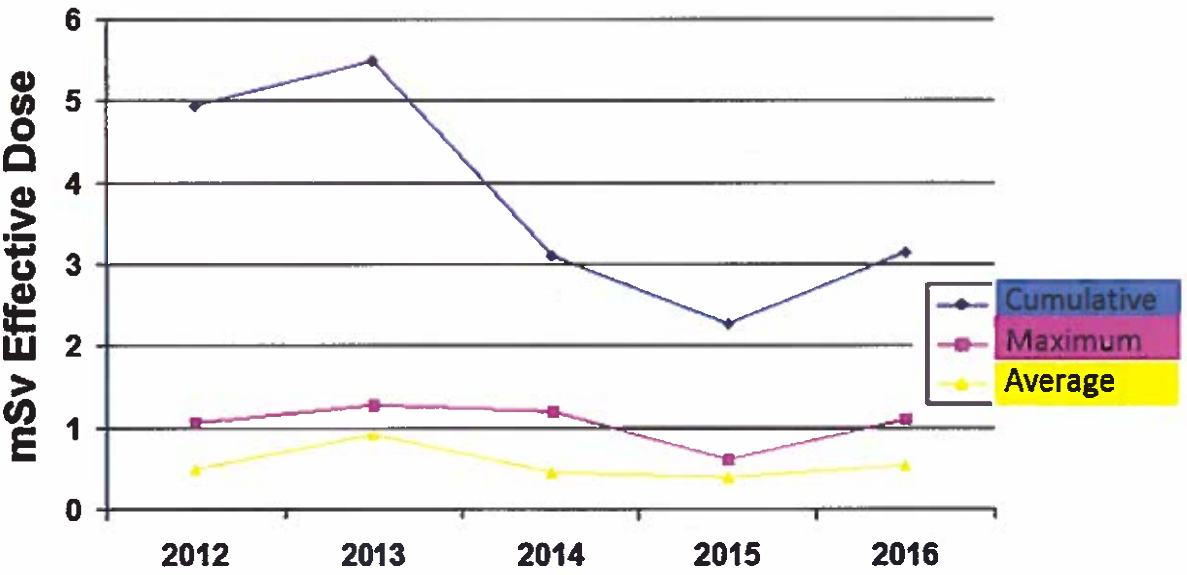


Figure 9: Mo-99, Xe-133 & Sr-82 Production Technicians

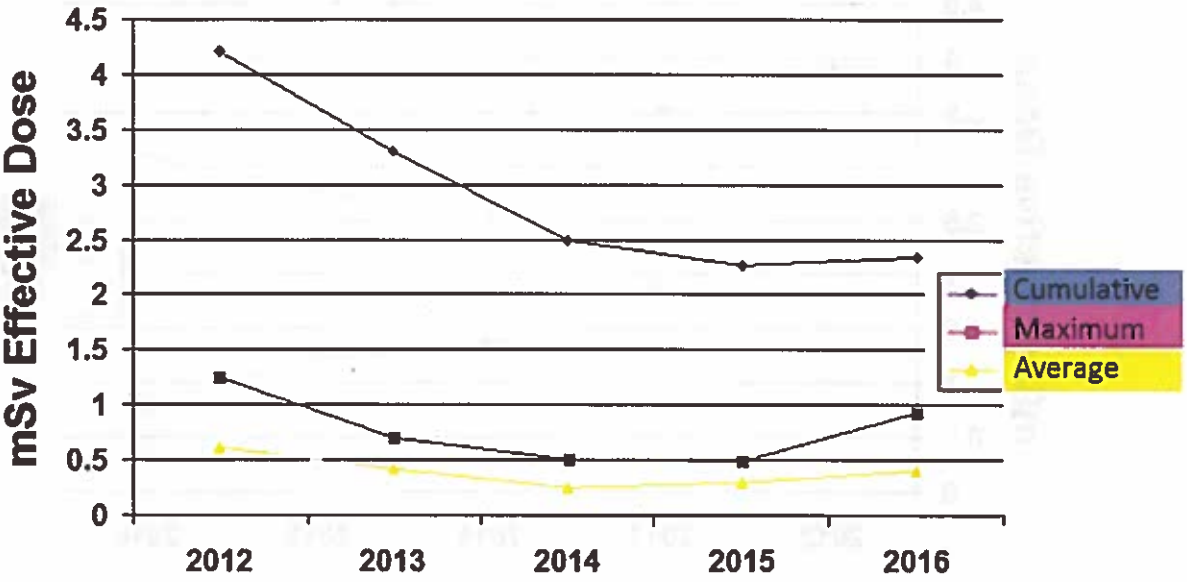


Figure 10: Radiopharm Production Technicians

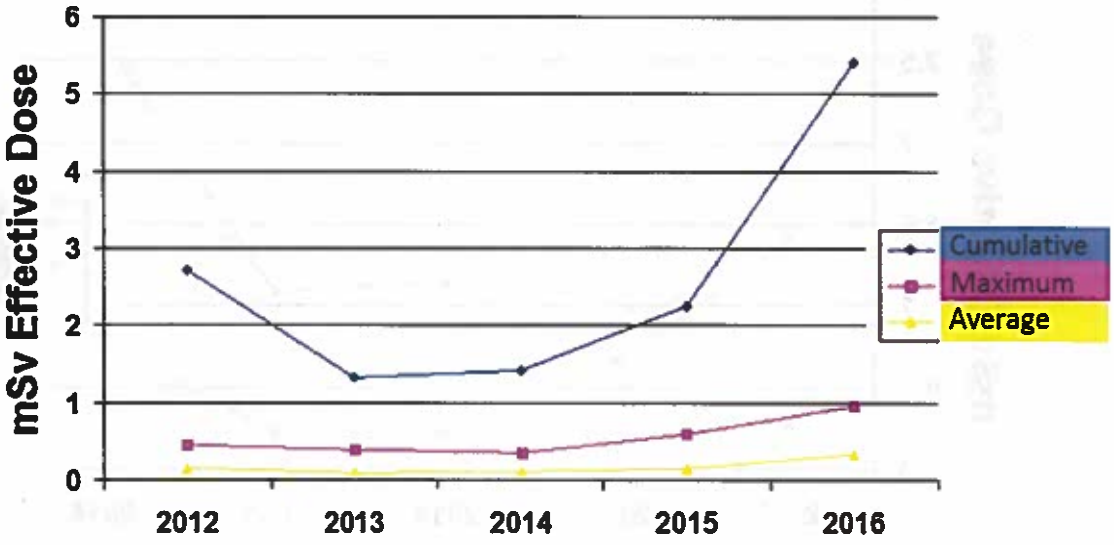


Figure 11: Machinists

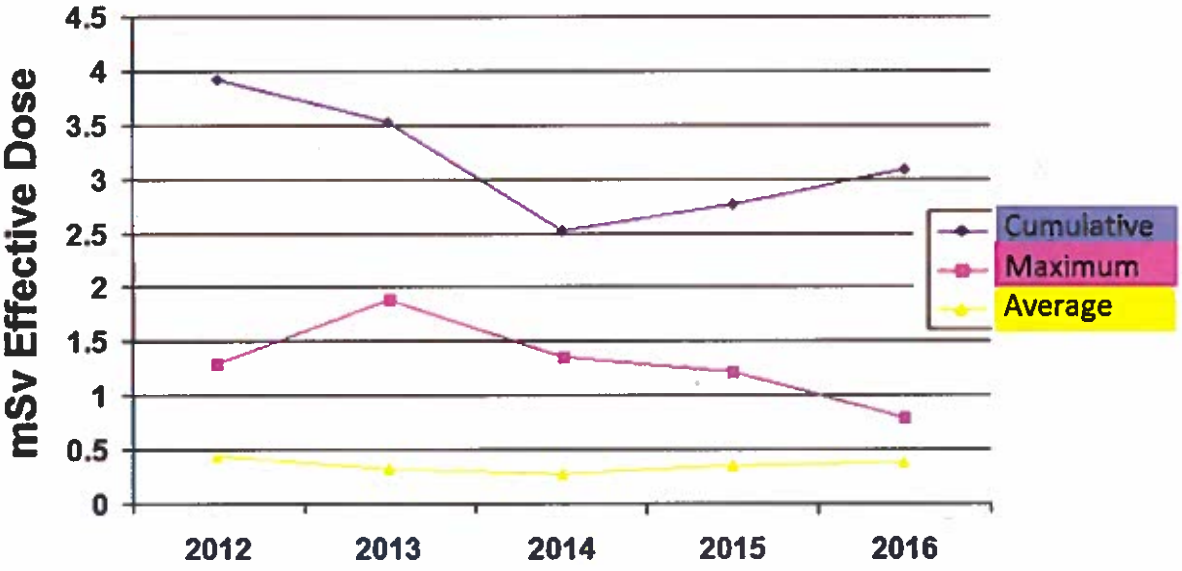


Figure 12: Nuclear Medicine QC

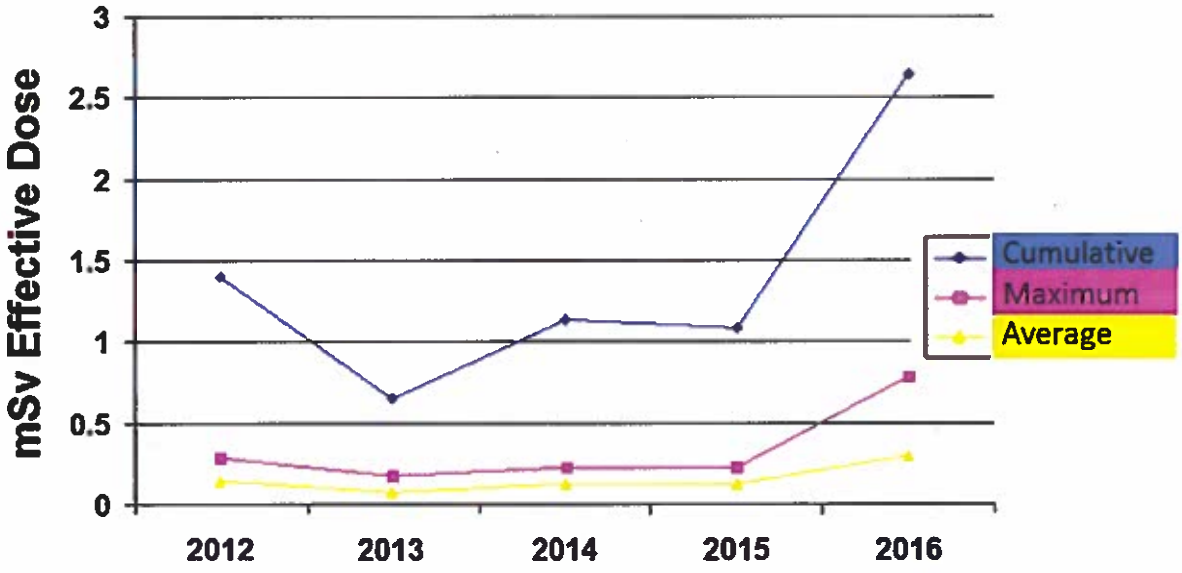


Figure 13: Surveyors

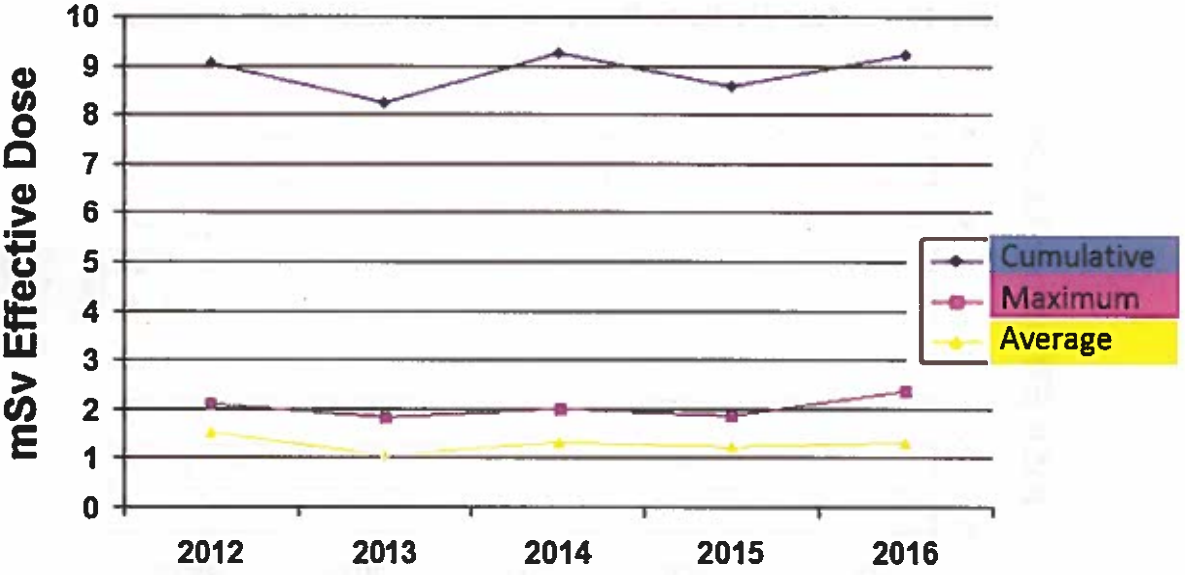


Figure 14: Nuclear Medicine Operators, Helpers

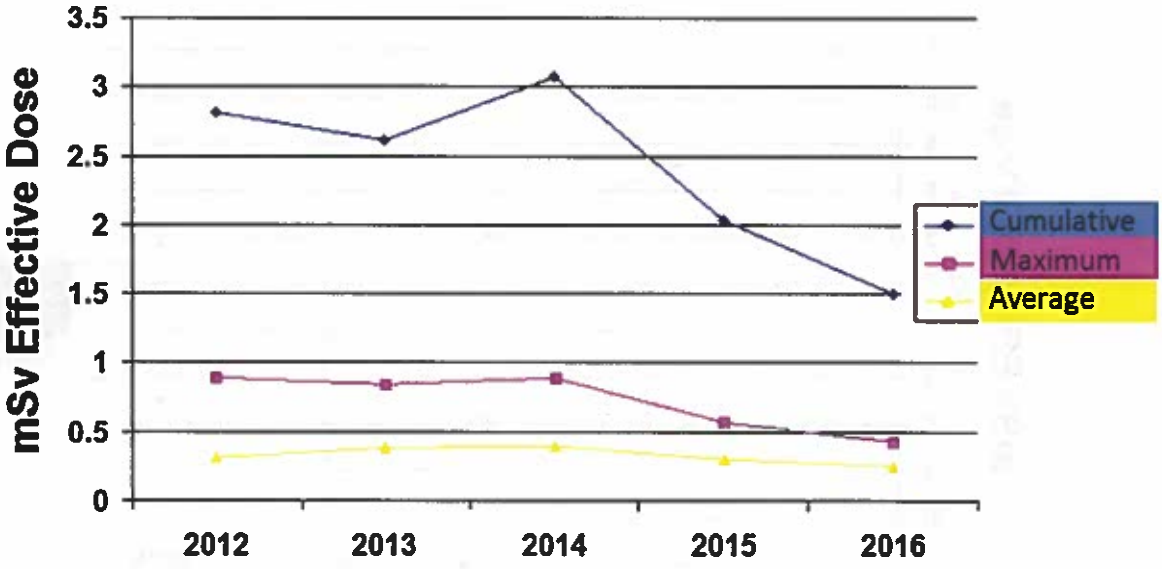


Figure 15: Nuclear Medicine Radiation and Contamination Monitors

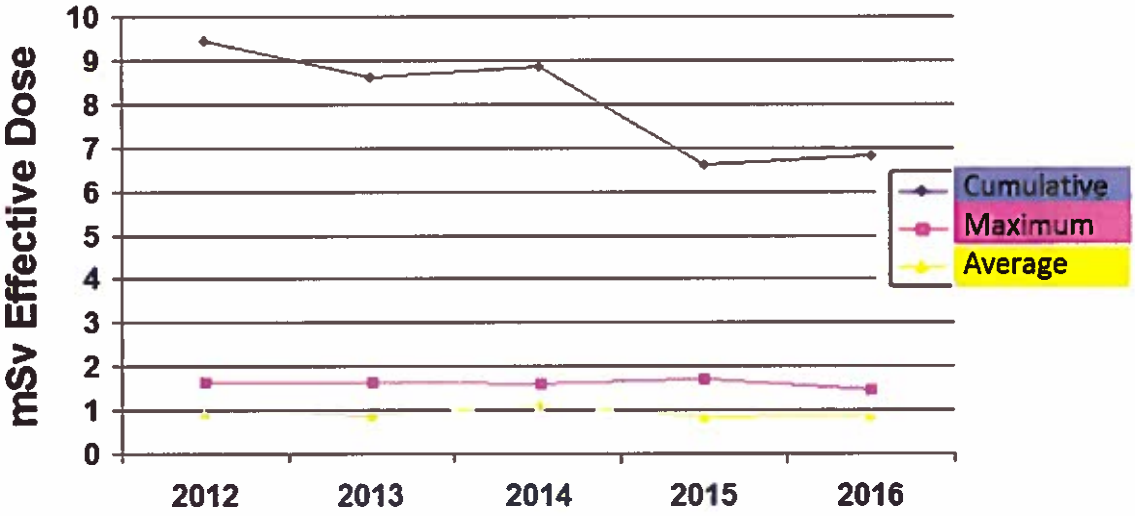


Figure 16: Facilities, Motor Pool

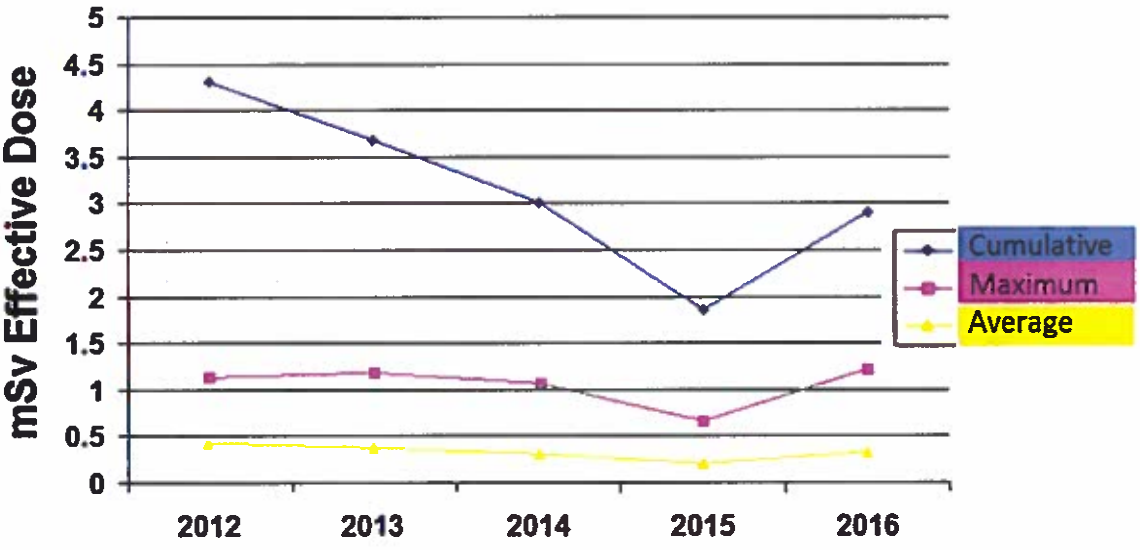


Figure 17: Facilities, Mechanical

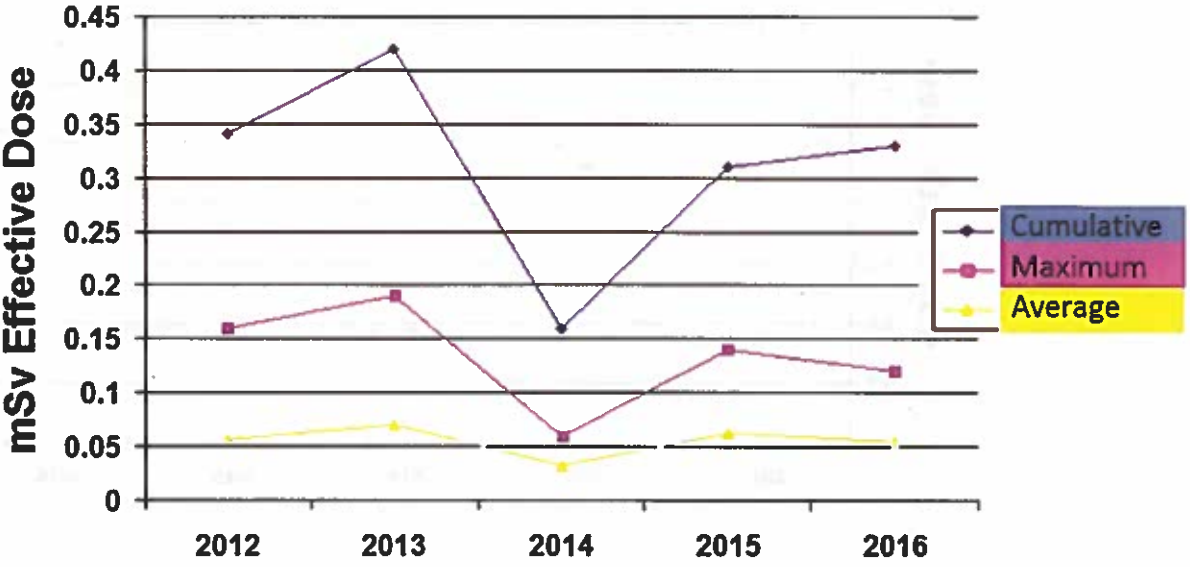


Figure 18: Radiopharm QC

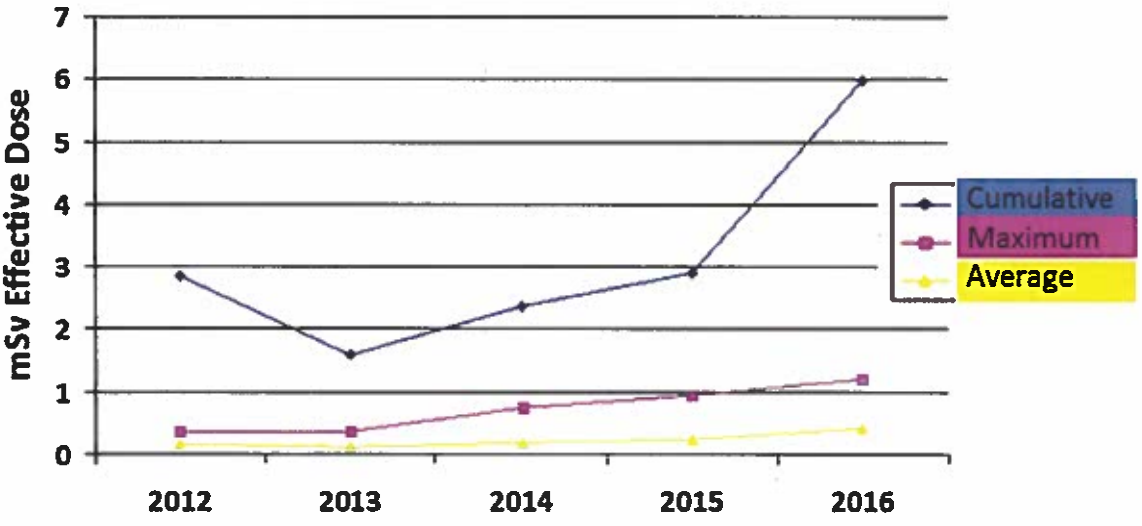


Figure 19: Facilities, Electricians & Electronic Calibration Lab

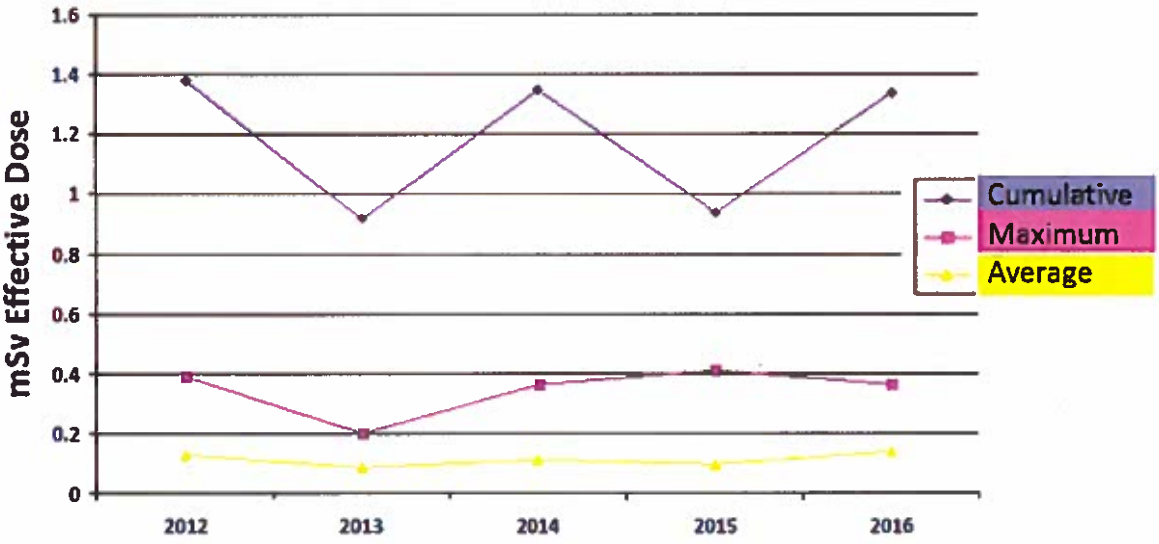


Figure 20 - Location of "Off Site" TLDs

Figure 21 - Location of "On Site" TLDs

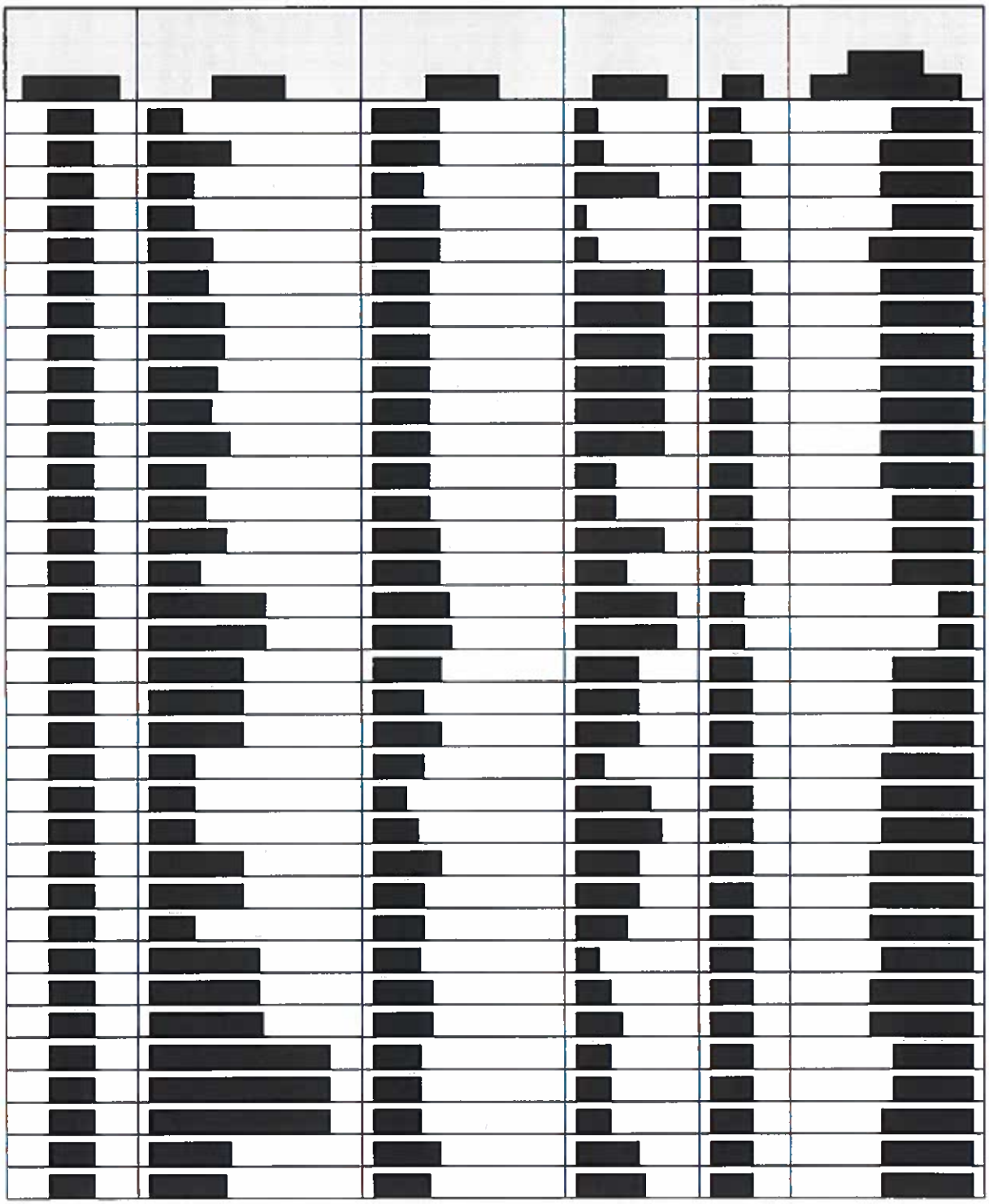
Figure 22: Groundwater Well Locations

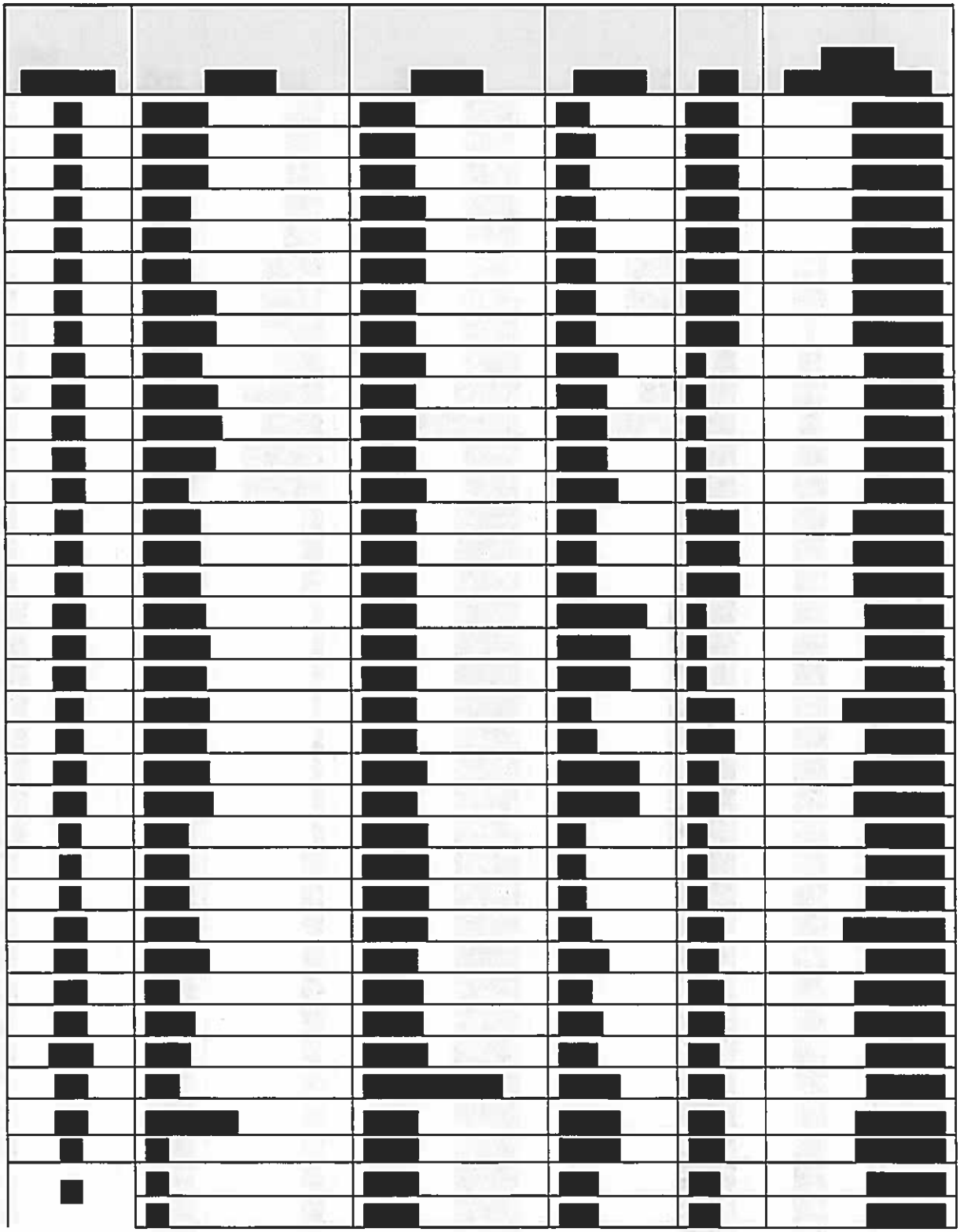
APPENDIX A
Reportable Events

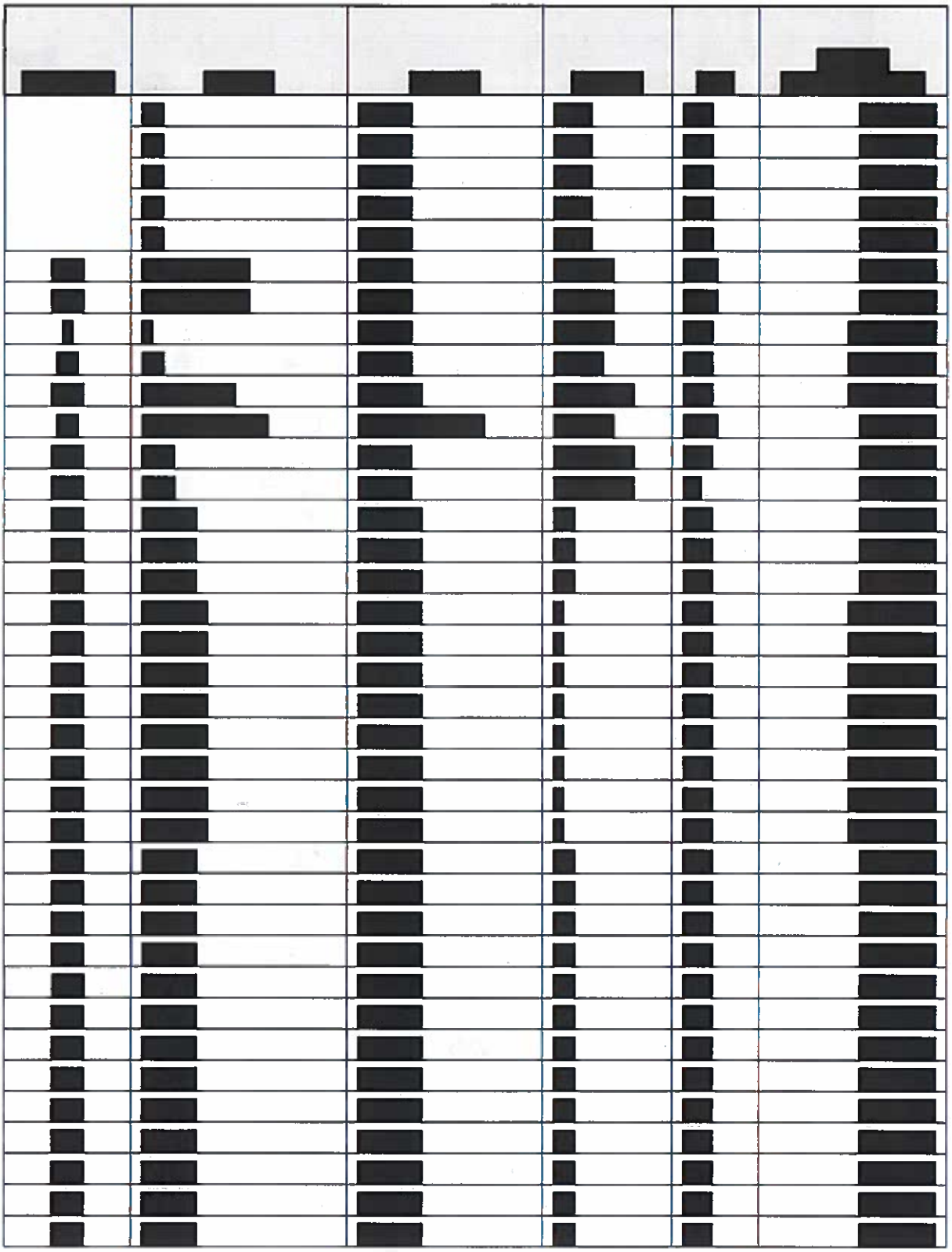
Date of Occurrence	Incident No.	Description	Regulation/Requirement to which the Event is Non-compliant and Reporting Requirement if applicable	Causes	Corrective Actions
16-Feb-03	16-02	A customer reported receiving Type A package with evidence of damage.	Noncompliance under Section 35(b) of the Packaging and Transport of Nuclear Substances Regulations (PTNSR) Reportable under Section 37(1) of PTNSR	Package was damaged in-transit.	Followed up with the carrier. No further action required by Nordion.
16-Feb-09	16-04	Excess levels of contamination found on a shipping skid returned to Nordion.	Noncompliance under Section 35(f) of the PTNSR Reportable under Section 37(1) of PTNSR	Not applicable; root cause conducted by customer.	Nordion notified customer who informed the consignor. No further actions were required by Nordion.
16-Feb-19	16-08	[redacted] package was not received by end user.	Noncompliance with Section 35(c) of the PTNSR Reportable under Section 37(1) of PTNSR	Not applicable: Root cause determination conducted by carrier.	Nordion provided feedback to the carrier. No further action required by Nordion.
16-Mar-17	16-10	A transport package was received with contamination in excess of the regulatory limits.	Noncompliance with Section 35(f) of the PTNSR Reportable under Section 37(1) of PTNSR	Potential water in drain line valve of the container.	A review of the current procedures and practices was performed by the supplier and Nordion. It was determined that no changes were required.

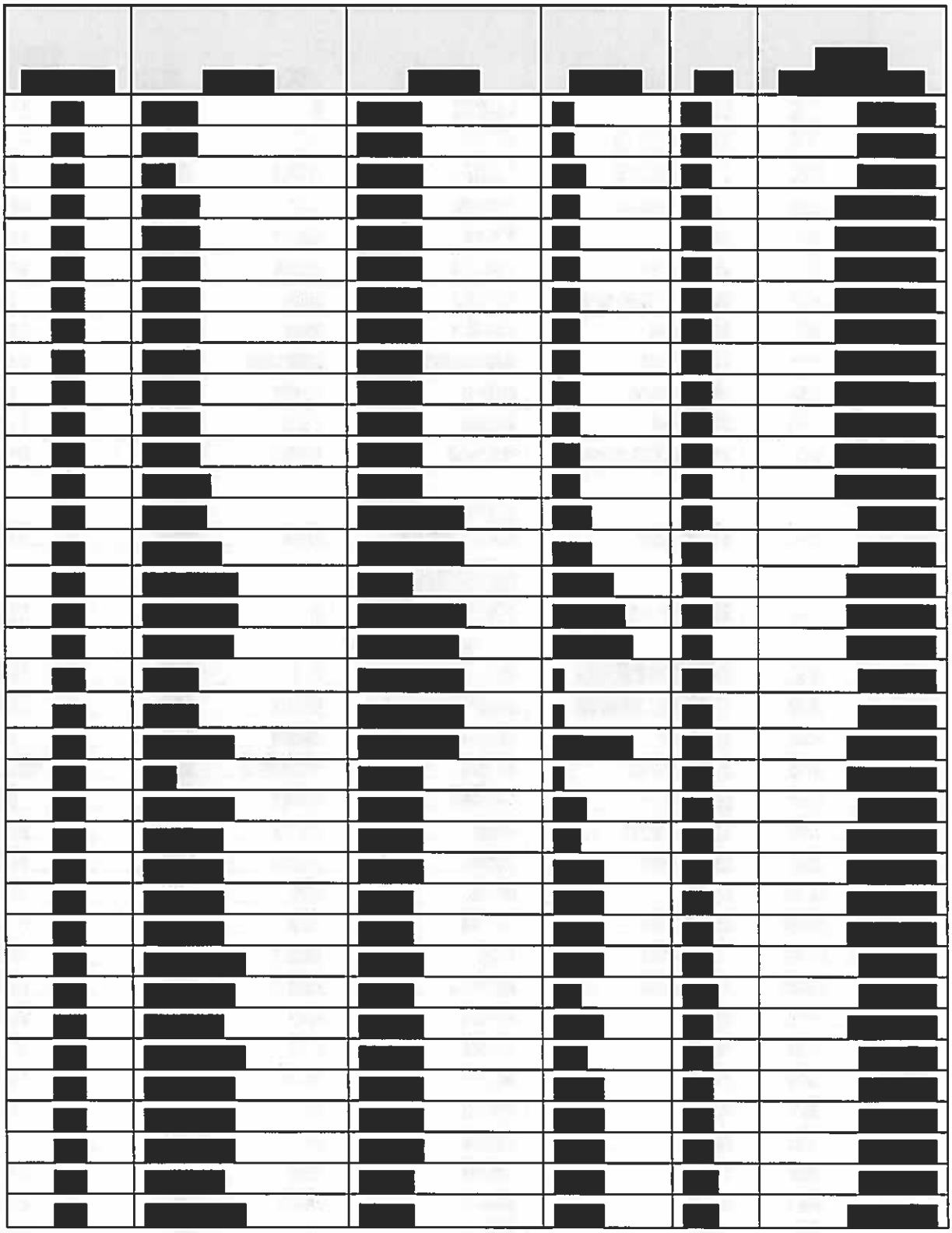
Date of Occurrence	Incident No.	Description	Regulation/Requirement to which the Event is Non-compliant and Reporting Requirement if applicable	Causes	Corrective Actions
16-Apr-07	16-11	Customer reported receiving Type A Package with contamination on the inside.	Noncompliance with Section 35(b) of the PTNSR Reportable under Section 37(1) of PTNSR	Unknown.	Nordion personnel were retrained in the package closure requirements.
16-May-19	16-15	A transport package was returned from a customer with one of the safety markings (heat emitter plate) damaged.	Noncompliance with Section 35(b) of the PTNSR Reportable under Section 37(1) of PTNSR	Safety marking damaged in-transit.	The package was repaired. No further action required by Nordion.
16-Jun-03	16-16	An Uninterruptible Power Supply (UPS) unit malfunctioned. The unit was unplugged. Smoke was visible from the unit; therefore, it was immediately removed from the building.	Reportable under Section 29(1)(f) of the General Nuclear Safety and Control Regulations	The unit had not received routine maintenance or battery replacement. The UPS was not installed as per manufacturer's specifications.	A review of all UPS units was completed to ensure they receive the required routine maintenance.
16-Jun-28	16-18	Nordion was preparing a shipment of sealed sources on behalf of a customer. During wipe testing of the sources, one source was found to have a wipe test that exceeded the 200 Bq limit.	Notification required as per Section 18(3) of the NSRDR	Not applicable: Root cause determination to be conducted by customer.	Customer was notified. No further action required by Nordion.
11-Aug-15	16-21	Dosimetry badges were inadvertently placed next to radioactive material during transit which resulted in elevated dose readings on a number of badges that exceeded action levels.	Reportable as per Nordion's Operating License Condition 8.1.	Communication and training	Nordion followed up with the courier and training was provided to employees emphasizing the importance of following special instructions regarding all shipments to the dosimetry provider.
16-Aug-10	16-27	Type A Package missing in-transit. Package was located four days later at the carrier's sorting hub, which was the package's intended location.	Noncompliance under Section 35(c) of the PTNSR Reportable under Section 37(1) of PTNSR	Not applicable: Root cause determination conducted by carrier.	Nordion discussed incident with carrier. No further action was required.

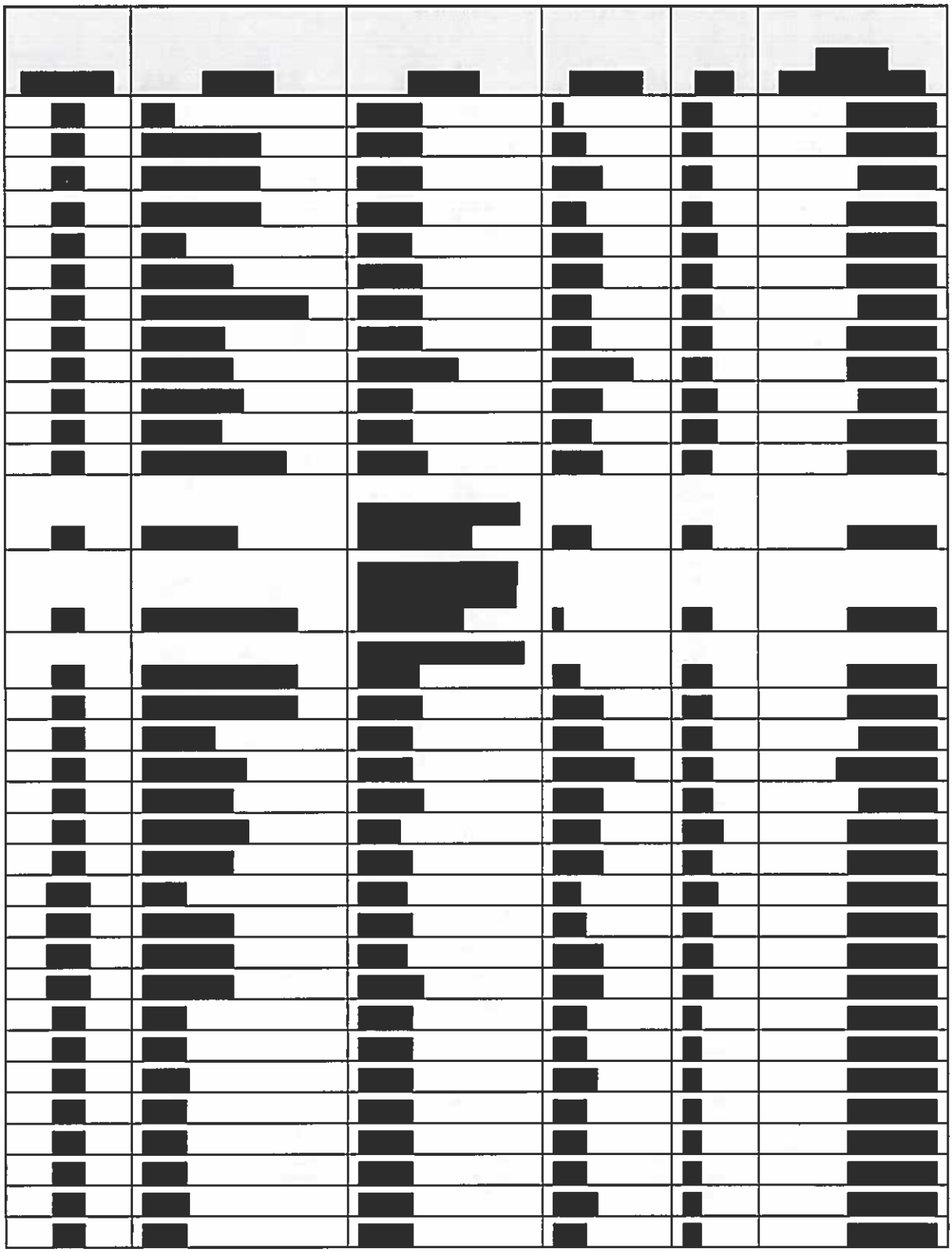
[redacted]

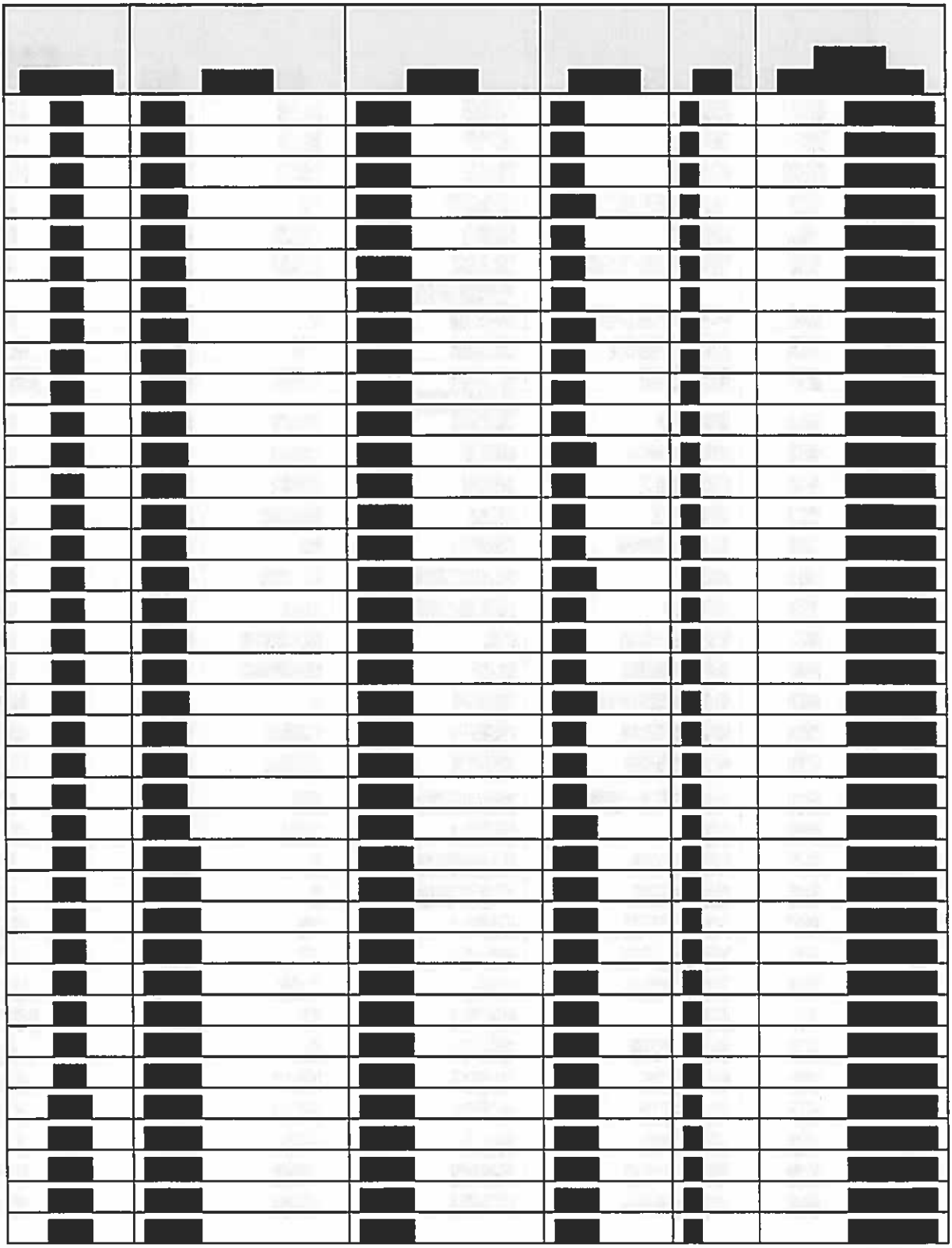


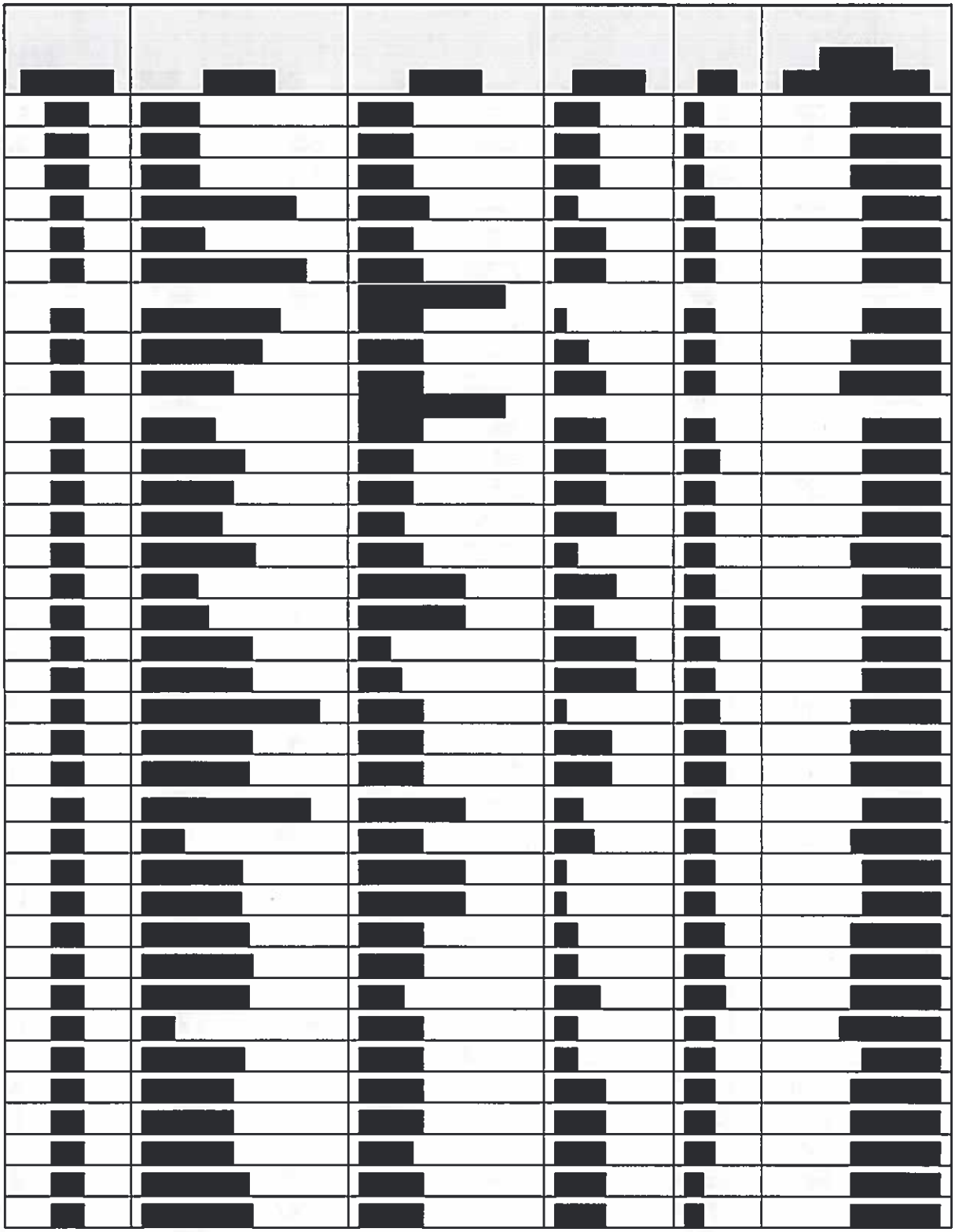


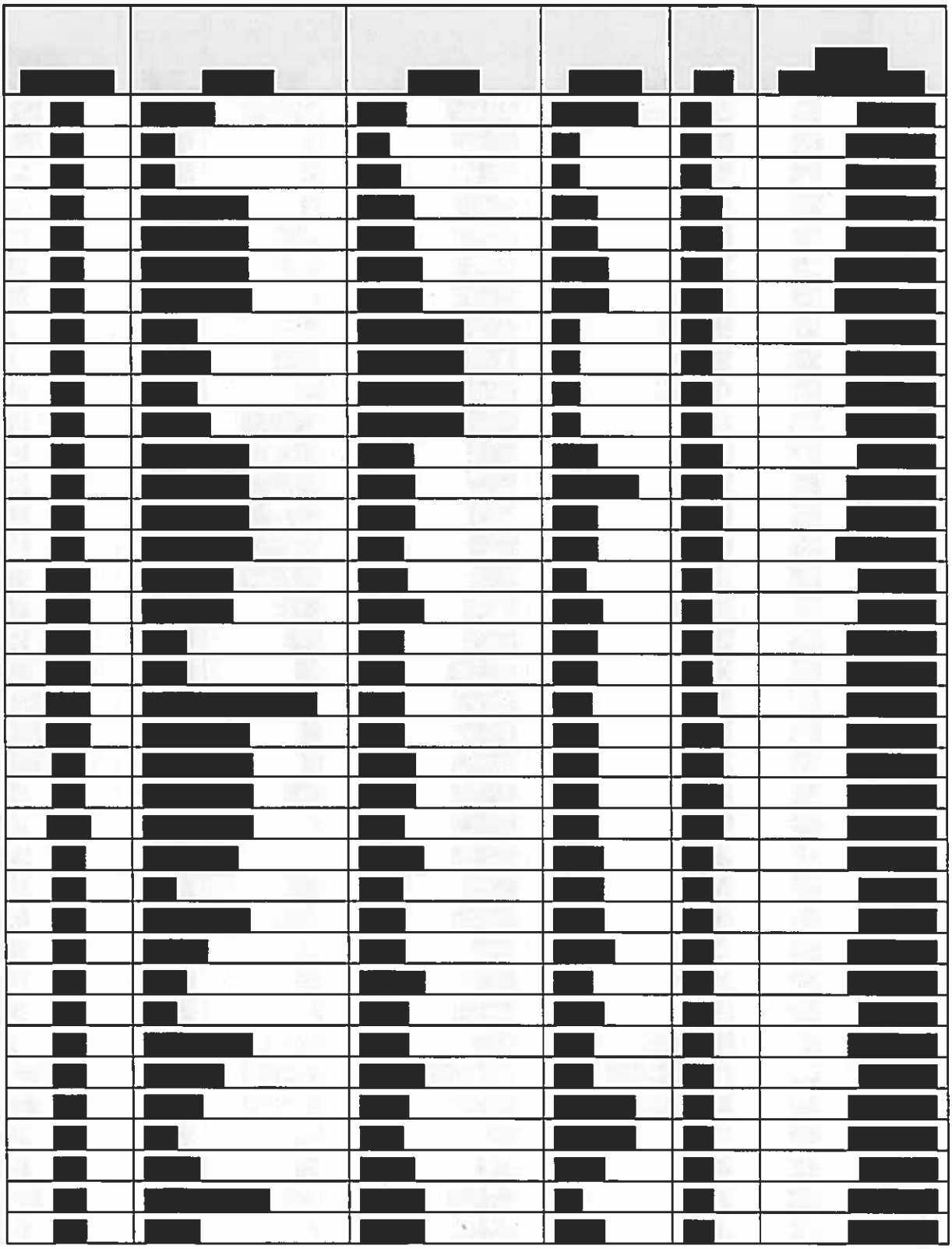


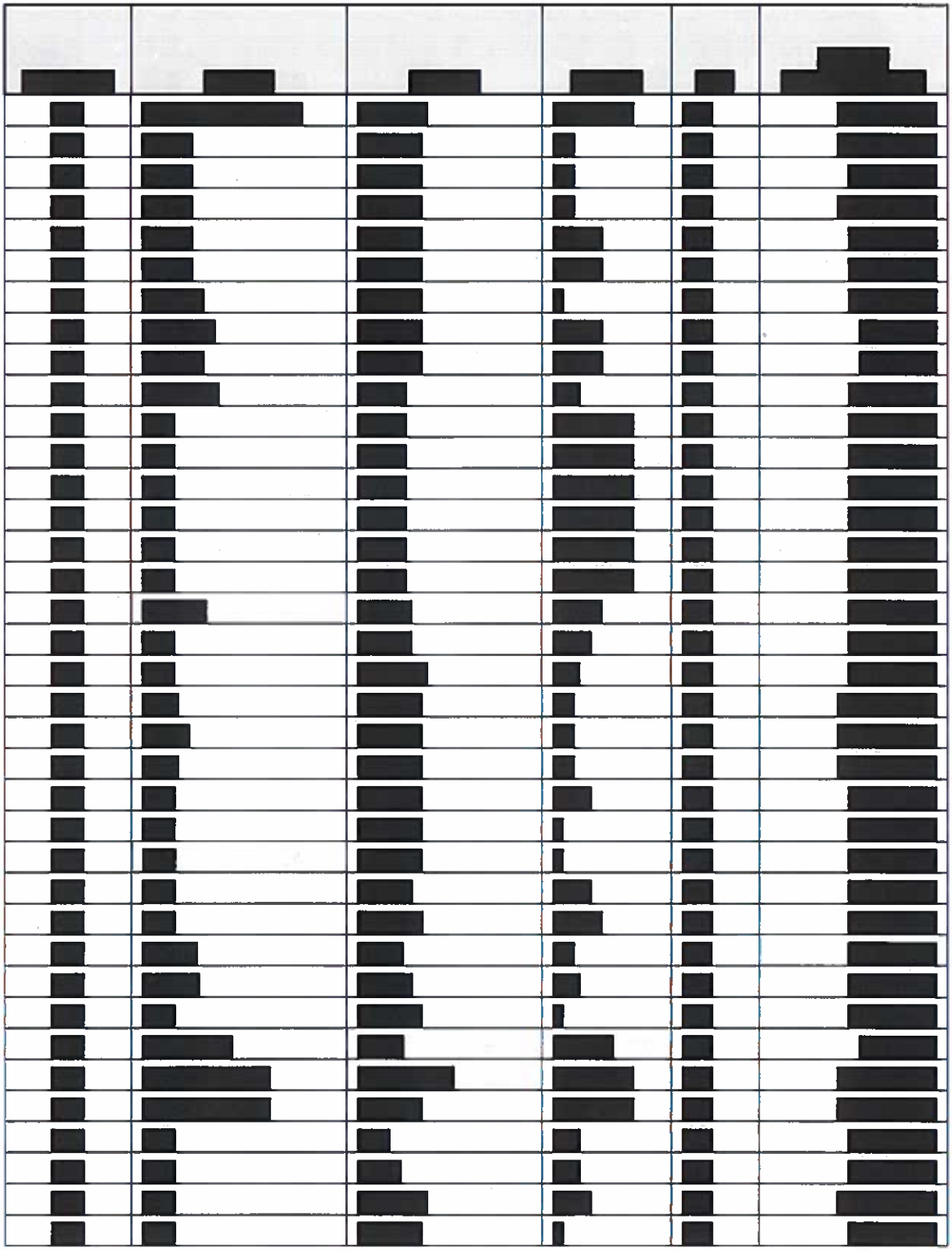


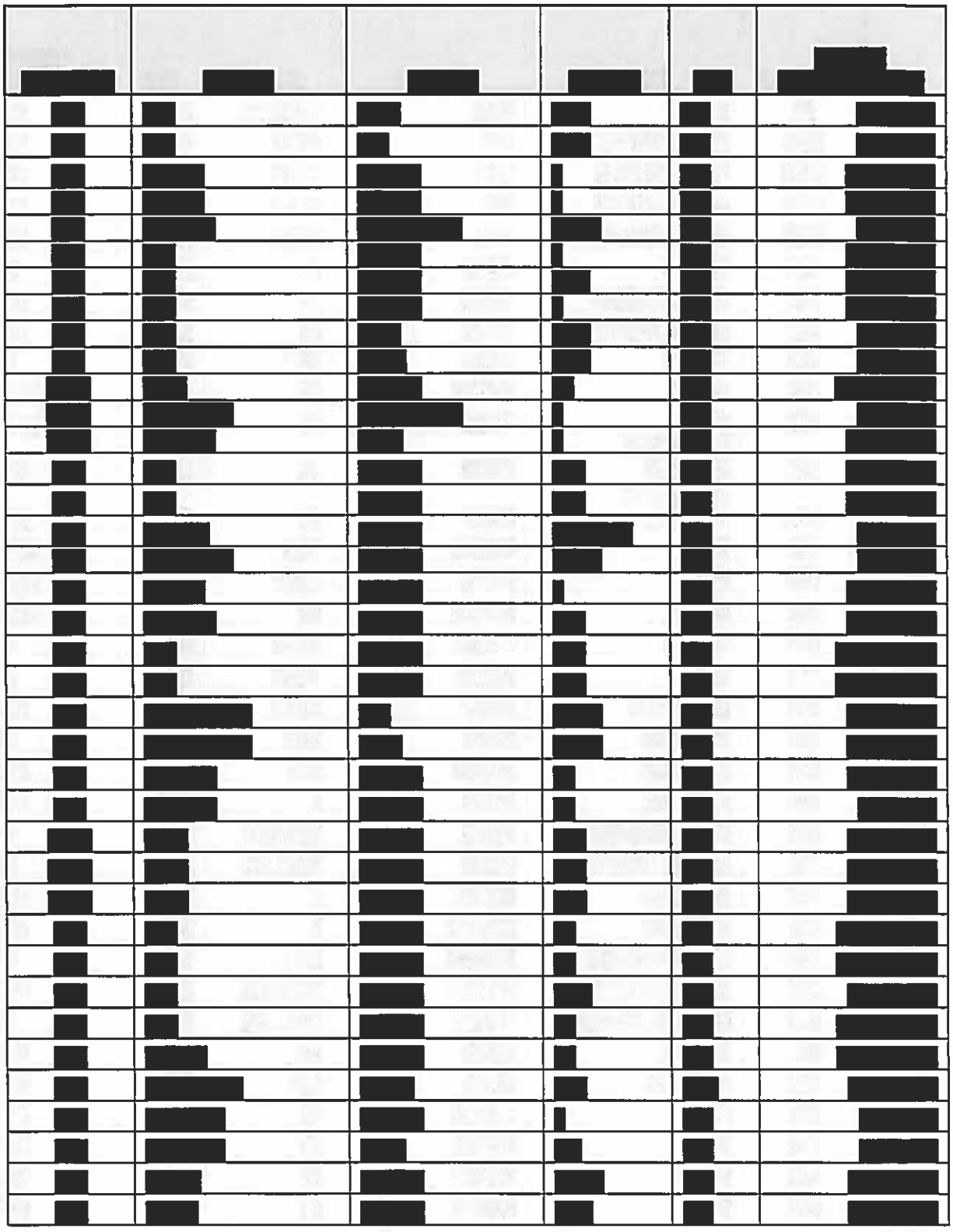


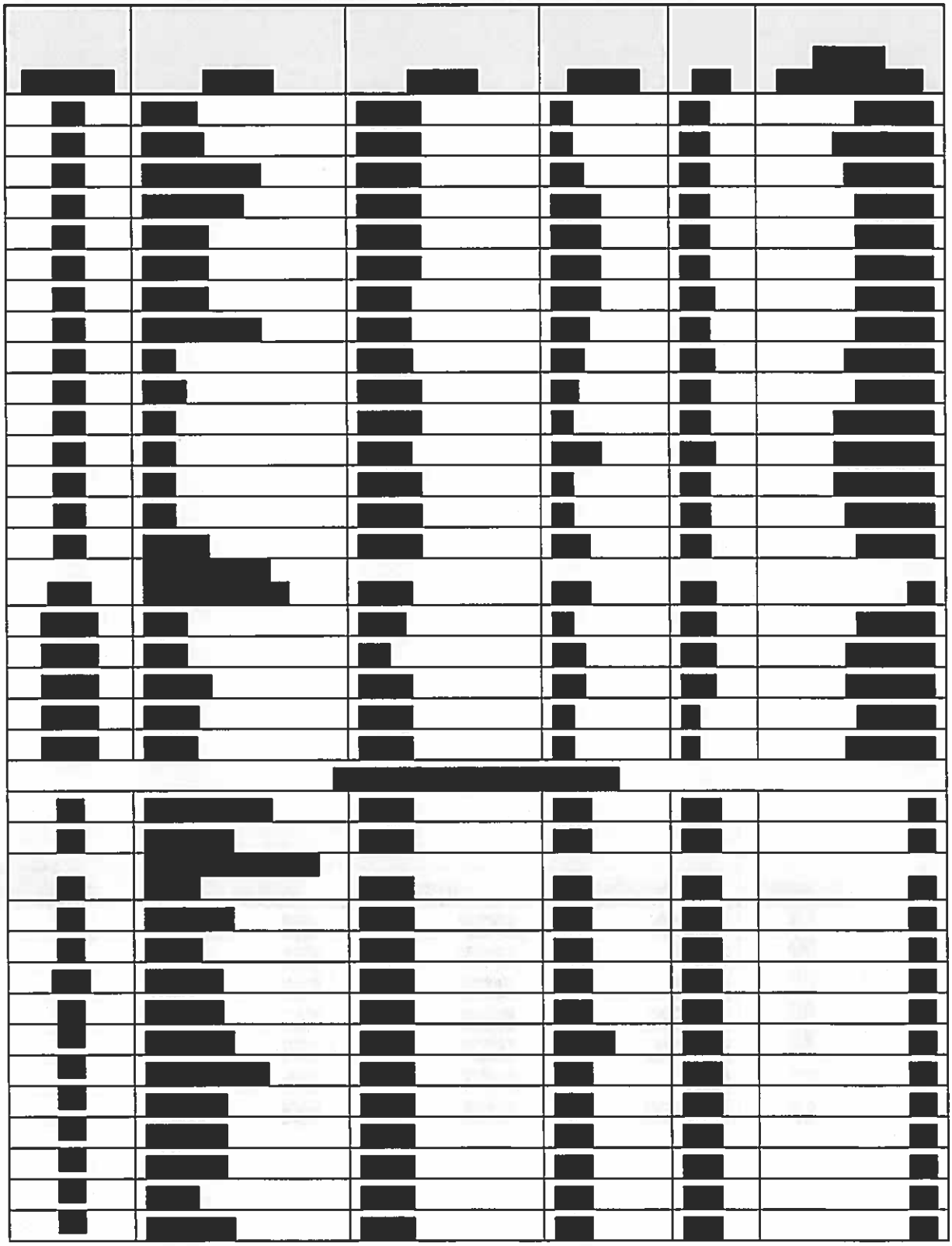




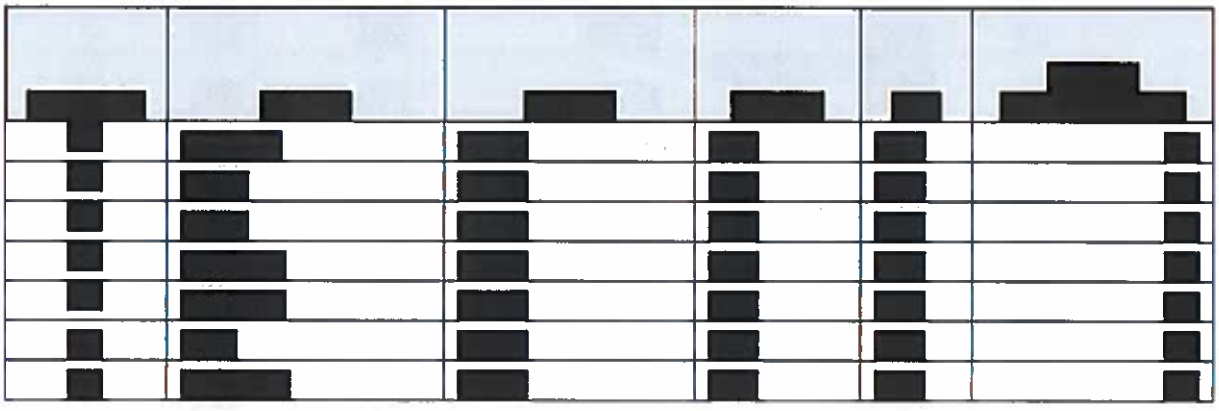


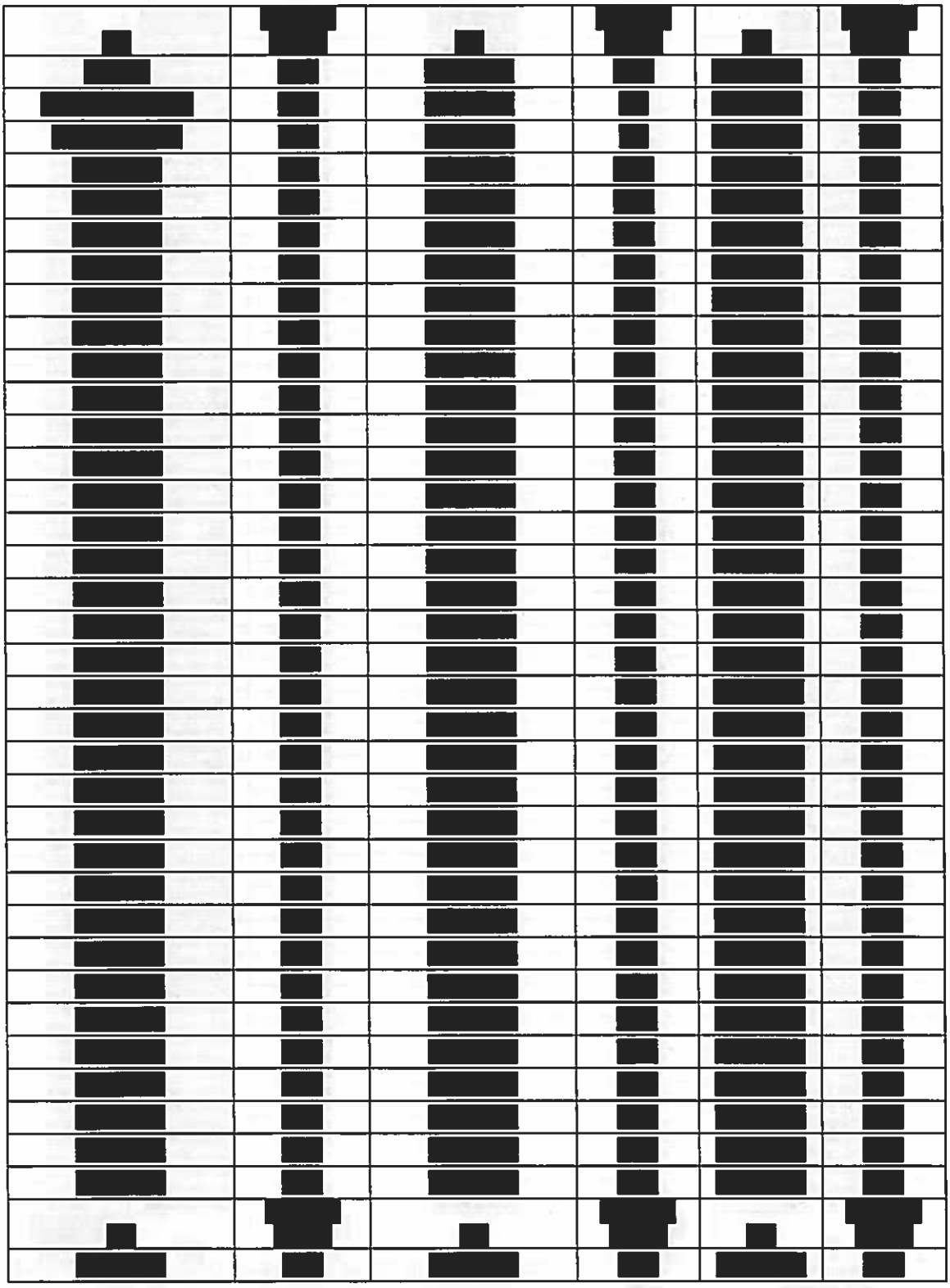


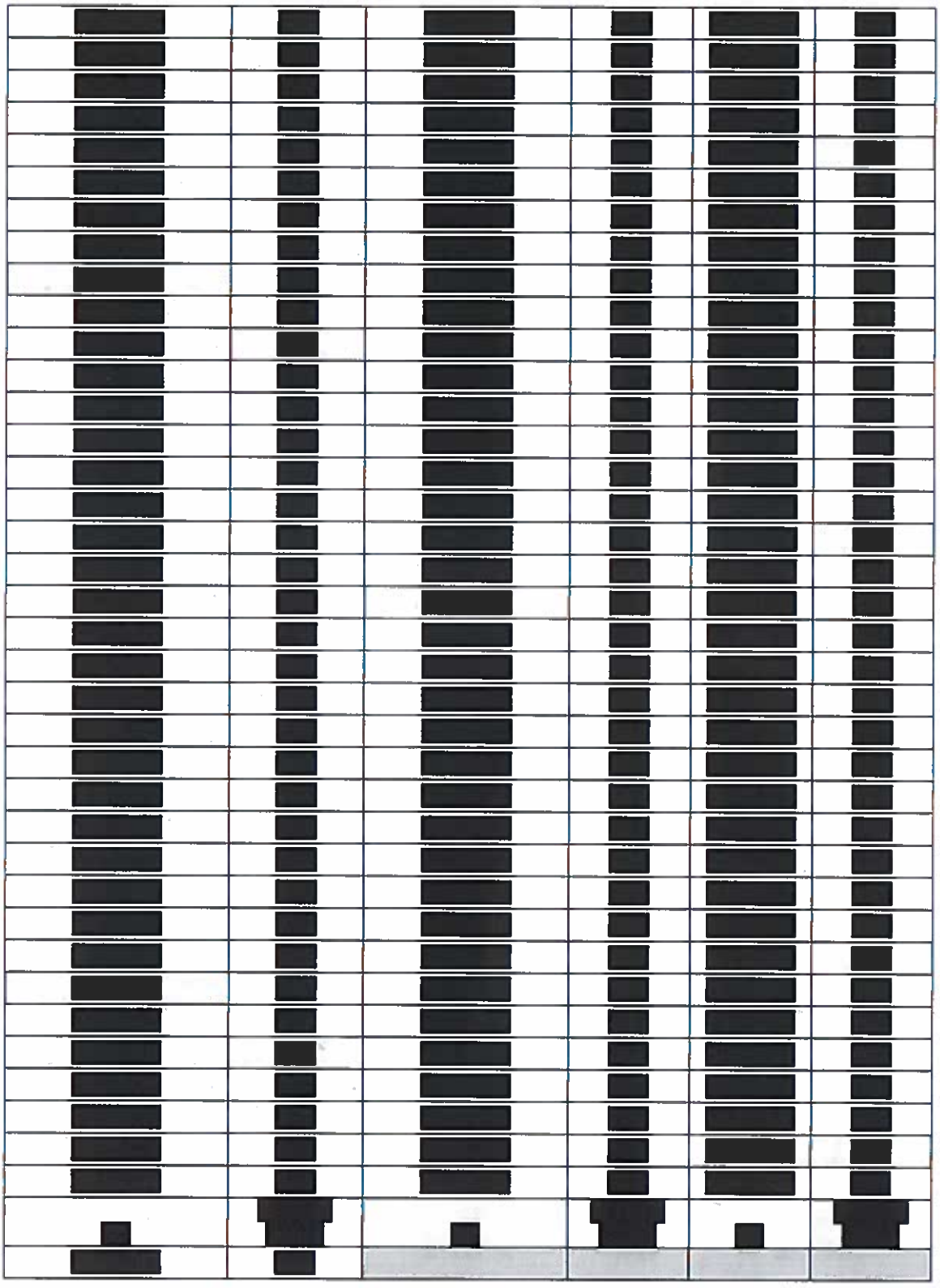




[redacted]







[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]
[redacted]	[redacted]	[illegible]	[illegible]	[illegible]	[illegible]

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

Sample Date:			2016-11-02	2015-10-05	2014-10-29	2013-09-18	2012-11-16	2011-11-01	2005-04-07 (Initial Sample)
Sample ID:			2005-BH2	2005-BH2	2005-BH2	2005-BH2	2005-BH2	2005-BH2	2005-BH2
Parameter	UNITS	MDL							
Alkalinity as CaCO3	mg/L	5	336	337	329	314	308	309	278
Biochemical Oxygen Demand	mg/L	1	<3	<1	<1	1	8	1	<1
Chemical Oxygen Demand	mg/L	5	<5	9	8	<5	29	5	7
Chloride (Cl)	mg/L	1	176	141	139	89	76	84	40
Conductivity	µS/cm	5	1200	1100	1080	888	834	828	676
Dissolved Organic Carbon	mg/L	0.5	0.7	2.8	2.2	1.6	5.7	1.6	1.6
N-NH3 (Ammonia)	mg/L	0.02	<0.01	<0.025	0.13	0.08	<0.02	<0.02	0.02
N-NO3 (Nitrate)	mg/L	0.1	1	0	0	0	0	0.24	0.53
pH			7.88	7.77	7.96	7.82	7.80	7.65	7.71
Sulphate (SO4)	mg/L	1	25	24	24	23	23	21	22
TDS (COND - CALC)	mg/L	5	816	715	702	577	542	538	439
Total Suspended Solids	mg/L	2	<3	81	58	24	18	56	1390
Calcium (Ca)	mg/L	1	134	124	125	97	92	94	80
Magnesium (Mg)	mg/L	1	50	48	44	37	33	32	29
Sodium (Na)	mg/L	2	47	36	38	30	29	25	18
Barium (Ba)	mg/L	0.01	0.02	0.03	0.02	0.02	<0.01	0.02	0.02
Boron (B)	mg/L	0.01	0.01	0.03	0.03	0.03	0.03	0.02	0.07
Iron (Fe)	mg/L	0.03	0.09	0.62	0.27	0.24	0.19	<0.03	<0.01
PHC F1 (C6-C10)	mg/L	0.2	<0.02	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F2 (C10-C16)	mg/L	0.2	<0.05	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F3 (C16-C34)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2
PHC F4 (C34-C50)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2

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

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

Sample Date:			2016-11-02	2015-10-05	2014-10-29	2013-09-18	2012-11-16	2011-11-01	2005-04-07 (Initial Sample)
Sample ID:			2005-BH2	2005-BH2	2005-BH2	2005-BH2	2005-BH2	2005-BH2	2005-BH2
Parameter	UNITS	MDL							
Alkalinity as CaCO3	mg/L	5	336	337	329	314	308	309	278
Biochemical Oxygen Demand	mg/L	1	<3	<1	<1	1	8	1	<1
Chemical Oxygen Demand	mg/L	5	<5	9	8	<5	29	5	7
Chloride (Cl)	mg/L	1	176	141	139	89	76	84	40
Conductivity	µS/cm	5	1200	1100	1080	888	834	828	676
Dissolved Organic Carbon	mg/L	0.5	0.7	2.8	2.2	1.6	5.7	1.6	1.6
N-NH3 (Ammonia)	mg/L	0.02	<0.01	<0.025	0.13	0.08	<0.02	<0.02	0.02
N-NO3 (Nitrate)	mg/L	0.1	1	0	0	0	0	0.24	0.53
pH			7.88	7.77	7.96	7.82	7.80	7.65	7.71
Sulphate (SO4)	mg/L	1	25	24	24	23	23	21	22
TDS (COND - CALC)	mg/L	5	816	715	702	577	542	538	439
Total Suspended Solids	mg/L	2	<3	81	58	24	18	56	1390
Calcium (Ca)	mg/L	1	134	124	125	97	92	94	80
Magnesium (Mg)	mg/L	1	50	48	44	37	33	32	29
Sodium (Na)	mg/L	2	47	36	38	30	29	25	18
Barium (Ba)	mg/L	0.01	0.02	0.03	0.02	0.02	<0.01	0.02	0.02
Boron (B)	mg/L	0.01	0.01	0.03	0.03	0.03	0.03	0.02	0.07
Iron (Fe)	mg/L	0.03	0.09	0.62	0.27	0.24	0.19	<0.03	<0.01
PHC F1 (C6-C10)	mg/L	0.2	<0.02	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F2 (C10-C16)	mg/L	0.2	<0.05	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F3 (C16-C34)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2
PHC F4 (C34-C50)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2

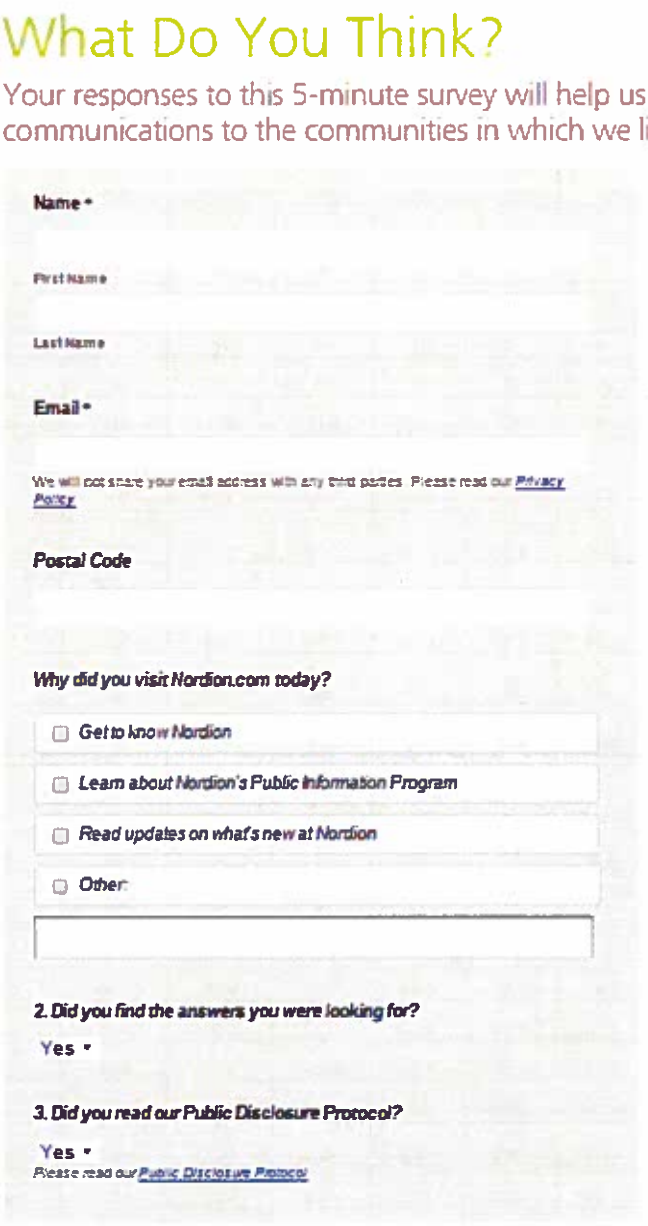
Borehole #3 (2005-BH3)

Sample Date:			2016-11-02	2015-10-05	2014-10-29	2013-09-18	2012-11-16	2011-11-01	2005-04-07 (Initial Sample)
Sample ID:			2005-BH3	2005-BH3	2005-BH3	2005-BH3	2005-BH3	2005-BH3	2005-BH3
Parameter	UNITS	MDL							
Alkalinity as CaCO3	mg/L	5	493	484	481	471	481	484	471
Biochemical Oxygen Demand	mg/L	1	<3	2	<1	2	>21	1	<1
Chemical Oxygen Demand	mg/L	5	<5	12	11	8	61	10	10
Chloride (Cl)	mg/L	1	63	69	66	59	57	56	64
Conductivity	µS/cm	5	1170	1150	1170	1140	1150	1120	1170
Dissolved Organic Carbon	mg/L	0.5	2.5	4.6	3.2	3.0	9.5	3.0	3.3
N-NH3 (Ammonia)	mg/L	0.02	<0.01	0.07	0.26	0.06	0.06	0.03	0.09
N-NO3 (Nitrate)	mg/L	0.1	0.40	0.31	0.35	<0.10	0.15	0.18	<0.10
pH			7.94	7.81	8.00	7.81	7.88	7.81	7.49
Sulphate (SO4)	mg/L	1	73	63	70	77	78	74	81
TDS (COND - CALC)	mg/L	5	796	748	760	741	748	728	761
Total Suspended Solids	mg/L	2	<3	22	18	8	8	6	496
Calcium (Ca)	mg/L	1	114	109	112	97	104	96	121
Magnesium (Mg)	mg/L	1	52	50	47	45	46	41	51
Sodium (Na)	mg/L	2	85	84	87	84	87	76	63
Barium (Ba)	mg/L	0.01	0.08	0.08	0.09	0.09	0.07	0.05	0.06
Boron (B)	mg/L	0.01	0.24	0.24	0.28	0.25	0.28	0.17	0.14
Iron (Fe)	mg/L	0.03	0.05	0.07	0.12	0.04	<0.03	<0.03	<0.01
PHC F1 (C6-C10)	mg/L	0.2	<0.02	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F2 (C10-C16)	mg/L	0.2	<0.05	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F3 (C16-C34)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2
PHC F4 (C34-C50)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2

Borehole #4 (2005-BH4)

Sample Date:			2016-11-02	2015-10-05	2014-10-29	2013-09-18	2012-11-16	2011-11-01	2005-04-07 (Initial Sample)
Sample ID:			2005-BH4	2005-BH4	2005-BH4	2005-BH4	2005-BH4	2005-BH4	2005-BH4
Parameter	UNITS	MDL							
Alkalinity as CaCO3	mg/L	5	297	271	272	264	245	275	279
Biochemical Oxygen Demand	mg/L	1	<3	1	2	2	5	1	<1
Chemical Oxygen Demand	mg/L	5	<5	11	13	<5	18	5	6
Chloride (Cl)	mg/L	1	25	28	22	18	15	32	15
Conductivity	µS/cm	5	670	701	665	657	611	684	646
Dissolved Organic Carbon	mg/L	0.5	3.3	3.2	3.4	2.5	4.7	2.9	2.1
N-NH3 (Ammonia)	mg/L	0.02	0.06	0.18	0.35	0.29	0.12	0.14	0.17
N-NO3 (Nitrate)	mg/L	0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
pH			7.99	7.85	8.10	7.97	7.92	7.53	7.84
Sulphate (SO4)	mg/L	1	54	56	58	55	56	52	41
TDS (COND - CALC)	mg/L	5	450	456	432	427	397	445	420
Total Suspended Solids	mg/L	2	<3	<2	4	<2	10	4	175
Calcium (Ca)	mg/L	1	49	54	45	36	36	56	39
Magnesium (Mg)	mg/L	1	21	22	18	16	14	21	18
Sodium (Na)	mg/L	2	71	70	78	81	78	47	76
Barium (Ba)	mg/L	0.01	0.08	0.08	0.08	0.07	0.05	0.08	0.07
Boron (B)	mg/L	0.01	0.20	0.21	0.27	0.22	0.24	0.11	0.19
Iron (Fe)	mg/L	0.03	0.43	0.69	1.26	0.29	0.71	0.23	0.16
PHC F1 (C6-C10)	mg/L	0.2	<0.02	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F2 (C10-C16)	mg/L	0.2	<0.05	<0.2	<0.2	<0.1	<0.1	<0.1	<0.2
PHC F3 (C16-C34)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2
PHC F4 (C34-C50)	mg/L	0.5	<0.4	<0.5	<0.5	<0.2	<0.2	<0.2	<0.2

Appendix D
Copy of Nordion Feedback Survey on nordion.com - Public Disclosure Protocol Consultation



What Do You Think?

Your responses to this 5-minute survey will help us to further refin communications to the communities in which we live and work.

Name *

First Name

Last Name

Email *

We will not share your email address with any third parties. Please read our Privacy Policy

Postal Code

Why did you visit Nordion.com today?

- ☐ Get to know Nordion
- ☐ Learn about Nordion's Public Information Program
- ☐ Read updates on what's new at Nordion
- ☐ Other:

2. Did you find the answers you were looking for?

Yes

3. Did you read our Public Disclosure Protocol?

Yes

Please read our Public Disclosure Protocol

4. If you answered "Yes" to #3, was there anything you think we could add or change to make the information more clear?

5. What was your level of understanding of Nordion's Public Information Program before you visited Nordion.com today?

High

6. What was your level of understanding of Nordion's Public Information Program before you visited Nordion.com today?

High

7. How do you prefer to receive updates from Nordion?

- Twitter
- Facebook
- Nordion.com
- Email
- Any of the above
- Other

8. Please provide any additional comments you have on our Public Information Program.

Appendix E
Community Café – Ads and Summary Report of Results

Copy of ads placed in the September 2016 issues of the *Kanata Kourier*

2016
COMMUNITY
Café

You're invited to Nordion's Community Café on October 5th

FACT
Nordion is a Class 1B nuclear facility and has safely operated in Kanata for 50+ years

FACT
We foster a safety-minded culture to protect employees, neighbours and the environment

FACT
We want to hear from you! Bring us your questions and concerns

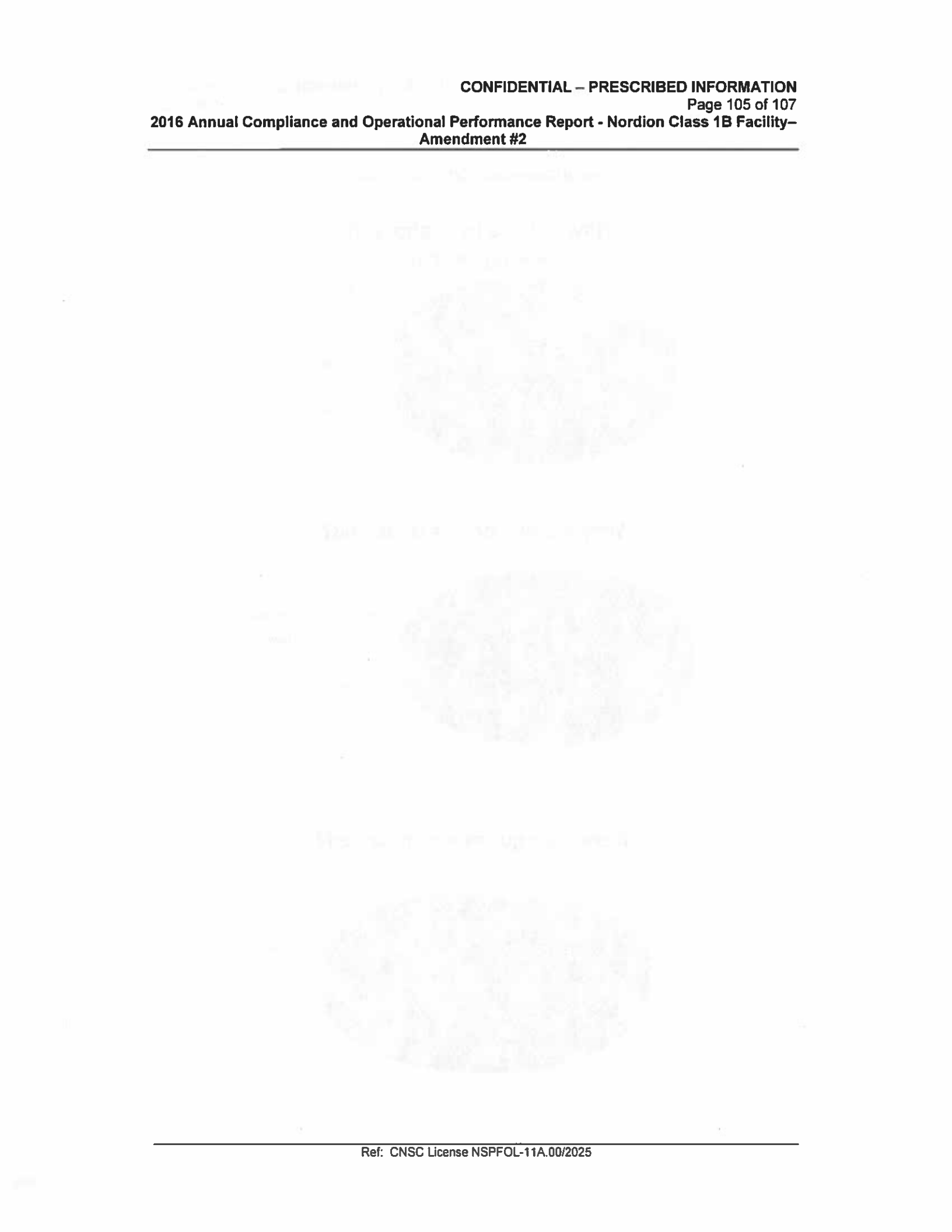
nordion
SCIENCE ADVANCING HEALTH

The Nordion team extends a warm
welcome to you
to attend our information session

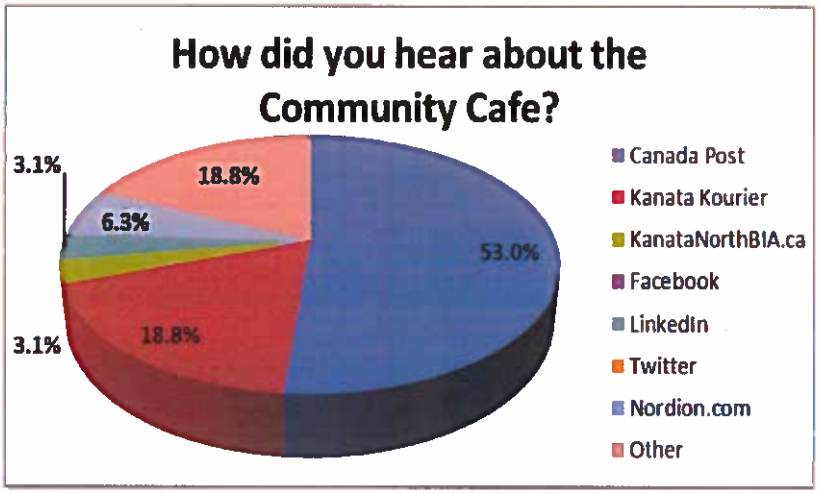
DATE / TIME
Wednesday, October 5th, 2016
Arrival 6:30-7:00 pm
Info Session 7:00-7:30 pm
Q&A 7:30-8:00 pm

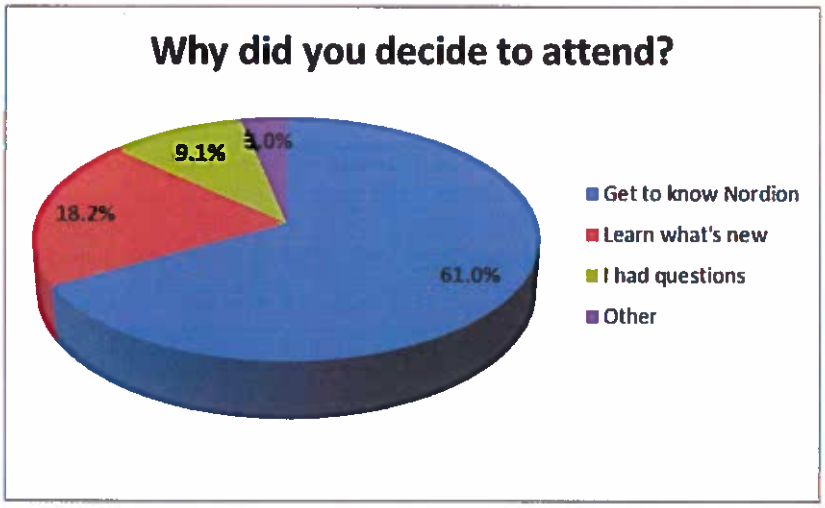
VENUE
The Marshes Golf Club
Buckhorn Room
320 Terry Fox Dr.
Kanata, Ontario K2K 3L1
Refreshments and snacks will be provided

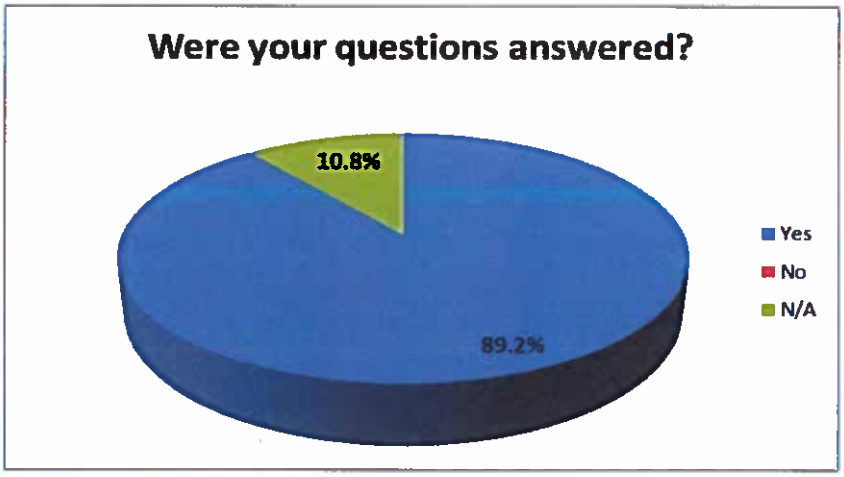
nordion
SCIENCE ADVANCING HEALTH
www.nordion.com

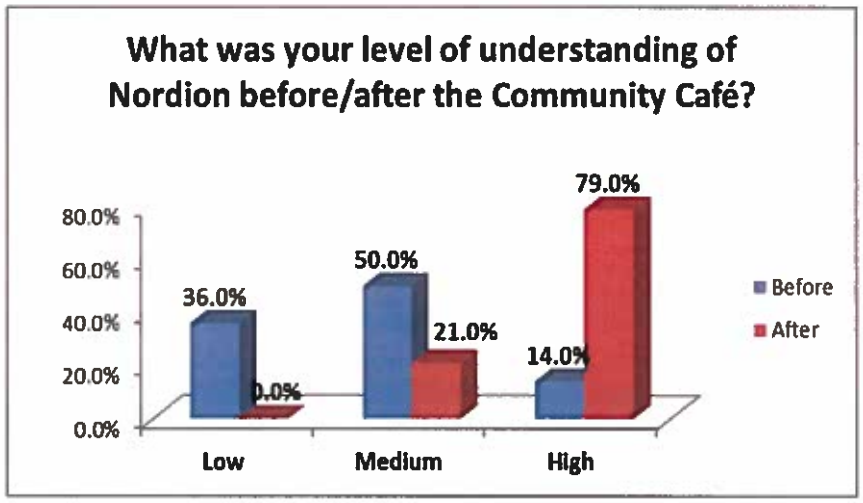


Copy of Community Café Survey Results

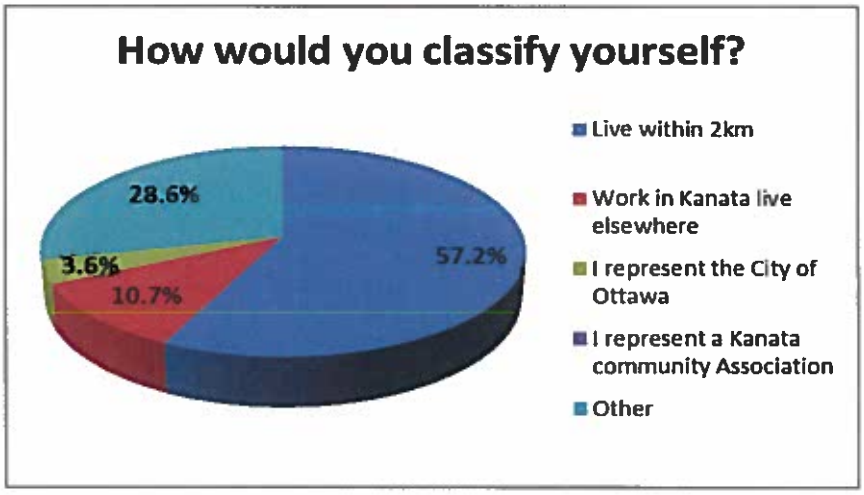







What was your level of understanding of Nordion before/after the Community Café?
80.0%
60.0%
40.0%
20.0%
0.0%
36.0%
0.0%
50.0%
21.0%
14.0%
79.0%
Low
Medium
High
Before
After


What is your level of confidence that Nordion's safety processes protect employees, community , and environment?
14.2%
85.8%
Low
Medium
High


How would you classify yourself?
28.6%
3.6%
10.7%
57.2%
Live within 2km
Work in Kanata live elsewhere
I represent the City of Ottawa
I represent a Kanata community Association
Other