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SCIENCE ADVANCING HEALTH

Nordion Class 1B Facility

License Number: NSPFOL-11A.04/2015

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Annual Compliance and Operational Performance Report to the Canadian Nuclear Safety Commission for the period JANUARY 2012 to DECEMBER 2012

Submitted: April 3rd, 2013
To: Ms. Ann Erdman

Signatures

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ABSTRACT

This Annual Compliance and Operational Performance Report (ACOPR) provides performance and operational information for Nordion's Class 1B Facility. It reports annual performance against the Nuclear Safety and Control (NSC) Act, applicable regulations, relevant safety and operational programs and the license conditions of the Nuclear Processing Facility Operating License issued by the Canadian Nuclear Safety Commission (CNSC) (License NSFPOL-11A.04/2015). It demonstrates that Nordion is operating in a safe 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, organization, occurrences, personnel radiation exposures and releases of nuclear substances and releases of 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.

The key points of this report are as follows:

- There were no major issues in 2012. The facility has operated according to its original design criteria. There were no physical design changes to any structural areas of the building or changes to the designated active areas.
- Conformance to internal training requirements was high in 2012.
- Testing of the radiation devices and instrument maintenance was performed at the required frequency and results were satisfactory. There were no observed trends related to equipment performance in 2012.
- The Environment, Health and Safety Committee met on a regular basis to review the environmental and safety aspects of the operations and to review and approve Final Safety Analysis Reports (FSARs).
- All measurable radiation dose received by personnel and the public were within the regulatory limit of 50 mSv/yr. and no internal dose levels or limits were exceeded.
- There were a total of 32 contamination incidents in 2012. All elevated levels of contamination were monitored and contained within the Active Area.
- There was one instance in which there was potential to exceed a regulatory limit or action level in 2012. There were no corrective actions as it was concluded that the dose was consistent with what would be expected from background for the four year period and it was non-personal.
- Various improvements were made to the Radiation Protection Program, Conventional Health and Safety Program, Environmental Protection Program and Fire Protection Program. These programs fall within the scope of the Quality Assurance (QA) Management Program.
- There were no disabling injuries in 2012.
- There were no instances of exceeding environmental regulatory limits or action levels in 2012. The maximum annual release of airborne from any one radionuclide was Xe-135m at 1.32% of the DRL.
- In 2012, Nordion received two EHS related external communications.
- In 2012, Nordion complied with each site-specific reporting requirement with one exception. This exception involved sealed source reporting. This instance was reportable under Section 6.1 (g) of the site license (NSPFOL-11.A.04/2015).

In 2012, Nordion's Class 1B Facility operated within the requirements of the Nuclear Safety and Control Act, the applicable regulations and the conditions of the operating license issued by the CNSC.

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TABLE OF ACRONYMS

ACOPR	Annual Compliance and Operational Performance Report
NSC	Nuclear Safety and Control
CNSC	Canadian Nuclear Safety Commission
FSAR	Final Safety Analysis Reports
QA	Quality Assurance
EHS	Environment, Health and Safety
EMS	Environmental Management System
WSIB	Workplace Safety Insurance Board
HRSDC	Human Resource Skills Development Centre
SOP	Standard Operating Procedures
NVS	Nuclear Ventilation System
PIT	Physical Inventory Taking
NPRMI	Non-production Radioactive Material Inventory
USNRC	United States Nuclear Regulatory Commission
KOB	Kanata Operations Building
NMPF	Nuclear Medicine Production Facility
COF	Cobalt Operations Facility
KRMF	Kanata Radiopharmaceutical Manufacturing Facility
NEW	Nuclear Energy Worker
TDG	Transportation of Dangerous Goods
HEPA	High Efficiency Particulate Air
CAD	Charcoal Adsorber
NFPA	National Fire Protection Association
NCSP	Nuclear Critical Safety Program
R&CM	Radiation & Contamination Monitoring
DRD	Direct Reading Dosimeter
STM	Standard Test Methods
AMMS	Advanced Maintenance Monitoring System
HVAC	Heating, Ventilation and Air Conditioning
OSL	Optically Stimulated Luminescent
TLD	Thermo-luminescent Dosimeter
RP	Radiation Protection
ALARA	As Low As Reasonably Achievable
OHI	Ottawa Heart Institute
DRL	Derived Release Limit
CSA	Canadian Standards Association
MDA	Minimum Detectable Activity
ER	Emergency Response
RE	Roy Errington
[redacted]	
CRL	Chalk River Laboratories
OPG	Ontario Power Generation
PIT-E	Physical Inventory Taking – Evaluation
PIP	Public Information Program
OCRI	Ottawa Centre for Regional Innovation
FAQ	Frequently Asked Questions
EQMS	Electronic Quality Management System
CAPA	Corrective Action Preventative Action

1. INTRODUCTION

1.1 General Introduction

Nordion 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 and the other involving sealed sources used in cancer therapy and irradiation technologies.

1.1.1 Summary of Production and Operational Limits

Nordion's license NSPFOL-11A.04/2015 does not include any production and operational limits.

1.1.2 Summary of Performance

Nordion operated in compliance with the Nuclear Safety and Control (NSC) Act in 2012 with the exception of seven non-compliances with Section 27(b)(ii) of the NSC Act. Each of the Environment, Health and Safety (EHS) objectives and targets were met in 2012. The objectives are reviewed yearly 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 2012.

1.1.3 Summary of Activities

The facility modifications that took place in 2012 were the installation of supply and exhaust ductwork in the Gammacell Room 1308 to improve ventilation, the modification of the Nuclear Ventilation System (NVS) 42 to improve ventilation at the service area of the Mo-99 cells and iodine cells in Room 1406 and the installation of an additional groundwater well to enable monitoring for radioactive materials.

There were no major structural changes or changes to the licensed facility boundary.

In 2012, Nordion implemented an Electronic Quality Management System (EQMS) that incorporates training management.

In June 2012, Nordion's supply contract with a Canadian customer for Ir-192 sealed sources expired; therefore, Nordion stopped manufacturing finished Ir-192 sealed sources at that time. Nordion continues to manufacture bulk Ir-192.

In October, 2012, Nordion implemented its new public disclosure protocol, which is an integral part of Nordion's Public Information Program. Also, in October, Nordion posted its Annual Compliance Report for 2011.

In November, Nordion underwent an organizational realignment, transitioning to newly created lines of business supported by centralized corporate functions.

For conventional health and safety, a number of programs have been enhanced including the Machine Safety program. Also, a company-wide assessment of machine guarding was completed.

For radiation protection, a number of hand and foot monitors in the Medical Isotopes Operations Facilities were replaced with a whole body contamination monitor. In addition, several radiation protection procedures were updated.

In the area of emergency preparedness, a significant number of on-site emergency response discussions and tours were conducted with the City of Ottawa Fire Services, and Nordion has established an Emergency Management Working Group to conduct a full review of Nordion's emergency response programs to identify areas for improvement.

1.1.4 Issues and Corrective Actions

There were no major issues in 2012. Three lesser occurrences were documented as Investigations 12-07, 12-09, 12-19. Refer to Appendix A.

1.1.5 Reportable Incidents

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

1.1.6 Compliance with Other Regulatory Agencies

Nordion applied to Environment Canada for Precautionary Permits to Charge a Fire Extinguishing System for in-cell fire suppression systems containing halon. These permits were approved and received on April 2012 and permit Nordion to refill halon fire extinguishing systems until April 4, 2013.

In compliance with Nordion's Comprehensive Certificate of Approval from the Ontario Ministry of Environment, there were no significant changes in emissions in 2012.

Nordion reports to the Workplace Safety Insurance Board (WSIB) whenever a reportable occupational injury or illness occurs. In 2012, there were six medical treatments reported to the WSIB. WSIB may inspect Nordion's Occupational Health and Safety programs at any time; however, no inspections were held in 2012.

In compliance with Part 2 of the Canadian Labour Code, there were no reportable occupational injuries or illnesses that required to be reported to the Human Resource Skills Development Centre (HRSDC).

In March 2012, a 5-year approval of Nordion's Transportation Emergency Response Assistance Plan was received from Transport Canada. This approval is effective until January 23, 2017.

1.2 Facility Operation

1.2.1 Facility Operation

The facility has operated according to its original design criteria in 2012. There were no investigations in 2012 related to facility operation.

1.2.2 Personnel Performance

The number and significance of corrective actions related to training would be an indication of how effectively personnel performed compared to their duties and how well personnel followed procedures. During 2012, only three of the twenty-nine EHS corrective actions (related to internal audits and investigations or external regulatory compliance inspections) initiated (10%) were related to training. These three corrective actions were determined to be low risk non-conformances. It is concluded that personnel effectively performed their duties and followed procedures. Two of the three training corrective actions were categorized as inadequate training, and the other was categorized as training not performed. These three corrective actions were identified as a result of an internal audit.

In addition, there were four minor comments on the Manager Self-assessment checklists regarding outstanding training and there were no comments that Standard Operating Procedures (SOPs) were not being followed.

1.2.3 Summary of Modifications and Repairs

Modifications and repairs that were carried out in 2012 included:

- The installation of supply and exhaust ducting in the Gammacell Room 1308.
- The modification of Nuclear Ventilation System (NVS) 42 to improve ventilation at the service area of the Mo-99 cells and iodine cells in Room 1406.
- The installation of an additional groundwater well to enable monitoring for radioactive materials.

1.2.4 Internal and External Audits

As part of the QA Program for Safety and the Environmental Management System, Nordion annually conducts internal audits to identify and correct potential environmental, health and safety related issues. In 2012, Nordion conducted a total of ten internal EHS audits. These audits included process audits as well as policy and program audits. In addition, Nordion conducted a total of 11 safety inspections.

In 2012, there were a total of five external audits of Nordion and one external audit conducted by Nordion. Out of a total of 29 EHS related corrective actions initiated in 2012, three corrective actions were a result of internal audits and nine were a result of external audits.

1.2.4.1 Internal Audits

The following internal audits were conducted in 2012:

1. Cobalt Operations Process. Numerous Environmental Management System (EMS) and QA safety elements were audited.
2. One EMS program audit. The audit was concerned with the EHS policy, communications, documentation, monitoring and measurement, evaluation of compliance, management review, environmental aspects, objectives, targets and programs, legal requirements, and emergency preparedness and response.
3. One QA Safety program audit. The following Quality Assurance Program for Safety elements were reviewed: organization and responsibilities, manager self-assessment, use of experience, and program definition.
4. Canadian Nuclear Safety Commission (CNSC) Export Control Licence Process.
5. Physical Inventory Taking (PIT) of safeguarded material.
6. Non-production Radioactive Material Inventory (NPRMI) Audit.
7. Transportation Program Audit of the United States Nuclear Regulatory Commission (USNRC) Security Orders.
8. Annual Review of Radiation Safety Program for New York State.
9. Internal EHS Audit Program.
10. Process Safety Audit of the TheraSphere® process.

1.2.4.2 External Audits of Nordion

The following external audits of Nordion were conducted in 2012:

1. On March 7-9, 2012 the CNSC conducted an Annual Compliance Inspection. There were four action notices and two recommendations identified during this inspection.
2. On March 13, 2012 the CNSC conducted a Security Inspection. No findings were identified during this inspection.
3. On March 19-21, 2012 the CNSC conducted an Export Controls Inspection. There were two action notices and three recommendations identified during this inspection.
4. On May 28-June 1, 2012 BSI conducted a re-certification audit against the ISO 14001:2004 standard. There were no non-conformances identified and sixteen opportunities for improvement.

5. On November 5-8, 2012 the CNSC conducted a Training Inspection. There were five recommendations identified during this inspection.

1.2.4.3 External Audits Conducted by Nordion

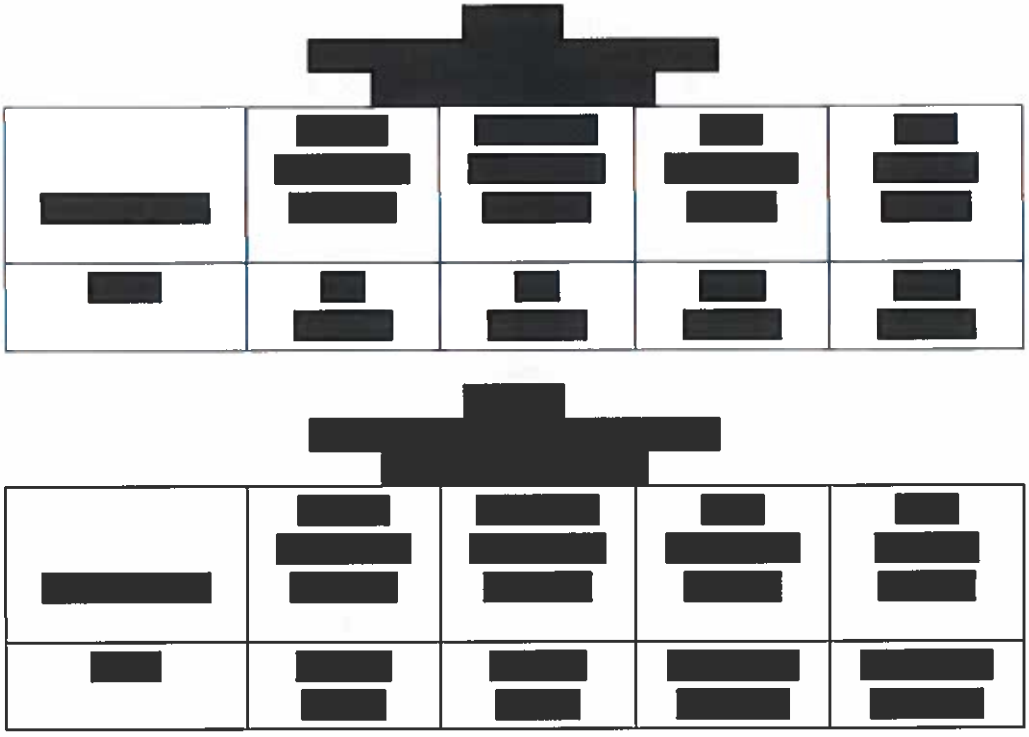
Nordion conducted one EHS Audit of a high risk Supplier in 2012. There were no correctives actions and one recommendation for improvement identified during this audit.

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.04/2015. The facility is comprised of the KOB, which houses the Nuclear Medicine Production Facility (NMPF) and Cobalt Operations Facility (COF), and the Kanata Radiopharmaceutical Manufacturing Facility (KRMF).

1.3.1 Sealed Source Manufacturing/Radioisotope Processing

[redacted]



1.3.2 Processing > 1 Petabecquerel (PBq)

[redacted]

1.3.3 Acquisitions of Finished Sealed Radioactive Sources

[redacted]

1.3.4 Sealed Sources/Devices > 50 Megabecquerels (MBq)

[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 2012, there were no changes to the designated active areas in the Kanata Operations Building (KOB), or Kanata Radiopharmaceutical Manufacturing Facility (KRMF).

1.4.1.2 Structural/Functional Changes Affecting Emissions

In 2012, 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 2012, Nuclear Ventilation System 42 was modified to improve ventilation at the service area of the Mo-99 cells and iodine cells in Room 1406.

1.4.1.4 Structural/Functional Changes Affecting the Active Liquid Waste System

During 2012, there were no structural or functional changes in the active liquid waste system program.

1.4.2 Changes to Procedures Related to Operations Safety and Control

Refer to Section 2.7.7 for changes to procedures related to operations safety and control.

1.4.3 Changes to the Training Programs

In June 2012, Nordion implemented an Electronic Quality Management System (EQMS) that incorporates training management. EQMS allows training to be assigned and tracked electronically and provides increased management visibility to the status of required training.

Nordion released one new EHS training course in 2012. Violence in the Workplace Training was provided using a computer based training software and is required training for all employees.

1.4.4 Changes to the Organizational Structure and Key Personnel

On November 1, 2012, Nordion underwent a corporate realignment, transitioning to

A Business Unit model with two distinct Business units: Targeted Therapies and Specialty Isotopes, of which are supported by centralized corporate functions. The Specialty Isotopes business includes two segments: Sterilization Technologies and Medical Isotopes.

As a result, EHS personnel are now organized into a Sterilization Technologies – Compliance Group and a Medical Isotopes – Compliance Group. The personnel of these two groups are outlined below. All of the positions for Sterilization are corporate wide functions, with the exception of the Senior Radiation Training & Safety Specialist.

Sterilization – Compliance

- Director, Nordion EHS Corporate Compliance & Sterilization QA
- Administrative Assistant (2)
- Security Manager
- Information Technology & Network Specialist
- Security Supervisor
- Security Officers (13)
- Receptionist (2)
- Senior Manager, Compliance, Facility & Transportation Licensing
- Nuclear Transportation Specialist
- Senior Licensing Coordinator
- Safety Analyst

- Safety Coordinator (Term)
- Training Specialist
- Safety Manager
- Environmental Specialist
- Occupational Health Specialist
- Senior Radiation Training & Safety Specialist
- Company Physician
- Fitness Coordinator

Medical Isotopes – Compliance

- Vice-President, QA Regulatory & EHS Compliance
- Administrative Assistant (1)
- Senior Manager, Radiation Safety & Compliance
- Radiation Surveyor (3)
- Junior Radiation Surveyor
- Senior Radiation Surveyor (2)
- Radiation and Contamination Monitor (7)
- Senior Radiation & Contamination Monitor (3)

The term positions of Training Specialist became a full time position in 2012. The term position of Environmental Health & Safety Specialist ended in August 2012.

2. SAFETY AND CONTROL AREA

2.1 Management System

2.1.1 Review of Quality Assurance/Management Program Activities

In 2012, Nordion conducted a total of ten internal EHS audits. These audits are described 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 April 5, 2012.

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 2012 annual review concluded that:

1. A majority of the outstanding actions from the previous meetings had been completed and closed (there was one action outstanding at the time of the meeting).
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. Resource requirements for the Environmental Management System and QA Program for Safety were discussed. The Committee agreed that the most critical issues are resourced adequately. However, the Committee agreed that the challenge is that the number of regulatory requirements is increasing.
4. There is one outstanding 2009 environmental objective and target related to the replacement of the halon fire suppression systems with a non-ozone depleting alternative.
5. The 2011 environmental objectives and targets were completed with the exception of the objectives with a target date of 2015 regarding the reduction of hazardous and other environmentally harmful materials, and the reduction of non-hazardous and hazardous waste.
6. The 2012 environmental objectives and targets were reviewed and it was determined that they were on target at the time of the meeting.
7. The 2013 EHS objectives were discussed and it was determined that they would be finalized in the fall.

There were thirteen new actions identified during the meeting. The EHS Committee had no further recommendations for improvement. As such, it is 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 2012, changes or revisions were 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. Also, the EQMS implemented improved Nordion's document and training management.

2.2 Human Performance Management

2.2.1 Training Program Effectiveness

The number of scheduled participants for internal safety training was 562. By the end of 2012, 554 scheduled participants completed the training, including refresher training. Therefore, the attendance completion rate in 2012 was 98%. The details of the training are documented in Table 4, below. There were no incidents in 2012 that demonstrated a lack of effectiveness in these training programs.

Nordion has 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/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.

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. A summary of the training programs and the number of participants is provided in Table 4.

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.

Table 4
Safety Training Programs – 2012

Program	Duration	Number of Participants	Refresher Training Overdue at end of 2012	Refresher Training Overdue at end of March 2013
Nuclear Energy Worker Indoctrination	6 Hours	6	Not Applicable	Not Applicable
Health, Safety and Environment Level II	Self Study	74	0	0
Radiation Instrumentation Workshop	3 Hours	71	1	1*
Radiation Safety Review for Operators	Half Day	27	3	0
Safe Handling of Radioiodines	2 Hours	65	1	1*
Transport of Dangerous Goods Level I	Self Study	4	0	0
Transport of Dangerous Goods Level II	Self Study	15	0	0
Transport of Dangerous Goods Level III	All Day In-Class (Once Upon Employment Self Study thereafter	48	0	0
TDG for Contractors	All Day	25	0	0
Transportation Regulations	2 Hours	17	1	1**
Working with BETA	1 Hour	55	0	0
Crane	Half Day	37	1	0
Pallet	Half Day	35	0	0
Forklift	Half Day	37	1	1*
Contractor Radiation Safety Training	Half Day	11	0	0
Contractor Radiation Safety Update Training	2 Hours	29	0	0
HEGS Safety Training	2 Hours	0	0	0
In-Depth Security Awareness	2 Hours	6	0	0

* Employee was on leave, returned on March 4, 2013. Training has been scheduled.
** Employee missed initial training. Training has been rescheduled.

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

Nordion's license does not specify a minimum number of responsible personnel required during operations.

2.3 Operating Performance

2.3.1 Effectiveness of Licensed Activities

The licensed activities were carried out according to Nordion's programs and procedures. There were no significant unplanned events and no major non-conformances. Nordion's programs in place for auditing and capturing non-conformances identified issues in areas that required corrective actions. These processes functioned as expected.

Summaries of the 2012 EHS Program objectives and Health and Safety Objectives are shown in Tables 5 and 6. Each of the EHS Objectives listed in Table 5 were met in 2012. Table 6 shows Health and Safety Objectives that EHS requires of Directors and Managers and employees of high risk areas. A system is in place to ensure that the performance reviews are completed. The completion of manager self-assessments is audited annually. EHS regularly follows-up with Managers to ensure they are reviewing health and safety issues with employees and to remind them that EHS staff are available to provide updates at team meetings. Deviations, Change Forms and complaints are reviewed yearly at the Annual Joint Environmental Management System and QA Program for Safety review.

Table 5
2012 EHS Program Objectives and Results

Applicable Nordion Job Function	Objective	Measures and Targets	Result
All Directors and Managers	Minimize the number and extent of occupational injuries, environmental and radiation incidents.	• The number of Incidents ≤ 6 • Lost Time Injuries ≤ 0.6 per 200,000 hours worked (3-yr rolling) • The severity of lost-time injuries to ≤ 5 days per 200,000 hours worked (3-yr rolling)	6 0.18 (3-yr rolling) 1.08 (3-yr rolling)
All Directors and Managers of Operations, Facilities, or Nuclear Energy Worker employees	Minimize the use and release of hazardous materials to the environment.	• Radioactive materials emissions to ≤ 7.5% of the Derived Release Limits (DRL) • No non-compliant sanitary sewer emissions of non-radioactive hazardous materials • Reduction in the use of hazardous materials and the generation of hazardous and non-hazardous waste	0.76 % DRL 0 45% reduction in use of hazardous materials from 2010 60% reduction in non-hazardous waste from 2010 12% reduction in hazardous waste from 2010
	Maintain radiation doses to employees as per ALARA principle.	• Average Active Area employee dose rate ≤ 2.0 mSv/yr for all sites • Maximum employee dose rate ≤ 8 mSv/yr Kanata • Radiation Incidents ≤ 5/year	0.40 mSv (Rolling 12) 5.04 mSv (Rolling 12) 0

Table 6
2012 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.
	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 as feasible. • Ensure all near-misses are reported and appropriate corrective action(s) are taken.
	Communicate monthly with teams about environment, health and safety performance and impacts. Openly evaluate employee environment, health safety concerns.	• 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	Work safely at all times. It is unacceptable to take risk in order to get the job done.	• Work follows applicable Nordion EHS standards and procedures, and is performed with care and attention to safety principles. • Wear all applicable personal protective equipment (PPE). • Submit all dosimeter(s) and rings for monitoring on time (i.e. no later than one month following end of monitoring period without good reason, i.e. extended illness or company travel, etc.).
	Report the occurrence of workplace injuries, unsafe conditions and near misses.	• All workplace injuries and observed unsafe conditions & near misses are reported immediately to the direct Supervisor.
	Correct co-workers who are working unsafely.	• Following Nordion values, coach co-workers who are seen working unsafely.
	Identify opportunities to reduce environmental impacts	• Identity opportunities for reducing waste, and using less harmful materials where feasible. • Immediately report all near-misses to your Manager.

2.3.2 Effectiveness in Implementing Operational Controls

EHS operational controls are documented in a specific series of documents (SE-OP series) and added to routine production documents for safety critical steps. These procedures are routinely updated using Nordion's change control process when safety improvements are identified.

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 NVS. Testing in 2012 was performed at the required frequency and results were satisfactory.

In-situ testing of High Efficiency Particulate Air (HEPA) filters and Charcoal Adsorbers (CADs) is required at a minimum once annually, but two testing campaigns were done for both in 2012.

Table 7 details the results of 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	74	239	74
Number tested	234	67	237	67
Filters which passed testing	234	67	237	67
Filters which failed testing	0	0	0	12
Failed filters replaced during test cycle	0	0	0	12
Not tested	2	7	2	7
Total replaced during this cycle	2	2	0	23
Filters (systems) removed from service	0	0	0	0
New Filters (systems) Added	3	2	0	0

Comments Q1/Q2 HEPA: Two filters were not tested because they were not in service. Two filters were replaced due to flow issues (not a fail). System 42 was operational in Q2 which added three more HEPA filters to the fleet.

Comments Q1/Q2 CAD: Six trench filters were not tested, but are changed every three years as per SE-OP-021, "Charcoal Adsorber Filter Testing". One CAD filter on System 5 was not tested as it is not in use. Two CAD filters were changed out due to their shelf life expiration (as per SE-OP-021). The in-situ/lab tests performed afterwards on the new filters were

successful. System 42 was operational in Q2 which added two more CADs to the fleet.

Comments Q3/Q4 HEPA: Two filters were not tested because they were not in service.

Comments Q3/Q4 CAD: The six filters on Systems 13 and the six filters on System 14 (a total of 12 CAD filters) were considered failed; however, only three of the 12 filters exceeded the fail criteria. System 13 ventilates the Decontamination Facilities and System 14 ventilates Service Areas. The tasks carried out in these areas involve very low activities of radionuclides, but large amounts of organic cleaners. Another 11 CAD filters were changed out due to their shelf life expiration as per SE-OP-021. See Q1/Q2 CAD comments for why filters were not tested.

Nuclear Medicine in-cell charcoal roughing filters are on a preventative maintenance schedule and replaced by cell technicians typically every 6 months. The replacement of these filters is described in Table 8. These filters are not credited with mitigating releases in Nordion's Safety Analysis reports.

Table 8
Roughing Filter Change-outs

Filter Type	Results
Nuclear Ventilation System Roughing Filters	117 replaced
Cobalt Production In-cell Filters	0 in-cell HEPA filters were replaced.

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 2012 was performed at the required frequency and results were satisfactory.

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 and Site Services staff. Testing in 2012 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 2012. The tests verify that the alarms sound at the preset 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 and Site Services personnel.

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 2012 was performed at the required frequency and results were satisfactory. All dry systems were tested and verified in good operating condition in 2012 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 2012 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 2012 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, checked daily, tested weekly and serviced on a routine basis and repaired as required; typically two to three times a year. Testing in 2012 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 and Site Services personnel.

2.3.4.10 Radiation Survey Instruments

Radiation Survey Instruments are tested on a monthly, bi-annual, or annual basis as required. There were no instruments in 2012 that tested outside of the acceptable range. Testing in 2012 was performed at the required frequency and the results were satisfactory.

2.3.4.11 Trends

There were no observed trends related to equipment performance in 2012.

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 managers and senior professionals that review 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 typically held on a bi-monthly basis with ad hoc meetings arranged as required. Typical agendas include Safety Analysis Reports, significant changes (repairs/modifications) to existing facilities, Radiation Incident Report reviews, safety procedures, and review of CNSC licensing requirements (radiation monitoring, ALARA program, emissions, dosimetry, project approval, etc.). In 2012, the EHS Committee met on seven occasions (five regular meetings and two ad hoc meetings).

Final Safety Analysis Reports (FSARs) are prepared by 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 and the Cobalt Operations FSAR, since these are the two main documents covering the production operations. Revisions to these documents are reviewed and approved internally, and submitted to the CNSC for approval. Secondary FSARs (for each individual production process) are reviewed and approved internally as per an established review schedule.

[redacted]

2.5 Physical Design

In 2012, within the boundaries of the active area for Nordion's production facilities, there were no physical design changes to any structural areas of the building.

2.6 Fitness for Service

The management structure of Nordion's Preventative Maintenance Program was not altered in 2012. 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 2012, 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 KOB. This review takes into account three criteria: safety of facility, regulatory requirements and site improvements. Projects are prioritized into three categories and funds are allocated as required to approved projects. During the 2012 review, it was determined that one of the two cooling towers which is 29 years old is reaching its life expectancy and it was decided that it should be replaced with a more efficient tower. The cooling towers are used to cool water for the chillers that supply cooling water for Heating, Ventilation and Air Conditioning (HVAC) of the building and for the Cobalt pools and for climate control within the Radiopharmaceutical Facility. This aging equipment review process, because of the link to the Senior Management team and Finance, has worked very well in keeping the Nordion facility up-to-date with current technology.

Following Nordion's Standard Operating Procedures for the verification of equipment has proved successful during 2012. There were no equipment failures.

2.7 Radiation Protection

2.7.1 Dose Control Data

2.7.1.1 Occupational External Dosimetry

Currently Nordion is using Luxel+ or Optically Stimulated Luminescent (OSL) dosimeters as Thermo-luminescent Dosimeter (TLD) technology. Nordion's Radiation Protection Manual states that the traditional term "TLD" may be used interchangeably with OSL or other CNSC approved dosimeters.

All employees who regularly work in the Active Area are classified as NEWs and are assigned monthly TLDs. NEWs are trained to work in various production processes and move from one production area to another during the year. In the Nuclear Medicine Operations, personnel may receive exposure from working with more than one radionuclide. Those working with radionuclides where there is concern for extremity exposure to radiation are assigned extremity TLDs. Other employees who normally work outside the Active Area and visit the Active Area on a regular basis are also classified as NEWs, but are assigned quarterly TLDs.

All measurable radiation dose received by personnel were within the regulatory limit of 50 mSv/yr in 2012.

Contractors who are given access to the Active Area are called "Contractor NEWs" at Nordion. Technically, they are NEWs as they are trained, tested and have security clearance, but are subject to the regulatory dose limit and Action Levels of non-NEWs. For accuracy of review, their doses are reported in a separate group and their results are not broken down in Tables 9 and 10. Minimum, maximum and average doses for Contractor NEWs are listed in Table 11.

Tables 9 and 10 provide dosimetry data with employees grouped in various ranges of exposure. Data on the minimum, maximum and average doses for all employees who received a measurable radiation dose are shown in Table 11.

Table 9
Personnel Dosimetry

Number of Employees										
Dose Range (mSv)	Whole Body					Skin				
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
< 0.2	92	201	169	192	187	94	186	152	180	186
0.2 - < 0.5	103	52	49	39	41	99	63	60	48	40
0.5 - < 1.0	73	31	39	30	28	69	31	39	30	30
1.0 - < 5.0	76	44	52	49	36	82	48	58	52	36
5.0 - < 20.0	1	0	0	1	1	1	0	0	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				
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
< 0.2	98	110	101	111	105	110	113	104	110	106
0.2 - < 0.5	20	12	13	15	15	15	13	17	12	15
0.5 - < 1.0	21	22	14	9	5	17	20	11	15	4
1.0 - < 5.0	34	25	35	28	16	31	23	30	28	15
5.0 - < 20.0	17	9	9	8	5	14	8	8	5	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 10
Breakdown of Whole Body Radiation Doses 5.0 to < 20 mSv

Dose Range	5<8 mSv	8<10mSv	10<15 mSv	15<20 mSv
2008	1	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	1	0	0	0
2012	1	0	0	0

Table 11
Maximum and Average Whole Body Doses (mSv)

		Active Area Personnel (NEWs)	Non-Active Area Personnel (NEWs)	Non-NEWs (Contractors)
Minimum	2008	0.00	0.00	0.00
	2009	0.00	0.00	0.00
	2010	0.00	0.00	0.00
	2011	0.00	0.00	0.00
	2012	0.00	0.00	0.00
Average	2008	0.8	0.53	0.14
	2009	0.62	0.14	0.34
	2010	0.65	0.12	0.05
	2011	0.64	0.06	0.05
	2012	0.56	0.13	0.03
Maximum	2008	6.12	2.11	0.38
	2009	4.63	1.95	0.55
	2010	4.86	1.48	0.36
	2011	5.08	0.79	0.45
	2012	5.19	1.34	0.21
CNSC Regulatory Limits		50/yr; 100/5yr	50/yr; 100/5yr	1/yr

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 2012, there were no cases of employees exceeding Nordion's administrative investigation level of 1000 Bq I-125 or I-131.

No whole body counting or urinalysis was required in 2012.

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. For brevity, only groups with individual maximums greater than or equal to 1 mSv/annum are included. In practice, if a graph appears anomalous, the actual data is examined, as group trends can be perturbed by changes in staff (transfers between groups, etc.). This trend data is reviewed yearly at the Annual Joint Environmental Management System and QA Program for Safety Review.

Table 9, Personnel Dosimetry, shows the distribution of dosimetry results for Nordion workers. The distribution of whole body doses year over year is similar, but a downwards shift is observed in 2012 over 2011. In fact 3.5% more people are in the 0–0.5 mSv range in 2012 than in 2011. This demonstrates continued high performance of Nordion employees in accordance with ALARA. This is substantiated by the trend observed in the data of the dose distribution shifting downwards. Graph 1 below shows the percentage of Nordion employees in the 0-0.5 mSv range out of the total number of employees monitored. Further note that the employee base decreased over this time and instead of this causing increased doses, the doses still decreased.

Year	2008	2009	2010	2011	2012
Employees Monitored	345	328	309	311	293

Graph 1: Percentage of Employees in the 0-0.5 mSv Range

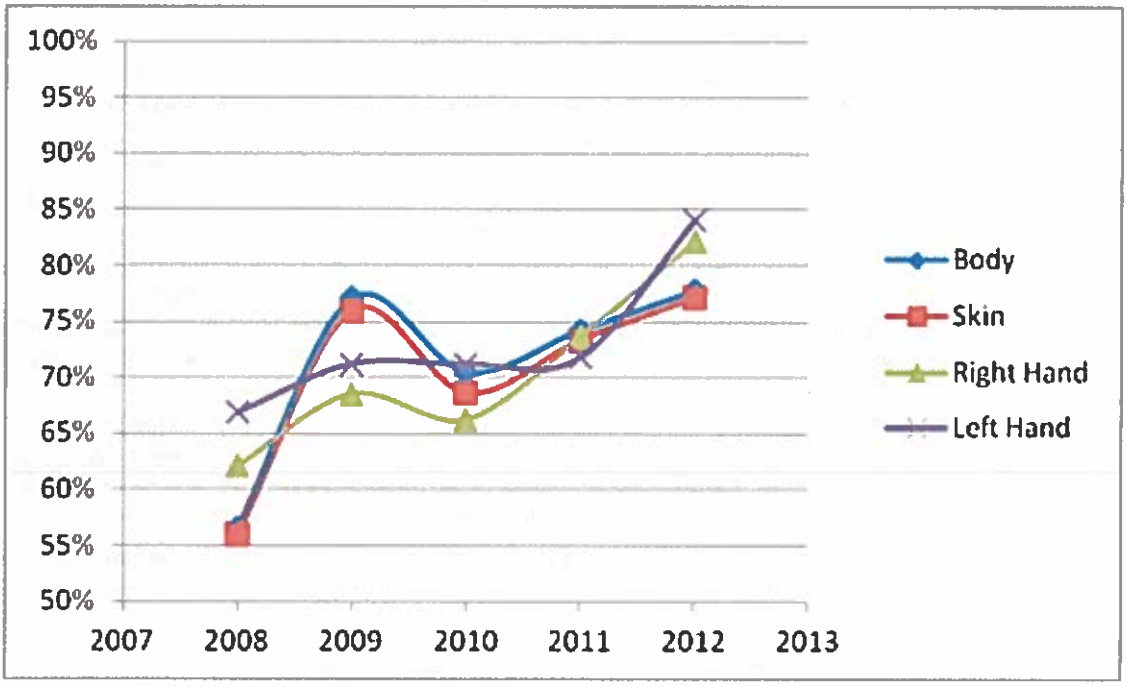


Table 10 shows very similar trend results to previous years where one employee (a Cobalt Shipper) is either slightly in excess of 5 mSv (5.19 mSv in 2012) or slightly below.

Table 11 shows a trend in the last three years attributed to the improvement of Contractor dosimeter management. A significant decrease is observed when comparing the average doses in 2008/2009 to those in 2010 to 2012. In the last three years, Contractor dosimeters have routinely been shipped with a proper control dosimeter, thus eliminating spurious results and providing a clear picture of the doses received. Average doses to Active Area personnel continue to fall and maximums are stable. The trend for average and maximum doses to Non-Active Area personnel is also trending downward over the five years.

In Figures 1-19, the cumulative doses are trending downward for most groups. In Figure 4: QC Cobalt, cumulative values are stable from 2008 to 2010 then increase slightly in 2011 to 2012 when new F-168 containers were introduced into the transport container fleet. These containers require surveying and acceptance which involves a small increase in dose to the team members. For all other Figures, if an average slope of the cumulative doses was drawn it would be negative over the five years period.

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.

2.7.3 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 equipment leaving the Active Area meets administrative and regulatory requirements.

During 2012 operations, there were instances where elevated levels of contamination (above "clean on swipe") were found and subsequently contained within the Active Area. Most were due to routine operations such as the replacement of manipulators and associated boots on a cell, decontamination of materials/equipment and shielding containers, and tracking of contaminants from a cell, glove-box, or fume-hood when product or samples were being removed.

There were a total of 32 contamination incidents in 2012 (Table 12). The downward trend in contamination incidents continued in 2012 and reflects a reduction in the amount of material processed into customer orders for sale. It is anticipated that should the amount of material processed for sale increase, the number of contamination incidents could rise to reflect this.

The distribution of contamination incidents in 2012 is shown in Table 12 and 13 and is illustrated in Graph 2 below. The distribution of contamination incidents by isotope reflects the amount of material processed for sale, with the exception of Co-60 due the fact that the activity of a given order is typically shipped in 200,000 Ci orders.

There does not appear to be a discernable trend in the contamination incidents by month.

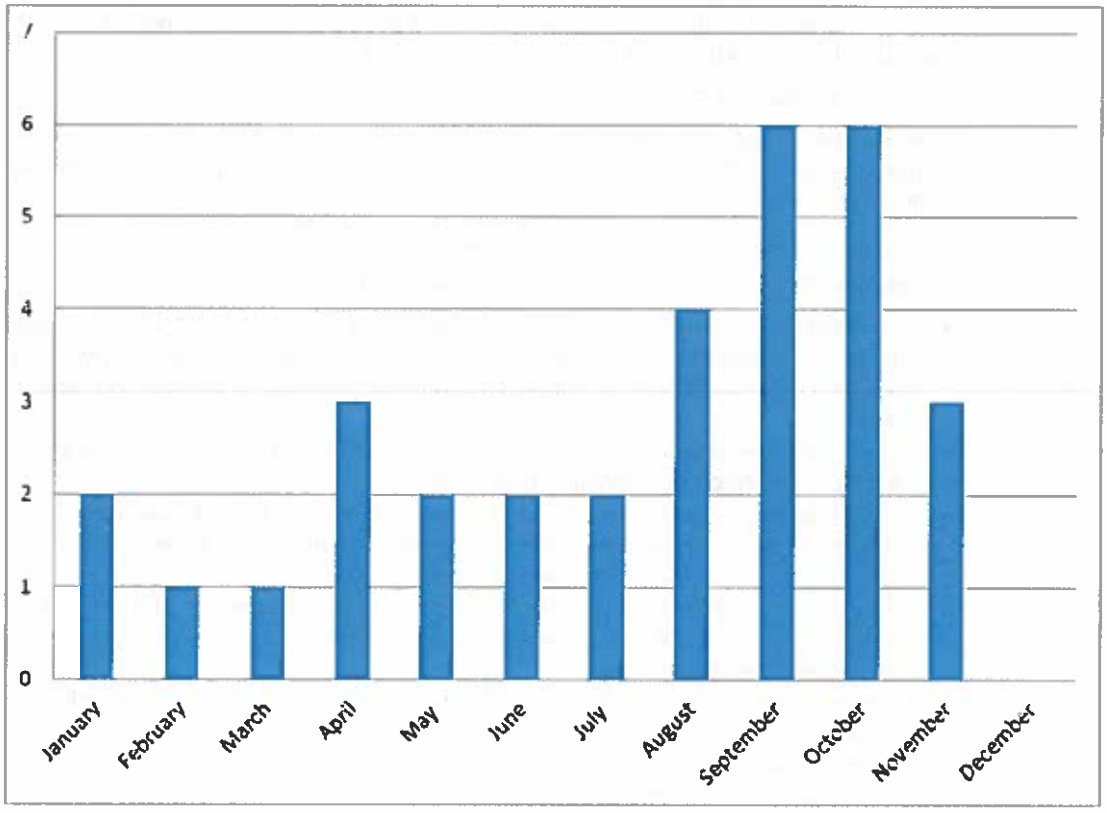
Table 12
Breakdown of Contamination Incidents by Contamination Level

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
2008	0	16	35	22	5	5	83
2009	4	5	35	23	7	5	79
2010	1	2	18	15	4	3	43
2011	0	11	11	9	3	3	37
2012	1	1	7	13	6	4	32

Table 13
Breakdown of Contamination Incidents by Radionuclide

Year	Not recorded	C-14	Co-60	I-125	I-131	Mo-99	Y-90	Decayed Mo-99
2008	1	2	15	2	21	29	3	
2009	1	0	21	1	20	10	9	
2010	0	0	3	1	13	3	8	5
2011	1	0	7	3	6	12	3	0
2012	1	0	5	2	7	10	5	0
Year	**Ir-192**	**In-111**	**Lu-177**	**Xe-133**	**Sr-82**	**I-123**	**Eu-152**	**Annual Total**
2008	5	0	0	3	0		0	82
2009	10	1	0	0	4	0	1	78
2010	2	0	0	1	7	1	0	43
2011	0	2	2	0	0	2	1	37
2012	1	0	0	0	0	1	0	32

Graph 2: Contamination Incidents by Month, 2012



2.7.4 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/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 2012.

2.7.5 Exceedances of Regulatory Limits or Action Levels

There was one instance in which there was a potential to exceed a regulatory limit or action level in 2012. This is documented as Investigation 12-09. Refer to Appendix A. There were no corrective actions as it was concluded that the dose was consistent with that expected from background for the four year period, and it was non-personal.

2.7.6 Radiation Protection Program Effectiveness

The Radiation Protection (RP) Program is reviewed by conducting process audits and process safety audits. Refer to Section 1.2.4.1. Data and performance of the Radiation Protection Program is reviewed regularly at EHS Committee meetings.

2.7.7 Radiation Protection Program Improvements

Improvements to the RP Program in 2012 included the following:

- Purchasing new equipment and implementing a new methodology for adjusting and measuring fume-hood face velocity for all fume-hoods in the active area. Procedure SE-OP-006, "KOB/KRMF/COBALT Fumehood Flow Rate Verification" was revised as a result.
- Replacing three hand and foot monitors in the Medical Isotopes Operations Facilities with a whole body contamination monitor.
- Implementing a system of tracking the non-production radioactive material inventory via Oracle. Relevant personnel were trained on the use of the system. Procedure SE-LIC-015, "Radioactive Material Inventory" was revised.
- Revising procedure SE-OP-040, "Procurement of Radioactive Material" to clarify instructions to ensure EHS is informed regarding the purchase of non-production related radioactive material.
- Developing a tracking tool for recording operational deficiencies related to safety and documenting the instructions for use in procedure SE-OP-053.
- Revising SE-RP-003, "Investigations" to indicate the requirement to evaluate significance of non-conformances and to include instructions for investigating and trending operational deficiencies.
- Introducing the use of a dose history form for contractors to record radiation exposure at other locations other than Nordion. Procedure SE-RP-004, "External Personal Monitoring" was revised.
- Revising procedure SE-RP-004, "External Personal Monitoring" to provide guidance to managers for reviewing dosimetry reports, to document the manager requirement to review dosimetry results monthly, and to document the intent and purpose of the electronic DRDs.

There were no new RP program procedures created.

2.7.8 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 2012. 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 22 for a summary of the initiatives and targets for the upcoming year. The 2013 target for radioactive materials emissions was lowered from ≤ 7.5% to ≤ 5% of the DRL to be in line with the recent CNSC discussion paper (Process for Establishing Release Limits and Action Levels at Nuclear Facilities Discussion Paper DIS-12-02). In addition, although challenges are presented by the fluctuation in Cobalt activities produced year over year and by staffing changes, the fairly consistent maximum and average doses for 2009, 2010 and 2011 indicated an opportunity to lower the maximum and average employee dose rate targets in 2013 by 0.5 mSv. Therefore, the maximum employee dose rate target was lowered from ≤ 8 mSv/yr to ≤ 7.5 mSv/yr and the average employee dose rate target was lowered from ≤ 2 mSv/yr to ≤ 1.5 mSv/yr.

2.7.9 Continuous Improvements Under ALARA Performance

ALARA objectives and performance is reviewed at EHS Committee meetings and all activities in the ALARA program are described in SE-RP-002, "Keeping Radiation Exposures and Doses "As Low as Reasonably Achievable (ALARA)". This procedure was followed in 2012, and performance against targets is demonstrated in Table 5 of Section 2.3.1.

2.7.10 Radiation Protection Training Program and Effectiveness

Refer to Section 2.2.1.

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 and updating the Hazard Assessment and Ranking system. In addition, the EHS Management Committee sets targets each fiscal year in the areas of Medical Treatment Incidents, Lost Time Incidents and Severity Rates. Refer to Sections 1.2.4.1 and 1.2.4.2 for a description of audits and inspections.

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 nine times in 2012. The KOB Health & Safety Policy Committee met on eight occasions in 2012. The accomplishments for 2012 were that the Safety Policy Committee continued to review the Hazard Prevention Program and participated in the enhancement of the Chemical Handling and Storage, and the Lead Control Programs. In addition, the Policy Committee implemented 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 2012 included the following:

- Enhancing Overhead Cranes and Manual Material Handling programs.
- Implementing the Safe Use of Cryogens program.

- Updating the Machine Safety program and completing a company-wide assessment of machine guarding. The improvements identified have been completed.
- Adding Ergonomic Principles of Design for cells and manipulator processes as an appendix to the document 000069.SOP, "Requirement and Guidelines for Control of Design".
- Completing Loading Dock assessments and implementing a Loading Dock Safety program. All dock levellers are now labelled with load capacity, and safe use and precautions signs have been posted.
- Enhancing the Confined Spaces program and completing the applicable training.
- Enhancing the Forklift program.
- Completing Chemical Awareness Training.
- Completing entry of hazard ratings for all chemicals in Chemical Inventory Database.
- Conducting Asbestos training for new Facilities employee and new contractors.

2.8.4 Hazardous Occurrences

During 2012, there were no disabling injuries.

Six minor injuries occurred. Five of the minor injuries were related to overexertion for which the employees required treatment from a Health Care Professional (Physiotherapy/Chiropractic services) and work accommodations. For the fifth minor injury, the employee sustained a fractured finger and an injury requiring sutures after their finger became caught between a remote control that was resting on the surface of a lifting device and the base of a cell. This occurrence was reviewed with HRSDC and a federal hazardous occurrence investigation conducted. Corrective actions following this occurrence resulted in a company-wide assessment of all lifting devices. This resulted in a number of changes including the redesign of two lifting devices to require two-handed operation.

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 (which is performed every two years and was performed in 2012).

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

Allowable releases to the environment are limited to the values in SE-OP-029 (4), "Derived Release Limits". A revised version of SE-OP-029 (5) has been submitted to the CNSC for approval. Some radionuclides are reported using SE-OP-029 (5) as values for these radionuclides were not listed in the previous version (Version 4). A summary of airborne releases is provided in Table 14 and presented in Graphs 3, 4, and 5.

In 2012, the maximum annual release of airborne from any one radionuclide was Xe-135m at 1.32% of the Derived Release Limit (DRL). No Action Levels were exceeded in 2012. Since the submission of SE-OP-029 (5), the Canadian Standards Association (CSA) has published a new standard for calculating DRLs. Nordion plans to submit a revised draft SE-OP-029 (6) with revised calculations as per the CSA-N288.1 standard to the CNSC in early 2013.

Table 14
Airborne Releases

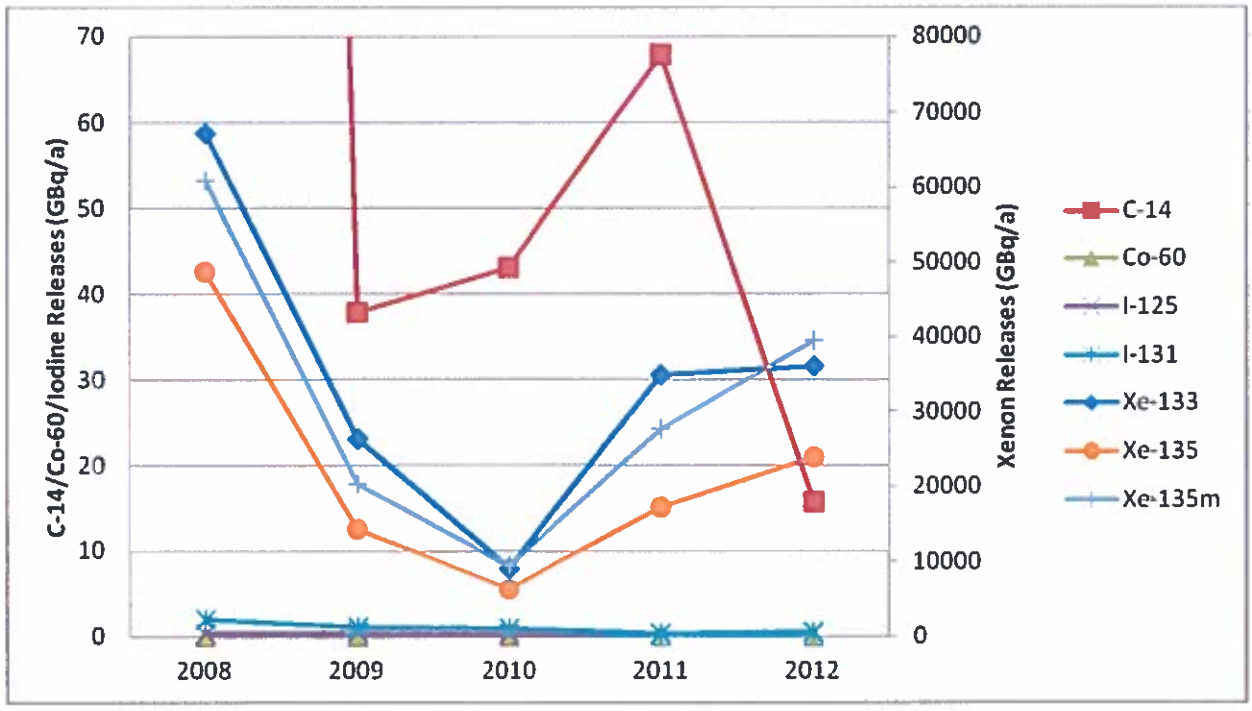
Year	C14 (GBq/a)	Co-60 (GBq/a)	I-125 (GBq/a)	I-131 (GBq/a)	Xe-133 (GBq/a)	Xe-135 (GBq/a)	Xe-135m (GBq/a)
2008	635.4	0.005	0.26	1.98	67193	48677	60845
2009	37.8	0.006	0.47	1.05	26407	14439	20444
2010	43.1	0.006	0.37	0.99	9066	6407	9366
2011	67.9	0.006	0.38	0.29	34967	17239	27688
2012	15.7	0.006	0.46	0.40	36153	23943	39498

	C14	Co-60	I-125	I-131	Xe-133	Xe-135	Xe-135m
DRL (GBq/a) Using SE-OP-029 (4)	**	78	990	1110	2.90E+07	**	**
% DRL (2012)	**	0.01%	0.05%	0.04%	0.12%	**	**
% Action Level (2012)	**	0.01%	0.09%	0.07%	0.25%	**	**

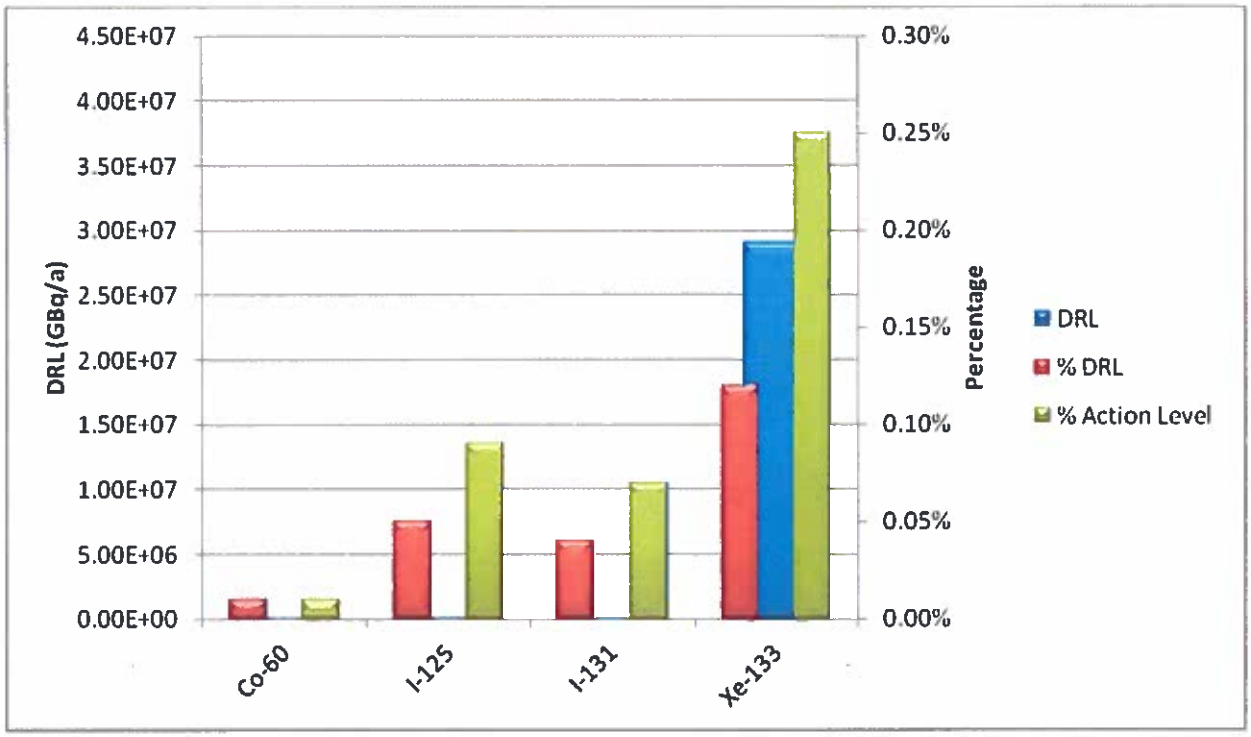
** No limit established for these isotopes in SE-OP-029 (4)

	C14	Co-60	I-125	I-131	Xe-133	Xe-135	Xe-135m
DRL (GBq/a) Using Draft SE-OP-029 (5)	9.95E+04	1.17E+04	1.22E+03	1.13E+03	4.27E+07	5.00E+06	3.00E+06
% DRL (2012)	0.02%	0.00%	0.04%	0.04%	0.08%	0.48%	1.32%
% Action Level (2012)	0.03%	0.00%	0.08%	0.07%	0.17%	0.96%	2.63%

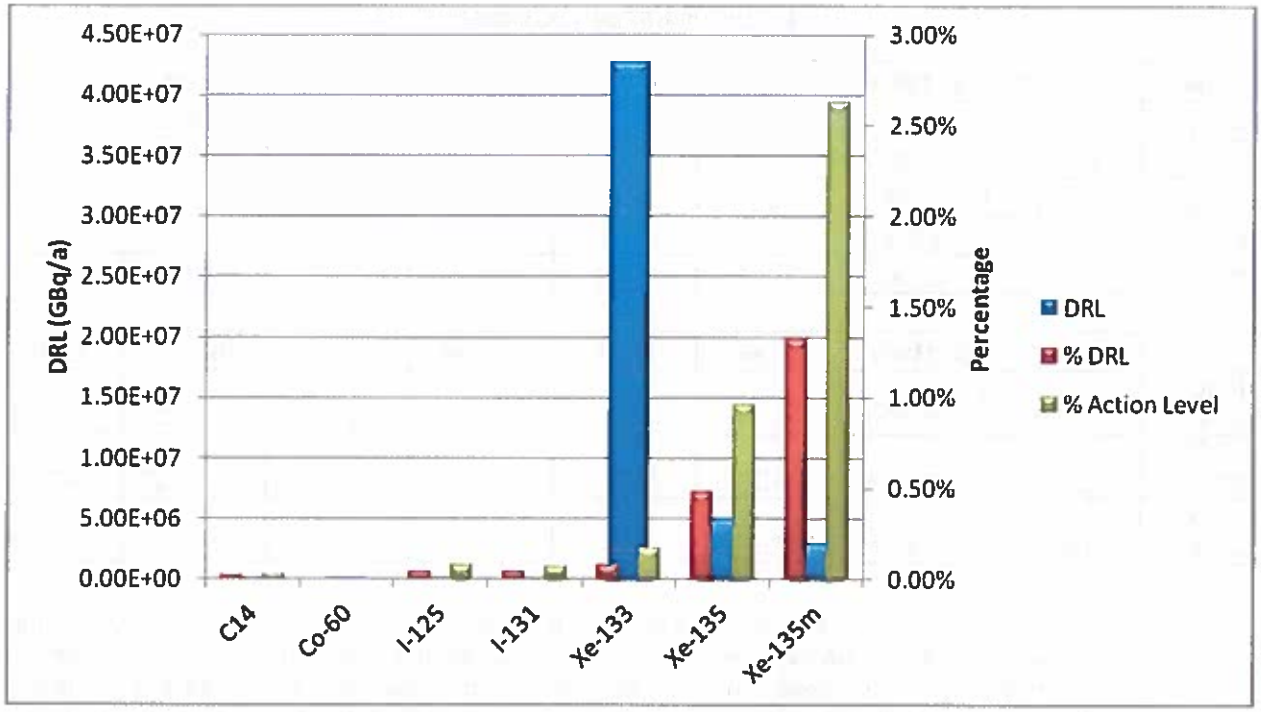
Graph 3: Airborne Releases per Year (GBq/a)



Graph 4: 2012 Derived Release Limit (GBq/a) Using SE-OP-029 (4)



Graph 5: 2012 Derived Release Limit (GBq/a) Using SE-OP-029 (5)



2.9.1.2 Liquid Effluent

Allowable liquid effluent releases to the environment are also limited to values in SE-OP-029 (4), "Derived Release Limits". The five year variation in activities released is listed in Table 15 and presented in Graphs 6 and 7.

No Action Levels or Administrative Levels were exceeded in 2012. 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 15.

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.

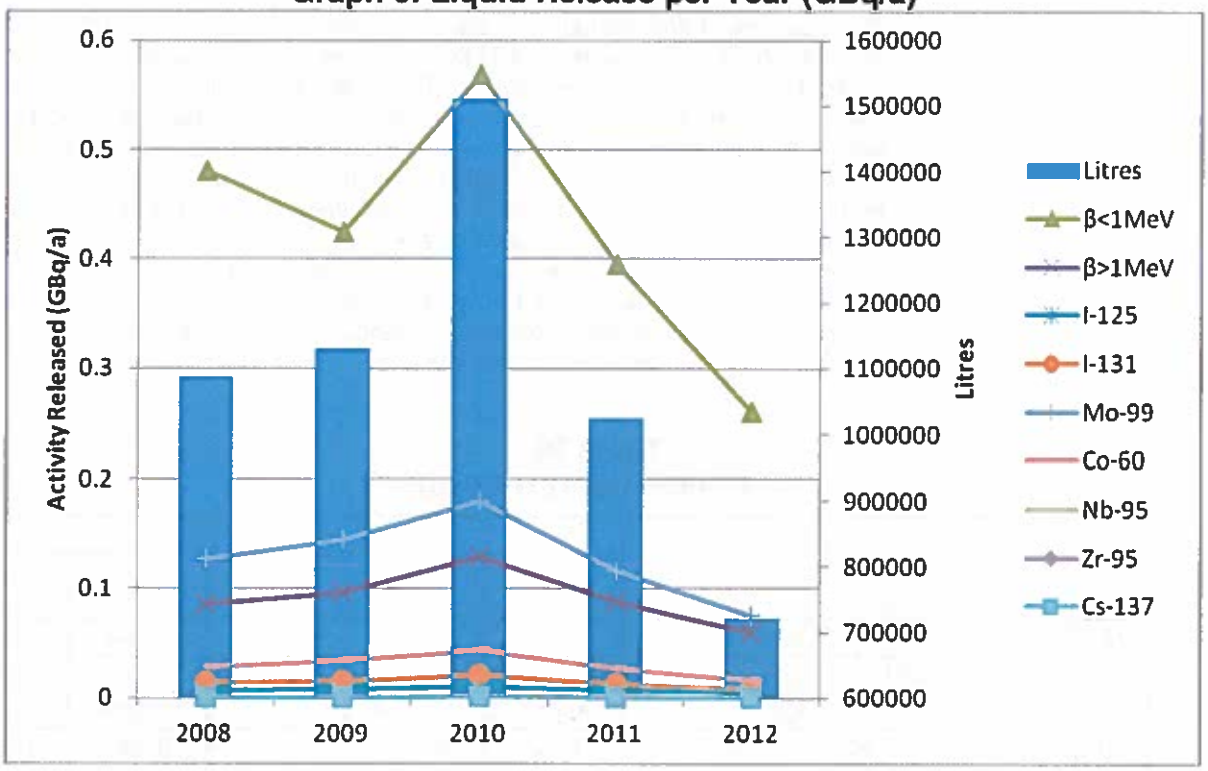
Table 15
Liquid Releases (GBq/a)

Year	Litres	β<1MeV	β>1MeV	I-125	I-131	Mo-99	Co-60	Nb-95	Zr-95	Cs-137
2008	1087471	0.481	0.086	0.007	0.014	0.127	0.029	0.0005	0.0005	0.0005
2009	1130670	0.424	0.096	0.008	0.016	0.144	0.034	0.0006	0.0004	0.0007
2010	1510764	0.569	0.129	0.011	0.021	0.18	0.044	0.001	0.001	0.001
2011	1024391	0.395	0.088	0.007	0.013	0.116	0.027	0.001	0.001	0.0004
2012	720821	0.261	0.060	0.005	0.009	0.075	0.017	0.0002	0.0003	0.0004

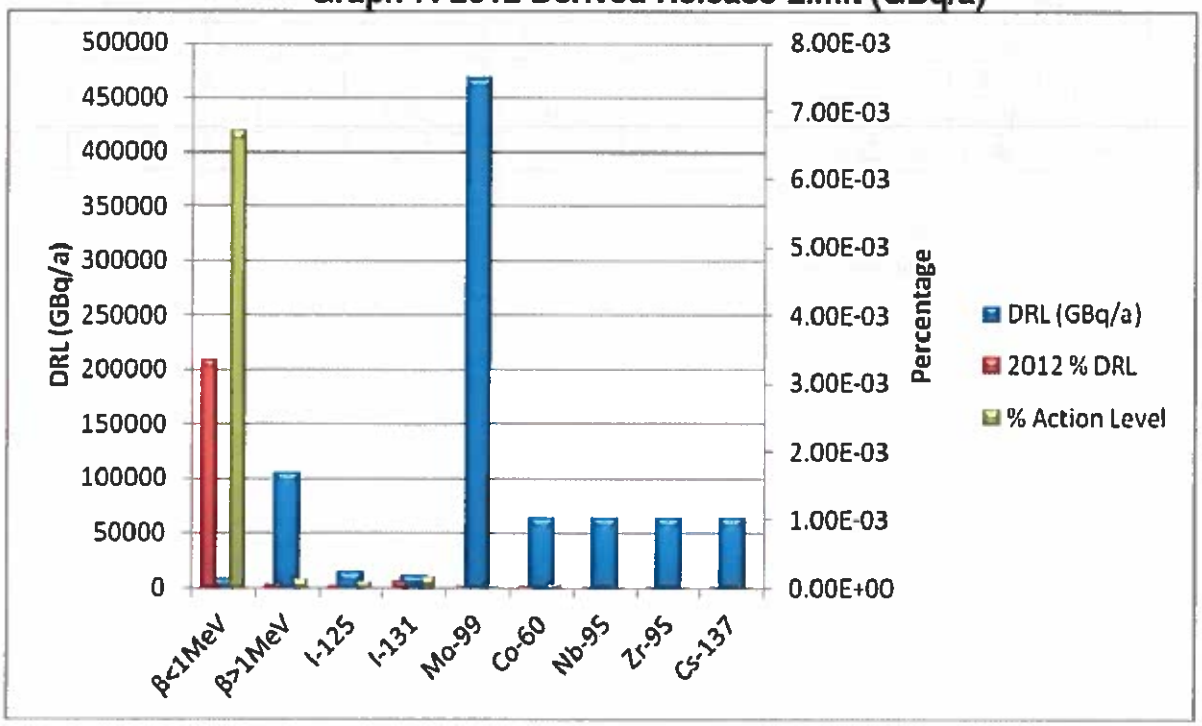
	β<1MeV*	β>1MeV*	I-125	I-131	Mo-99	Co-60	Nb-95*	Zr-95*	Cs-137*
DRL (GBq/a)	7780	105,000	14,700	10,800	467,000	64,100	64,100	64,100	64,100
% DRL (2012)	3.35E-03	5.76E-05	3.59E-05	7.92E-05	1.62E-05	2.63E-05	3.58E-07	4.97E-07	6.63E-07
% Action Level	6.70E-03	1.15E-04	7.17E-05	1.58E-04	3.23E-05	5.27E-05	7.16E-07	9.95E-07	1.33E-06

* The DRL for Sr-90 is used for β<1MeV and the DRL for Y-90 is used for β>1MeV. Nb-95, Zr-95 and Cs-137 are contaminants which are expected to be present in small quantities or non-detectable. Although we do not formally monitor for these contaminants, their presence was detected by the analysis method used to check the liquid effluent samples for our major isotopes. DRLs are required for only the major isotopes. The majority of the recorded releases are the minimum detectable activities being conservatively reported as real values instead of using zero. This number is then directly proportional to volumes released, which explains the lower reported releases in 2012 than in recent years.

Graph 6: Liquid Release per Year (GBq/a)



Graph 7: 2012 Derived Release Limit (GBq/a)



2.9.1.3 Environmental TLDs

The locations of environmental TLDs are shown on Figures 20 and 21 and listed in Table 16. The Environmental TLD results are shown in Table 16 and presented in Graph 8. Environmental TLDs were placed in these locations as they monitor the fields at representative points at the perimeter of the Kanata site. These locations are detailed in procedure SE-OP-012, "Environmental and Office Monitoring Dosimeters". The environmental TLD placement corresponds roughly to the historical locations of these dosimeters, which is useful for trending. The placement of these TLDs is unchanged from 2006. 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. No specific trends can be inferred from the data.

Table 16
Environmental TLD Results

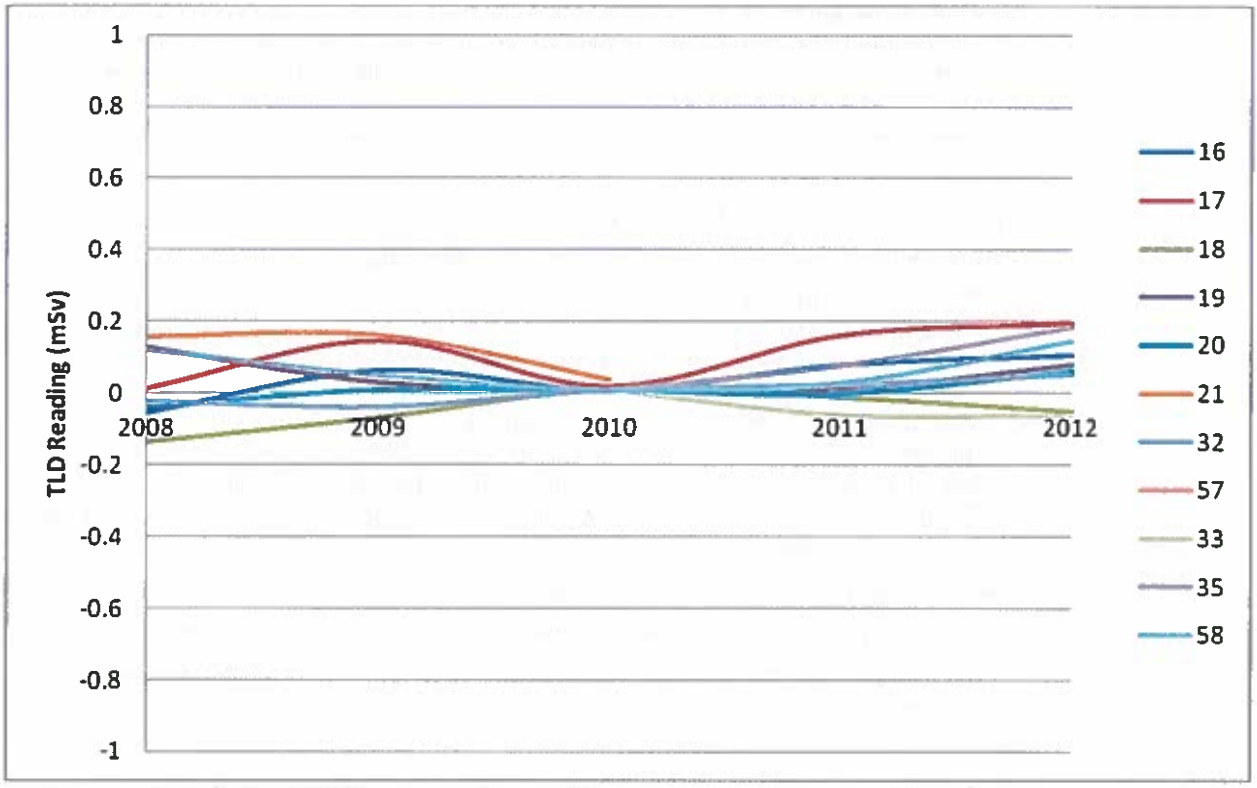
		Totals				
Location		2012 (mSv)	2011 (mSv)	2010 (mSv)	2009 (mSv)	2008 (mSv)
16	R.E. BUILDING, ROOM 5513	0.107	0.08	0.01	0.064	-0.054
17	POLE, NORTH CORNER	0.197	0.163	0.02	0.147	0.014
18	HEATING PLANT, ROOF	-0.051	-0.0124	m	-0.069	-0.137
19	HYDRO POLE, SOUTH-WEST	0.08	0.012	m	0.031	0.127
20	TREE, EAST CORNER	0.065	0.0	m	0.011	-0.039
21	THERAPY SYSTEMS, ROOM 209	ND	ND	0.04	0.163	0.159
32	RESIDENCE	0.053	0.025	m	-0.038	-0.021
57	RESIDENCE	0.058	ND	*	*	*
33	RESIDENCE	ND	-0.061	m	*	0.036
35	RESIDENCE	0.185	0.077	0.01	*	*
58	LOCAL BUSINESS	0.147	0.03	m	0.051	0.121

* missing TLD

m = less than 0.01 mSv

ND = not deployed

Graph 8: Environmental TLD Results (mSv)



Note: Results <0.01 mSv are displayed as 0.01 on graph.

2.9.2 Significance of Air and Water Release Monitoring Results

Unlike in 2009 and 2010, Mo-99 production was mostly uninterrupted throughout the year, but production quantities were smaller than in 2007 and 2008 leading directly to the observed changes in noble gas (Xe-133/-135/-135m) air releases. The year over year (2011-2012) changes in radio-xenon releases are within normal variations (of reactor processing times) for similar production levels in the two years. C-14 production stopped toward the end of 2008; and therefore, a decrease in C-14 releases for 2009 through 2012 is observed. The C-14 production cell was dedicated to another process in 2009. Nordion stopped C-14 monitoring of CO and CO_2 in 2012. Possible C-14 releases during the dismantling of the C-14 production glove-boxes and fume-hoods will be verified via particulate monitoring. Releases for I-125 increased by ~20%, though production increased by 80%. Releases of I-131 continue to be low, relative to years prior to 2011 when the use of new in-cell charcoal roughing filters began in the new I-131 processing facility. No other specific trends were noted.

Lower volumes of water were released from the facility in 2012 compared to 2011. Nordion employs a conservative practice of assuming the Minimum Detectable Activity (MDA) is always released. Nordion's practice of assuming releases equivalent to the MDA explains why the year over year trend very closely follows the number of litres released. The next largest factor is variation in the MDA between the Cobalt Operations Facility and the Nuclear Medicine Facility. A small percentage of the release reported is activity detected over the MDA.

2.9.3 Exceedances of Regulatory Limits or Action Levels

There were no instances of exceeding environmental regulatory limits or action levels in 2012.

2.9.4 Environmental Protection Program Effectiveness

The Environmental Protection Program is evaluated on an annual basis. In 2012, this review was held during the Annual Joint Environmental Management System and QA Program for Safety Review held April 5, 2012. The results of the review are identified 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 2012 included the following:

- Conducting a total of 14 fire and environmental inspections to identify areas for improvement and/or concerns. These were completed as part of a process to conduct routine environmental inspections implemented in 2011. Significant improvements have been observed as a result of these inspections.
- Maintaining ISO 14001: 2004 certification. In 2012, Nordion was subject to a full recertification audit of the system. There were no non-conformances and sixteen opportunities for improvement identified during the course of this audit.
- Conducting a supplier audit of a supplier whose goods/services could have a significant impact on the environment.

2.9.6 Environmental Protection Program Improvements

Improvements to the Environmental Protection Program in 2012 included the following:

- Installing a new groundwater well to enable monitoring for radioactive materials beginning in 2013.

2.9.7 Environmental Program Performance

A description of the Environmental Protection Program Initiatives is provided in Table 17, along with the results/outcome.

A summary of initiatives and targets for the upcoming year is provided in Table 18.

Table 17
2012 Environmental Objectives

Objective	Result / Outcome
Reduce the use of hazardous and other environmentally harmful materials (Ottawa and Vancouver)*	Reduction of 5% by 2015 (refer to Table 5 for 2012 results)
Reduce Waste (Ottawa and Vancouver)*	Reduction of non-hazardous waste by 5% by 2015 (refer to Table 5 for 2012 results) Reduction of hazardous waste by 5% by 2015 (refer to Table 5 for 2012 results)
Conduct an audit of a 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

** Standardized by revenue to allow for growth. Baseline year of 2010. Hazardous material refers to hazardous chemicals and excludes radiological materials.*

Table 18
2013 Environmental Objectives and Targets

Objective	Target
Reduce the use of hazardous and other environmentally harmful materials (Ottawa and Vancouver)*	Reduce use of hazardous and other environmentally harmful materials by 5% by 2015
Reduce Waste (Ottawa and Vancouver)*	Reduce non-hazardous waste by 5% by 2015 Reduce hazardous waste by 5% by 2015
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

** Standardized by revenue to allow for growth. Baseline year of 2010. Hazardous material refers to hazardous chemicals and excludes radiological materials.*

2.9.8 Well and Soil Sampling and Measuring/Monitoring

2.9.8.1 Soil Sampling

Soil sampling is conducted at least every two years to determine the presence/absence of radioactive materials in the soil. Soil sampling was performed in 2012. No radionuclides attributable to licensed activities were detected in the soil samples.

2.9.8.2 Groundwater Sampling

Groundwater sampling (non-radiological) was conducted in November 2012.

Results of the recent analysis, results from four years previous, original analysis data and trends are provided in Appendix C by borehole, with borehole two (BH2) representing background conditions. This analysis concluded that there were a number of contaminants that exceeded or came close to Ontario Drinking Water Standards or were uncharacteristically high; however, many of these contaminants were also elevated in BH2 (background well) indicating these contaminants came from an external source. The other contaminants of concern identified were believed to be the result of low precipitation levels in 2012. The average annual precipitation for Ottawa for 2007-2011 was 964.4mm; however, in 2012 the annual precipitation was only 747.5 mm. In addition to this, October and November precipitation levels were extremely low.

As a result of the unusual findings from the samples conducted in November 2012, Nordion plans to conduct sampling in the early spring of 2013 to verify these levels were a result of low water levels.

In 2011, Nordion repaired old groundwater wells that were installed in 1991 and in 2012 Nordion installed one additional well to enable monitoring for radioactive materials. Nordion was unable to conduct radioactive sampling in 2012 due to low water levels. As a result, this sampling is planned for 2013.

2.10 Emergency Management and Response

2.10.1 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 2012 a number of Emergency Response (ER) exercises were conducted to test these emergency response plans and provide training to employees having responsibilities within the plans. Activities which took place in 2012 included:

- Five on-site emergency response discussions including tours were conducted with City of Ottawa Fire Services with a total of 98 Ottawa Fire Services personnel attending.
- A test of the Emergency Response Fan-Out Phone List performed in October 2012 to ensure accuracy of telephone numbers listed, to determine availability of personnel and to estimate response time. Findings from this drill indicated that there were adequate emergency response personnel from the key support groups available. Further to this, there was also at least one person available from each of the additional support groups. This drill also indicated that a majority of personnel surveyed had access to the emergency response contact numbers if they had needed them.
- On-going emergency response training (refer to Section 2.10.3 for additional information).
- Testing of the Fire Safety Plan in each of the three buildings (KOB, Roy Errington (RE) Building, and Heating Plant).
- Completing a Chemical Spill Response exercise.

2.10.2 Emergency Preparedness Program Improvements

Improvements to the Emergency Preparedness Program in 2012 included the following:

- Establishing an Emergency Management Working Group to conduct a full review of Nordion's emergency response programs to identify areas for improvement.

2.10.3 Emergency Preparedness Training Program Effectiveness

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

During 2012, the following emergency response training was provided to employees and those working on behalf of Nordion:

- Fire Warden and Marshall Training – 96 Participants
- ER Personnel – 40 Participants
- New Employee/Contractors Emergency Alarm and Response Training – 43 Participants
- Emergency Alarms & Response Training – 47Participants

2.10.4 Fire Protection Program Activities and Effectiveness

Activities which took place in 2012 included:

- Conducting a total of 14 routine fire and environmental inspections.
- Conducting testing of the fire safety plan.

The fire safety plan is tested annually. This test involves evacuation of the three buildings (KOB, RE Building and Heating Plant) by activation of the building fire alarm system. During the KOB Fire Drill, it was identified that some Fire Wardens did not check in with the Fire Marshal. The Fire Safety Plan has since been revised to include a new role for Facilities personnel to assist in these instances in the future. Facilities personnel are now to report to the Building Fire Marshal and/or Fire Prevention Officer who can request they check an area that is not cleared if it is safe to do so.

During the RE Building Fire Drill, it was identified that the Fire Marshal arrived late to their designated position and this caused some confusion. Although the employee had just recently completed computer based training for this role, it was determined to be a training issue due to the fact that the Marshal did not normally fill this role. During the debrief, it was discussed that the Marshal would immediately evacuate in the future and get into their designated position. It was also identified that a vest would better identify the Fire Marshal as opposed to an arm band. The targeted completion for this corrective action is June 2013. In addition, it was identified that Facilities personnel were unable to reset the evacuation alarm on the panel immediately following the exercise. This was attributed to the fact that the panel had recently been replaced and there was a temporary issue with the system. During the exercise, the manufacturer recommended rebooting the system which appeared to correct the issue. The manufacturer had a planned annual maintenance scheduled shortly after the exercise, during which time they assessed the issue and made a modification to the software.

Nordion's Inspection, Testing and Maintenance report is submitted to the CNSC annually. This report was submitted to the CNSC in December 2012 with no deviations identified.

2.10.5 Fire Protection Program Improvements

Improvements to the Fire Protection Program in 2012 included the following:

- Updating the Fire Safety Plan which has been submitted to the Ottawa Fire Services for review and approval.
- Upgrading the Fire panel in the RE Building allowing better communication between buildings and the ability to view alarm details from the panel.

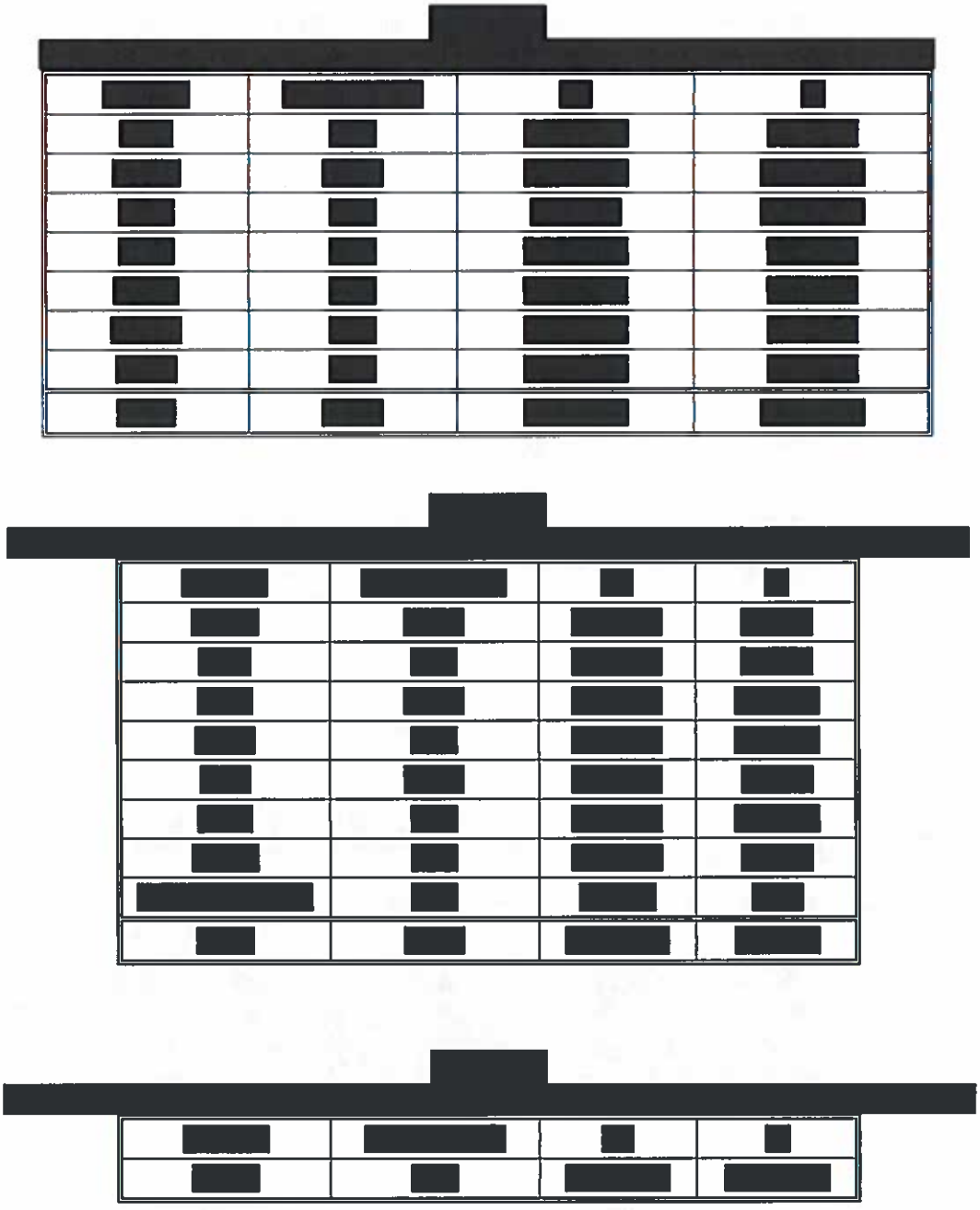
2.11 Waste Management

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 [redacted]

[redacted]

Waste from other radioisotope licensees is not transferred to Nordion for subsequent disposal. However, spent sealed sources may be returned to Nordion where they may be reprocessed or included with other product material for disposal. [redacted]

[redacted]



2.12 Nuclear Security

Details of Nordion security and all of the security improvements of 2011 were provided in the Nordion Physical Security Report for 2011, submitted March 31, 2012. These safeguards and improvements were reviewed with CNSC Security during an inspection on March 13th, 2012, including new fencing around the facility, improved lighting, additional security cameras and other improvements that are prescribed information. There were no additional enhancements made in 2012.

2.13 Safeguards and Nuclear-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 Nuclear Non-Proliferation Import and Export Control Regulations, the Nuclear Safety and Control Act and General Nuclear Safety and Control Regulations and was recently revised to meet the safeguards requirements of the CNSC regulatory document RD-336, "Accounting and Reporting of Nuclear Material".

In 2012, one safeguards inspection was conducted by the CNSC. This safeguards inspection was the Physical Inventory Taking - Evaluation (PIT-E) conducted on October 2, 2012. There were no follow-up items required as a result of this inspection.

2.14 Packaging and Transport of Nuclear Substances

In 2012, Nordion reported 18 non-conformances. 12 reports were against the Packaging and Transportation of Nuclear Substances Regulations (Section 19 (1)). The remaining events were reported as required by the Nuclear Safety Act (other non-conformances with regulations). Eleven of the reported non-conformances were external to Nordion's control (damaged packages, improper delivery, incomplete package closure, or improper labelling). Of the non-conformances that fell within Nordion's control, the issues were due to improper labelling/documentation (three), component failure (one), incorrect shipment (one), pressure build up (one), and packaging error (one). Two of the incidents occurred prior to 2012 (1999 and 2011 respectively); however, they are included as they were reported in 2012. Refer to Appendix A for further information regarding these incidents.

2.15 Public Information Program

2.15.1 Public Information Program Activities

On October 25, 2012, Nordion posted the CNSC's results on the company's 2011 compliance performance noting that under the 14 categories in which Nordion was rated, the company met or exceeded all compliance requirements and CNSC expectations.

In 2012, Nordion received two external communications. Both came from customers - one requesting a copy of Nordion's ISO 14001 certification and the other requesting to complete an environmental survey.

Nordion regularly issues news releases to inform the public of company initiatives, achievements and issues the business may be facing. On October 11, 2012, Nordion posted an ad in the *Kanata Kourier-Standard EMC*, a free weekly distribution newspaper that has a circulation of 23,400, and serves the communities surrounding Nordion's Kanata site.

The ad underlined Nordion's ongoing commitment to protect the safety of employees, the community and the environment. It noted that Nordion is certified to ISO 14001 - an international standard for environmental management systems, directed people to the Nordion website, provided the names of key contacts within the company, and overall, encouraged the public to contact Nordion with any questions, comments, or concerns. The ad also highlighted a new feature of Nordion's Public Information Program (PIP) program, directing people to the feedback form on the Corporate Social Responsibility section of the company web site, which provides them with the opportunity to tell Nordion what they want to hear about and how they want the program to evolve.

Nordion continues to update and enhance the Corporate Social Responsibility section of its website to include more information on safety programs and the environmental management system, and to update the Frequently Asked Questions (FAQ) section. The Safety page outlines Nordion's commitment to radiation, employee, public and environmental safety and outlines the regulators for the facility with links to the regulatory body's homepages. The Environmental Management page outlines the commitments made to environmental stability, including Nordion's ISO 14001:2004 certification, which

demonstrates the company's commitment to improving environmental performance. The FAQ page answers common questions posed by the general public.

In 2012, the Corporate Social Responsibility site received close to 3,000 visits.

There were no Nordion media articles relating to environment, health, and safety issues/topics during 2012.

2.15.2 Public Information Program Improvements

In October 2012, Nordion implemented its new public disclosure protocol which commits to informing the public of desired information related to the licensed facility during the course of the license period. This public disclosure protocol is an integral part of Nordion's Public Information Program.

In addition to ongoing updates to the Corporate Social Responsibility section on Nordion.com, on October 23, 2012, Nordion posted its Annual Compliance and Operational Performance Report to the CNSC for the period January 2011 to December 2011. While some portions of this report were redacted on the grounds of commercial confidentiality, the posting provides the public with a detailed overview of Nordion's compliance and operational performance.

Recently, Nordion broadened the scope of its PIP program to include local community speaking opportunities and work with key local leaders. Led by a new position in the Public Affairs team, the Senior Manager of Corporate Communications, the program includes a speaker's bureau with a focus on local events.

This program, in addition to Nordion's active and well-established community relations program, enhances Nordion's commitment to actively engage with members of the local community at various events aimed at raising awareness and sharing information about our business. Recent examples starting in late 2011 and throughout 2012 included:

- In December 2011, Nordion invited local community leaders from the Ottawa Centre for Regional Innovation (OCRI), the Ottawa Chamber of Commerce, and a representative from city council for a business update at Nordion's Kanata Operations Facilities and to launch our new GammaFIT™ irradiator. Members of the Sterilization Technologies technical team and our senior executives fielded questions from members of the community and community leaders.
- On February 22, 2012, the Nordion team presented to a group of local retirees who had questions about Nordion's business and Kanata operations. The group was comprised of dozens of seniors from Kanata, Manotick, and Stittsville all areas situated nearby Nordion's Kanata Facility. The 1.5-hour presentation was well received and the presentation team fielded questions about radiation and safety, as well as Nordion's business overall.
- On July 13, 2012, Nordion spoke to 59 local students and 11 professors involved in the Shad Valley Program being held at Carleton University. The Shad Valley program is geared at exceptional high school students with a focus on mathematics and sciences. The Nordion Director of Radiopharmaceutical Development on the Global Research and Development team presented details of Nordion's business, products, and Nordion's commitment to the environment, communities and employees.

2.16 Site Specific Information

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

- 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 as indicated in the site license and within the specified timeframes as detailed in the site license.

In 2012, Nordion complied with each site-specific reporting requirement with one exception involving sealed source reporting, Investigation Report 12-07. This instance was reportable under Section 6.1 (g) of the site license (NSPFOL-11.A.04/2015). Refer to Appendix A for further details.

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

3.2 Safety Performance Objectives for Following Year

Nordion plans to replace its in-cell halon fire suppression system with a more environmentally friendly argon fire suppression system.

There are no projected changes to the organizational structure for 2013.

Nordion's 2013 EHS Program Objectives and Targets and Health and Safety Objectives are shown in Tables 22 and 23. For 2013, the target for lost time injuries was lowered from ≤ 0.6 to ≤ 0.5 (rolling three year average) per 200,000 hours worked and the target for severity of lost-time injuries was lowered from ≤ 5 to ≤ 4 days (rolling three year average) per 200,000 hours worked. The target for radioactive materials emissions was lowered from ≤ 7.5% to ≤ 5.0% of the DRL. The targets for average and maximum employee dose were reduced from ≤ 2.0 mSv/yr and ≤ 8 mSv/yr respectively to ≤ 1.5 mSv/yr and ≤ 7.5 mSv/yr respectively. Additional targets regarding the timely closure of EHS Corrective Action Preventative Actions (CAPAs) and EHS review and approval of all new hazardous materials or chemicals prior to ordering were added. The EHS Committee has been reviewing the measure of EHS CAPA closure time since 2010; therefore, it was added as an official measure for 2013. The other targets remain unchanged for the 2013 fiscal year.

Table 22
2013 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 Incidents ≤ 6 • Lost Time Injuries ≤ 0.5 per 200,000 hours worked (3-yr rolling) • The severity of lost-time injuries to ≤4 days per 200,000 hours worked (3-yr rolling)
	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 sanitary sewer emissions of non-radioactive hazardous materials • Reduction in the use of hazardous materials and the generation of hazardous and non-hazardous waste
	Maintain radiation doses to employees as per ALARA principle.	• Average Active Area employee dose rate ≤ 1.5 mSv/yr • Maximum employee dose rate ≤ 7.5 mSv/yr • Radiation Incidents ≤ 5/year

Table 23
2013 Health and Safety Objectives

Applicable Nordion Job Function	Objective	Measures and Targets
All Directors and Managers	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.
All Directors and Managers of Operations, Facilities, or Nuclear Energy Worker employees	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 as feasible. • Ensure all near misses are reported and appropriate corrective actions(s) are taken. • Ensure timely closure of EHS CAPAs.
	Communicate monthly with teams about environment, health and safety performance and impacts. Openly evaluate employee environment, health safety concerns.	• 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	Work safely at all times. It is unacceptable to take risk in order to get the job done.	• Work follows Nordion applicable EHS standards and procedures, and is performed with care and attention to safety principles. • Wear all applicable personal protective equipment (PPE). • Submit all dosimeter(s) and rings for monitoring on time (i.e. no later than one month following end of monitoring period without good reason, such as extended illness or company travel, etc.).
	Report the occurrence of workplace injuries, unsafe conditions and near misses.	• All workplace injuries and observed unsafe conditions & near misses are reported immediately to the direct Supervisor.
	Correct co-workers who are working unsafely.	• Following Nordion values, coach co-workers who are seen working unsafely.
	Reduce environmental impacts.	• Identify opportunities for reducing waste, and using less harmful materials where feasible. • Ensure EHS reviews and approves all new hazardous materials or chemicals prior to ordering.

3.3 Concluding Remarks

The key points of this report are as follows:

- There were no major issues in 2012. The facility has operated according to its original design criteria. There were no physical design changes to any structural areas of the building or changes to the designated active areas.
- Conformance to internal training requirements was high in 2012.
- Testing of the radiation devices and instrument maintenance was performed at the required frequency and results were satisfactory. There were no observed trends related to equipment performance in 2012.
- The Environment, Health and Safety Committee met on a regular basis to review the environmental and safety aspects of the operations and to review and approve Final Safety Analysis Reports (FSARs).
- All measurable radiation dose received by personnel and the public were within the regulatory limit of 50 mSv/yr. and no internal dose levels or limits were exceeded.
- There were a total of 32 contamination incidents in 2012. All elevated levels of contamination were monitored and contained within the Active Area.
- There was one instance in which there was potential to exceed a regulatory limit or action level in 2012. There were no corrective actions as it was concluded that the dose was consistent with what would be expected from background for the four year period and it was non-personal.
- Various improvements were made to the Radiation Protection Program, Conventional Health and Safety Program, Environmental Protection Program and Fire Protection Program. These programs fall within the scope of the Quality Assurance (QA) Management Program.
- There were no disabling injuries in 2012.
- There were no instances of exceeding environmental regulatory limits or action levels in 2012. The maximum annual release of airborne from any one radionuclide was Xe-135m at 1.32% of the DRL.
- In 2012, Nordion received two EHS related external communications.
- In 2012, Nordion complied with each site-specific reporting requirement with one exception. This exception involved sealed source reporting. This instance was reportable under Section 6.1 (g) of the site license (NSPFOL-11.A.04/2015).

In 2012, Nordion's Class 1B Facility operated within the requirements of the Nuclear Safety and Control Act, the applicable regulations and the conditions of the operating license issued by the CNSC.

Figure 1: Cobalt Production Technicians

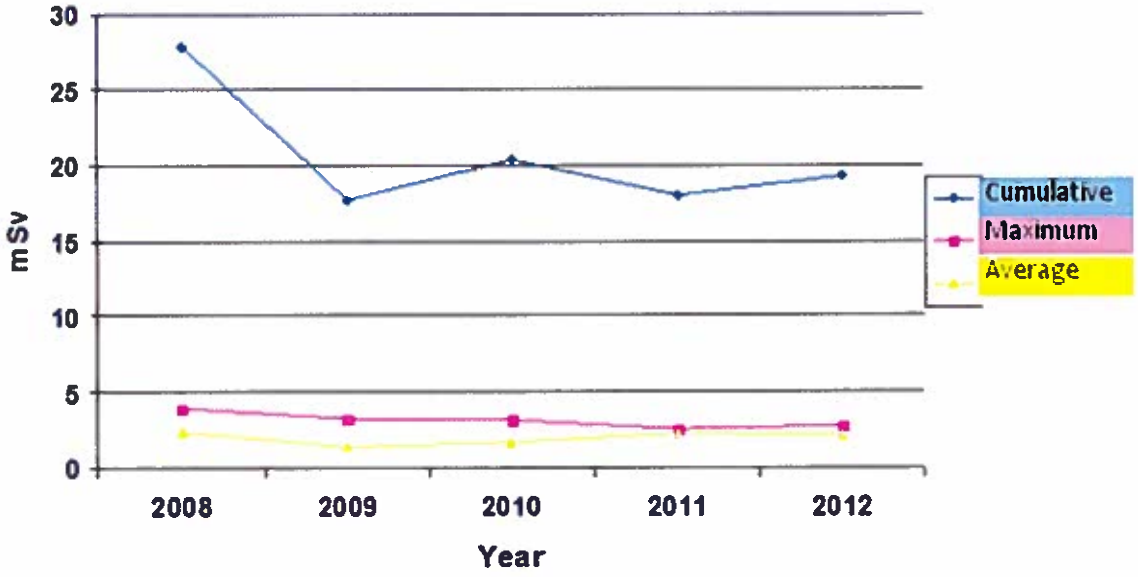


Figure 2: Cobalt Monitoring, Decontam and Shipping

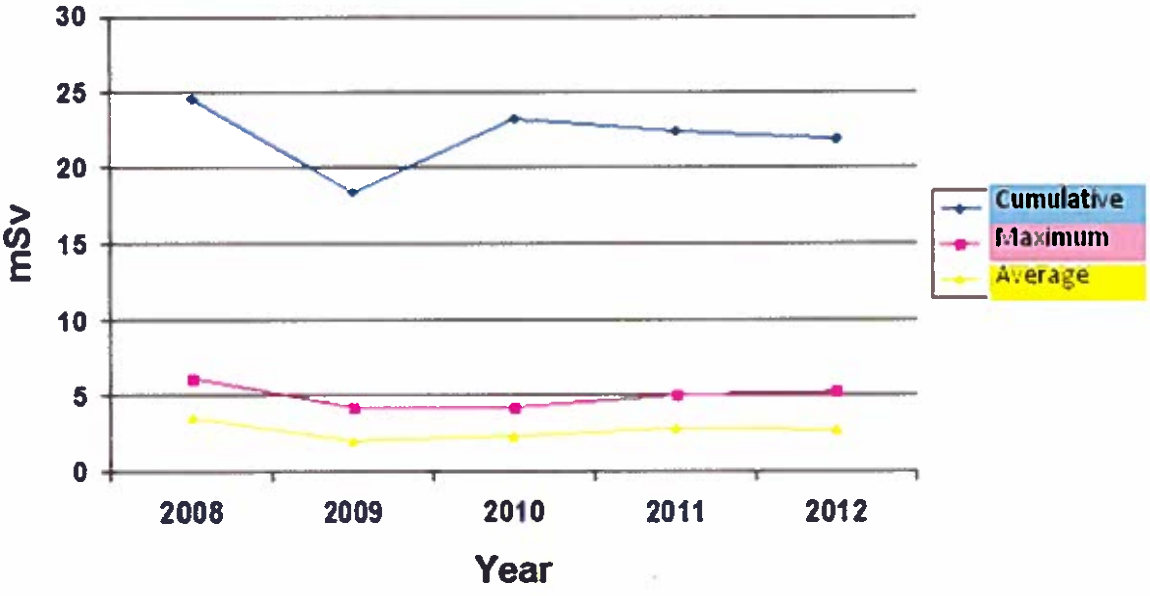


Figure 3: Cobalt Development

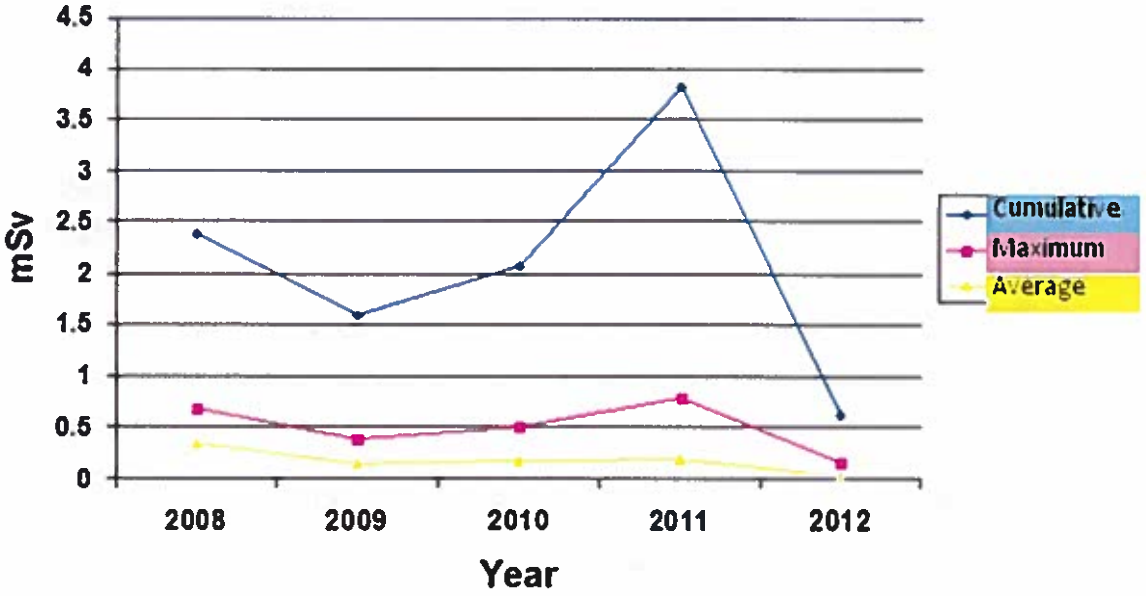


Figure 4: QC Cobalt

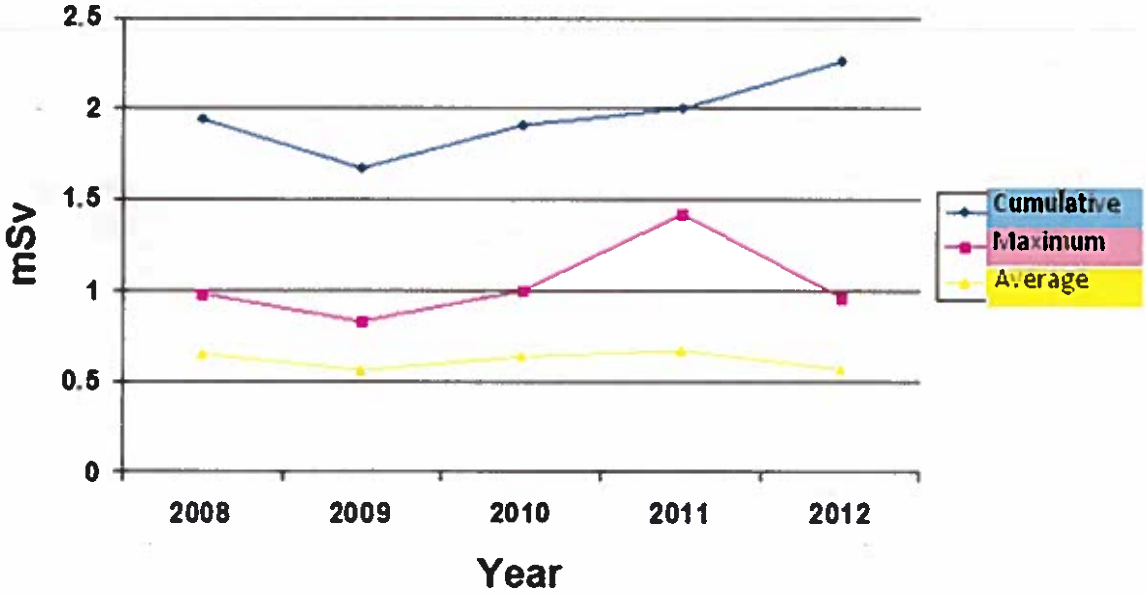


Figure 5: Radiopharm Development

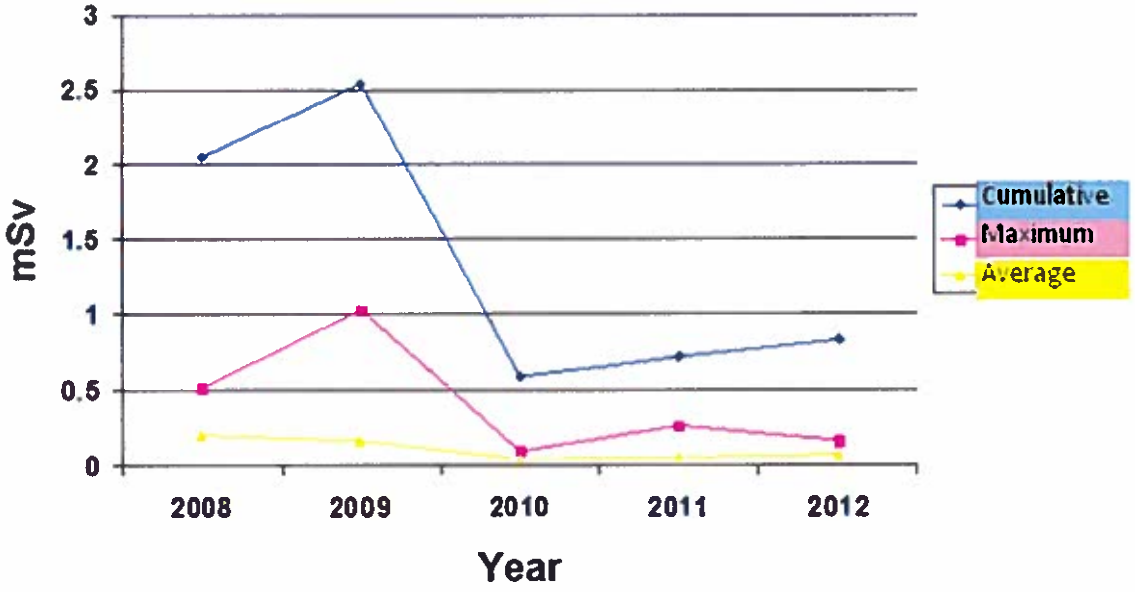


Figure 6: Technical Support

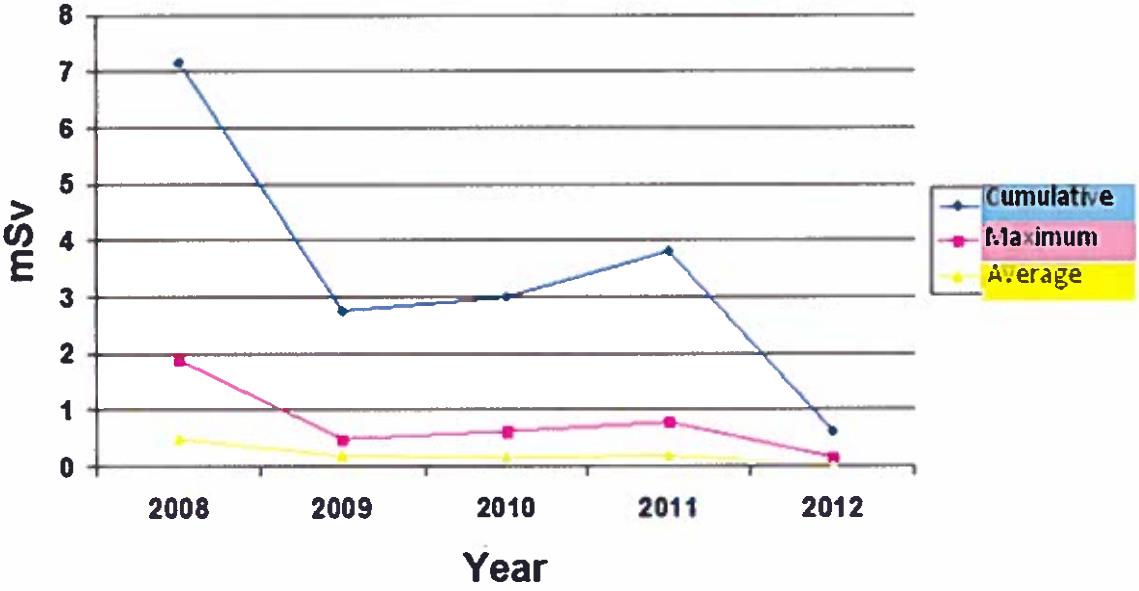


Figure 7: Nuclear Medicine Shippers, Waste, Containers

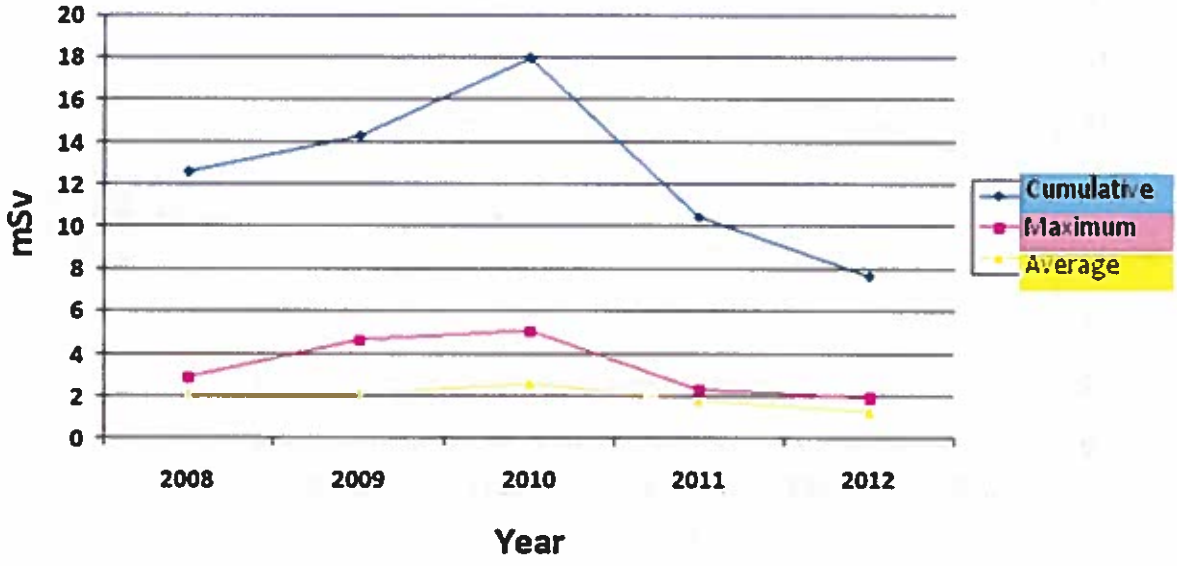


Figure 8: I-131, Ir-192 & Miscelaneous Production Technicians

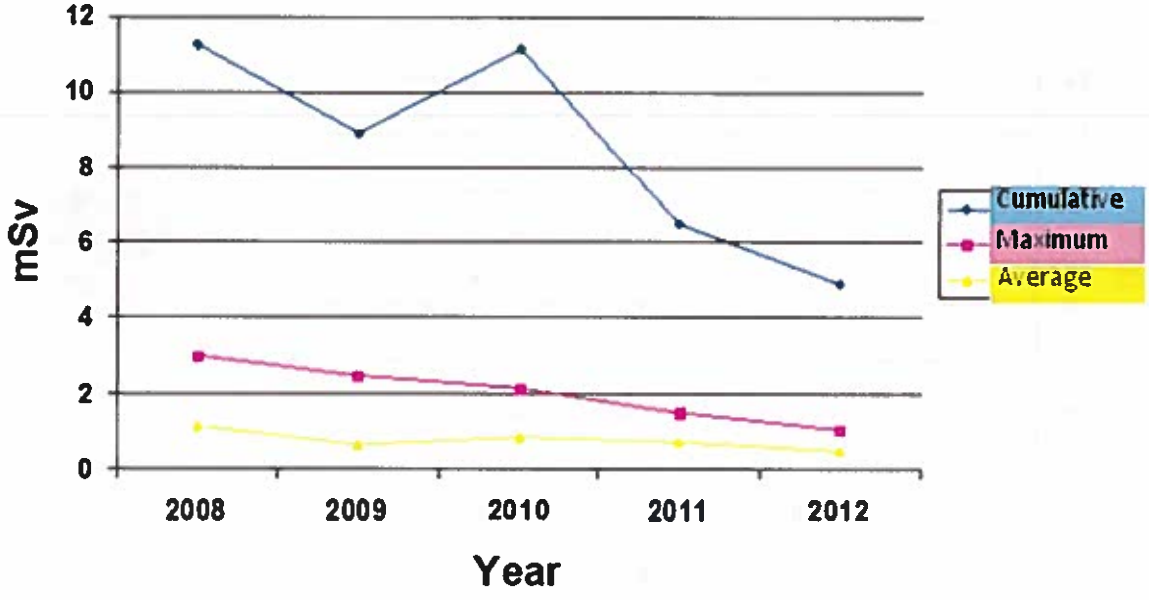


Figure 9: Mo-99/I-125 Production Technicians

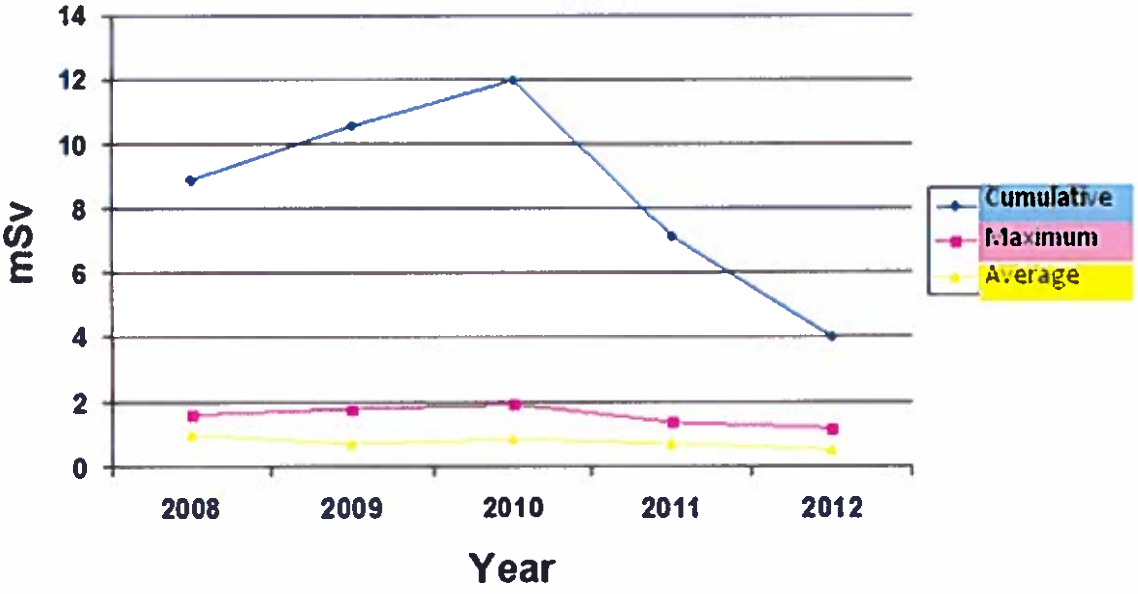


Figure 10: Radiopharm Production Technicians

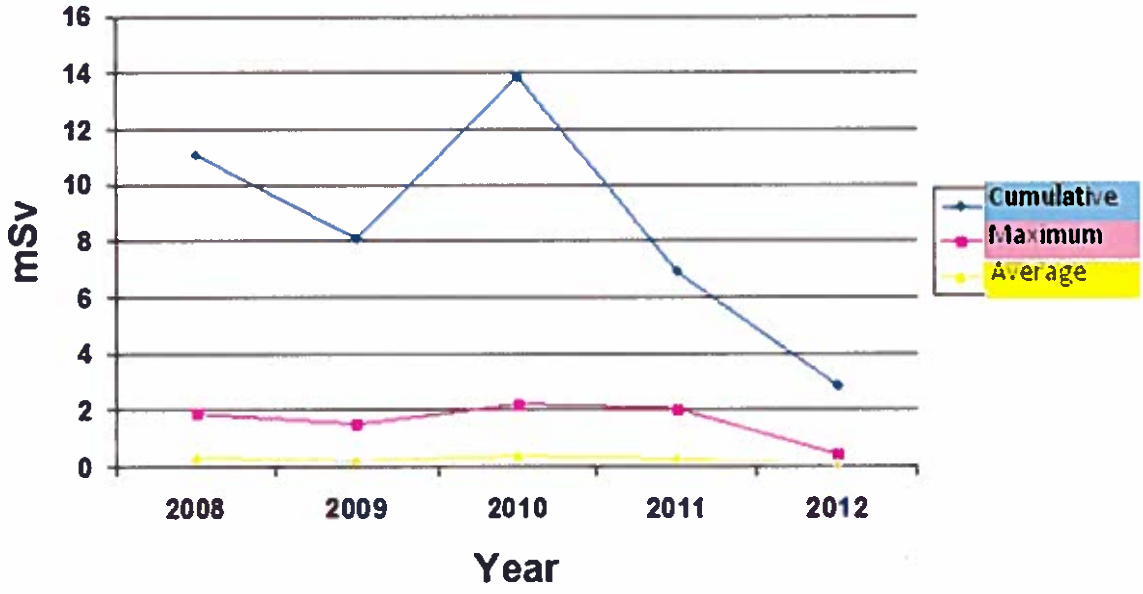


Figure 11: Machinists

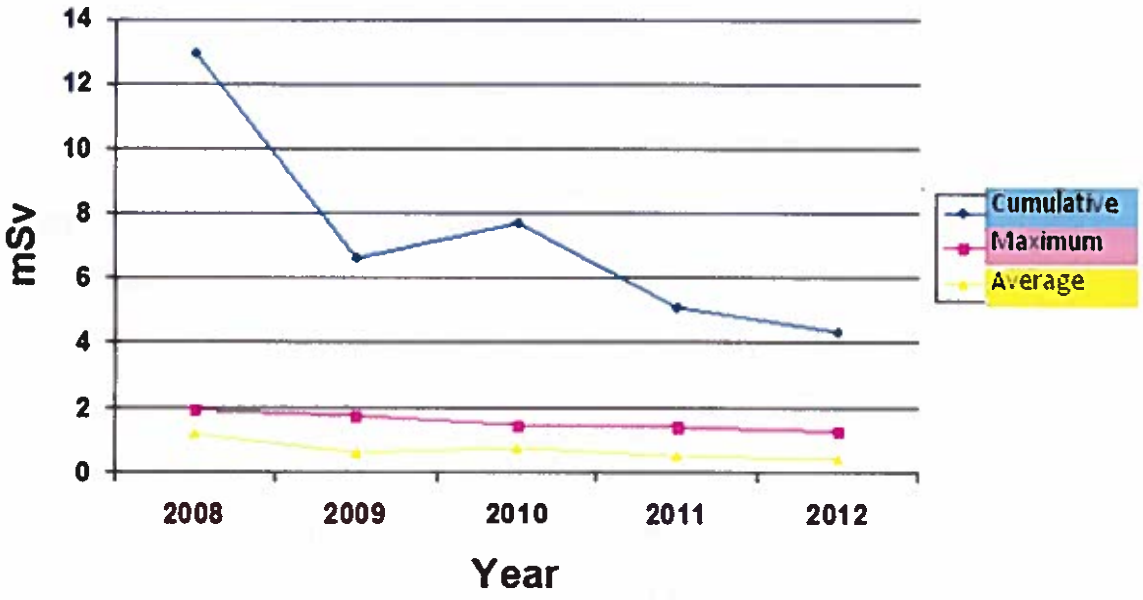


Figure 12: Nuclear Medicine QC

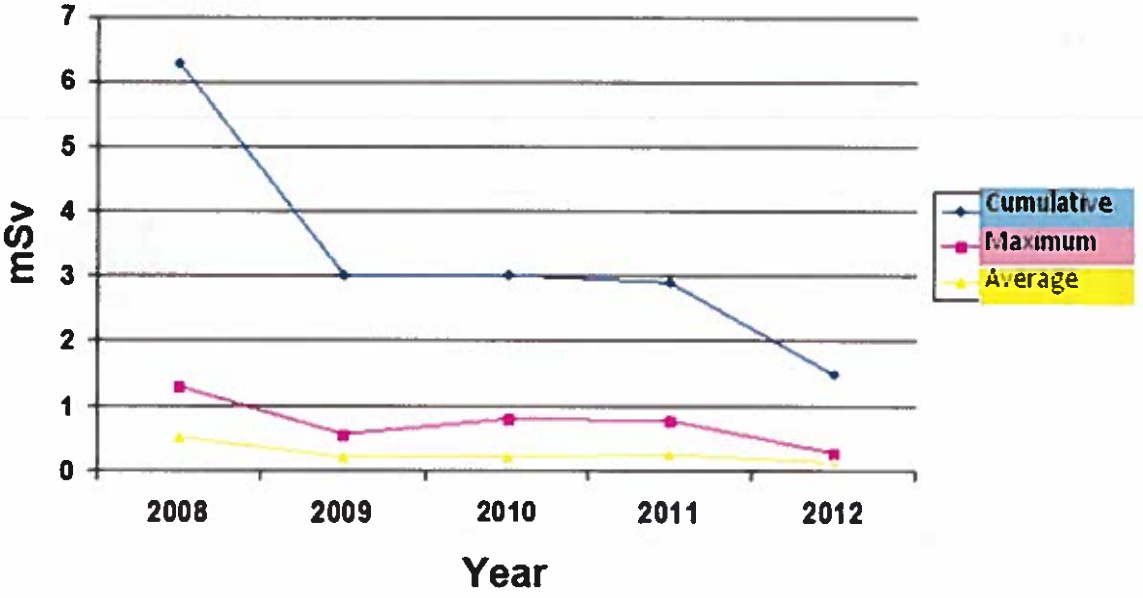


Figure 13: Surveyors

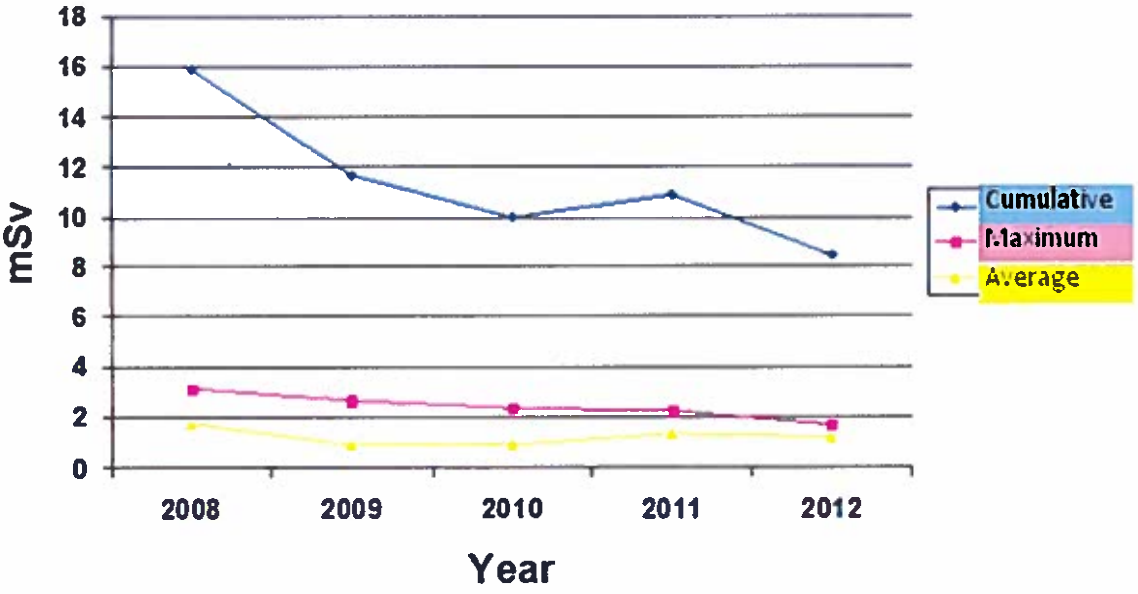


Figure 14: Nuclear Medicine Operators, Helpers

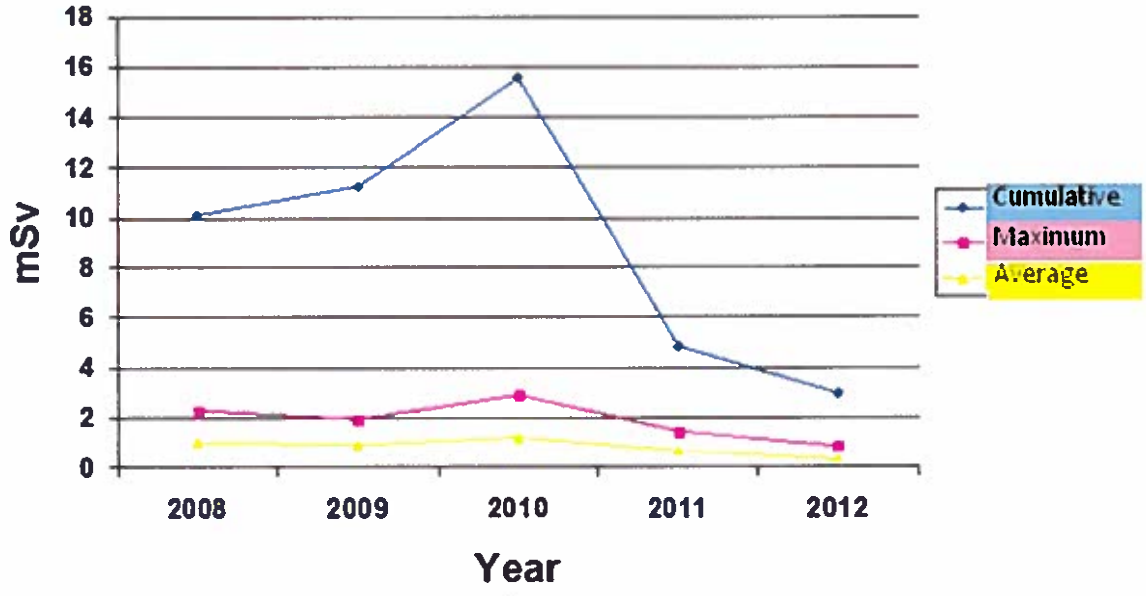


Figure 15: Nuclear Medicine Radiation and Contamination Monitors

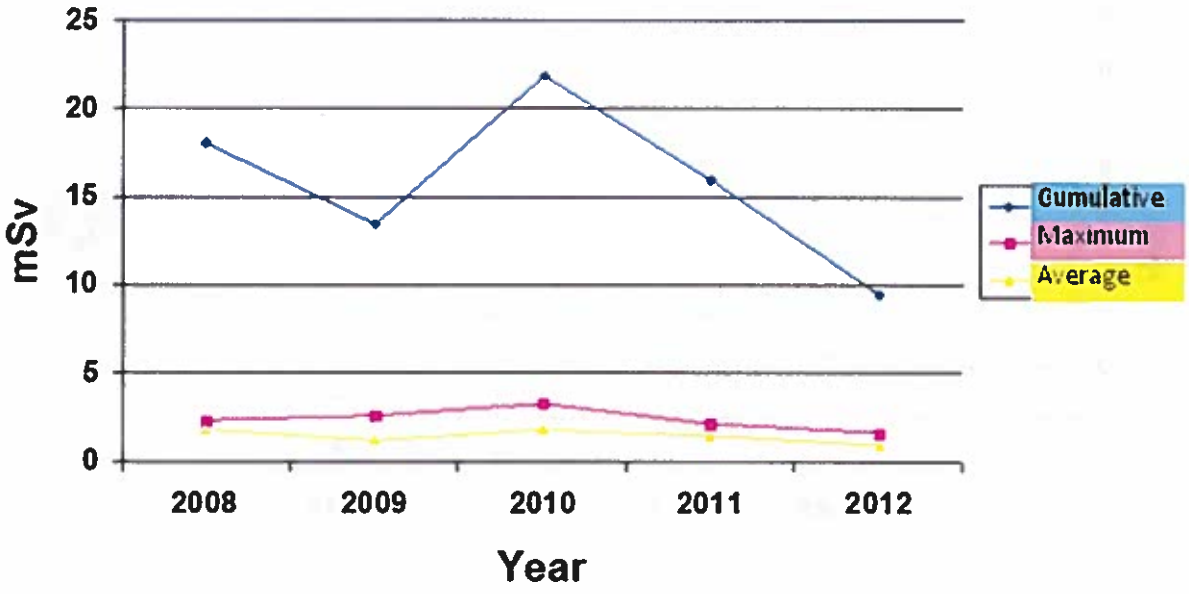


Figure 16: Maintenance & Motor Pool

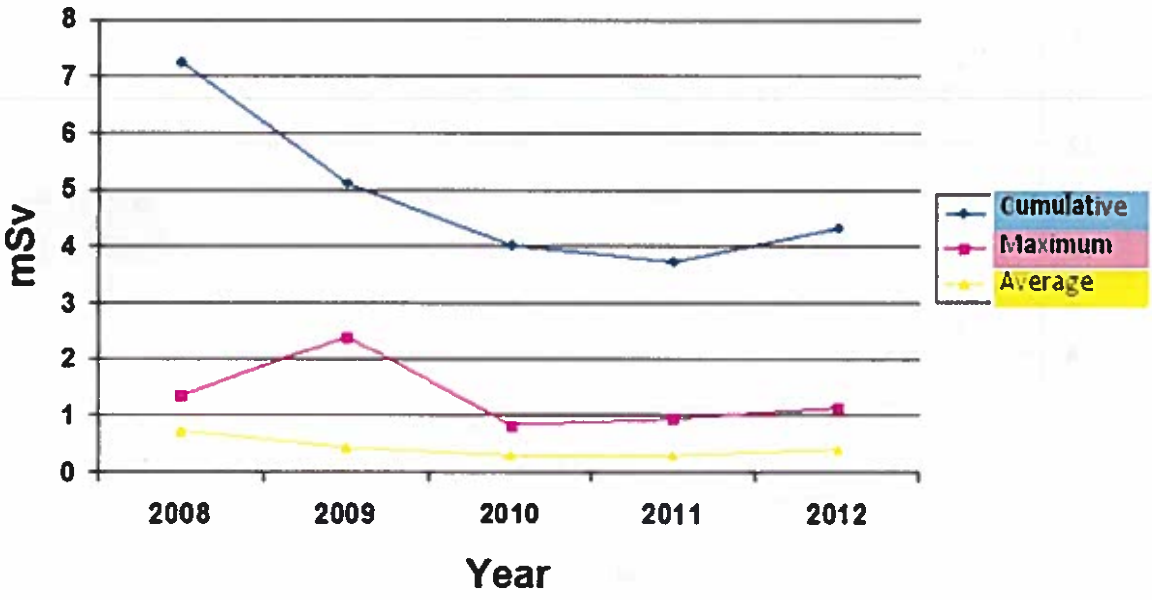


Figure 17: Maintenance & Electronic Calibration Lab

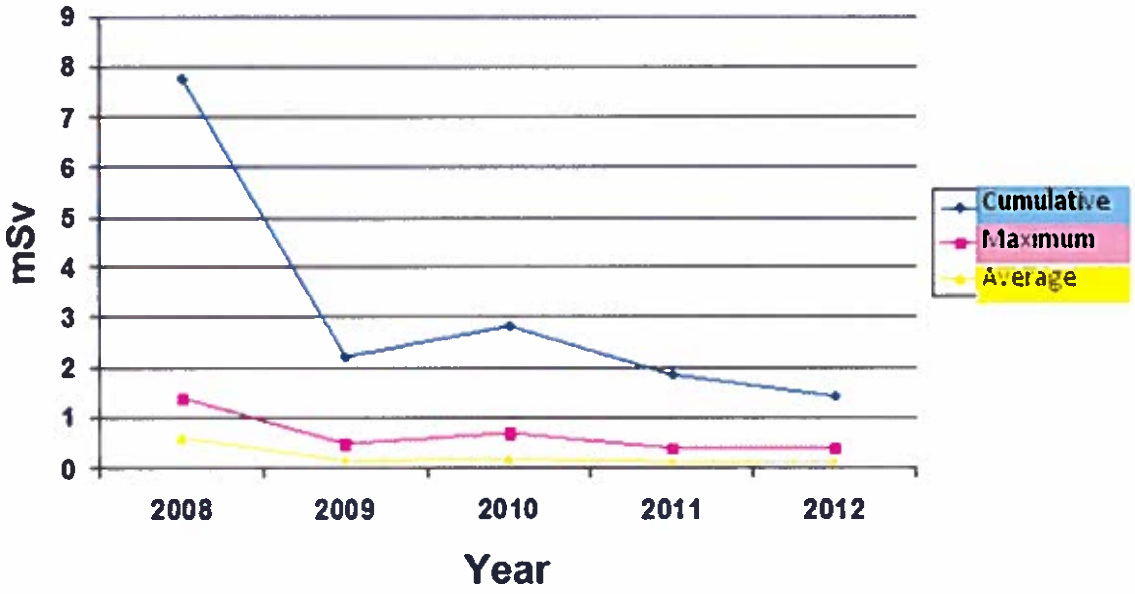


Figure 18: Radiopharm QC

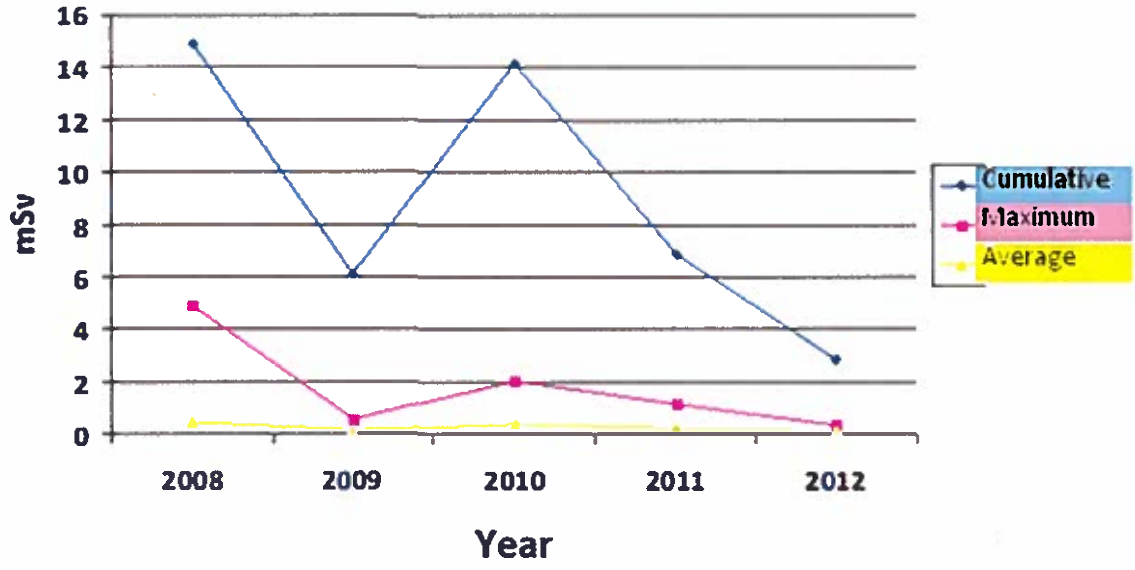
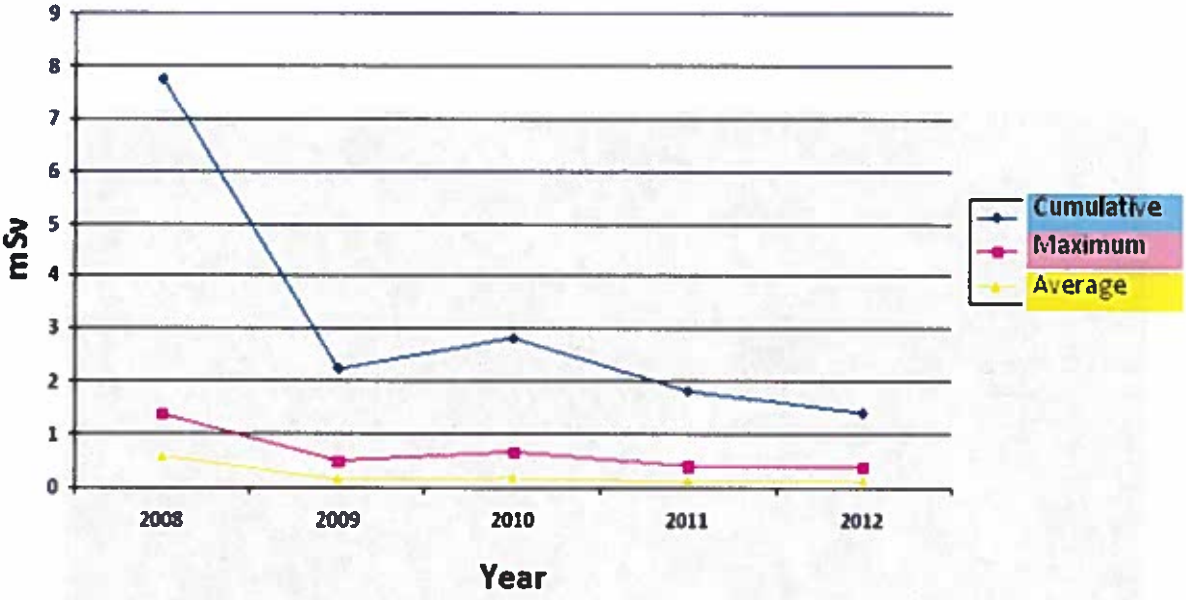


Figure 19: Facilities, Electrical



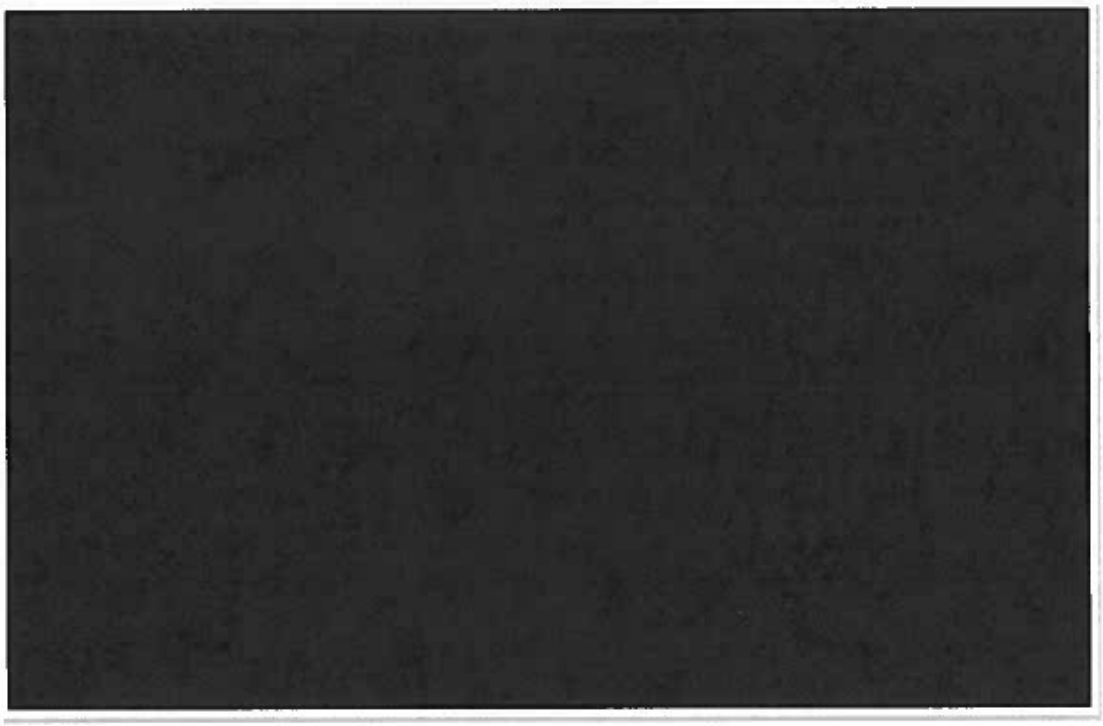


Figure 20 - Location of "Off Site" TLDs

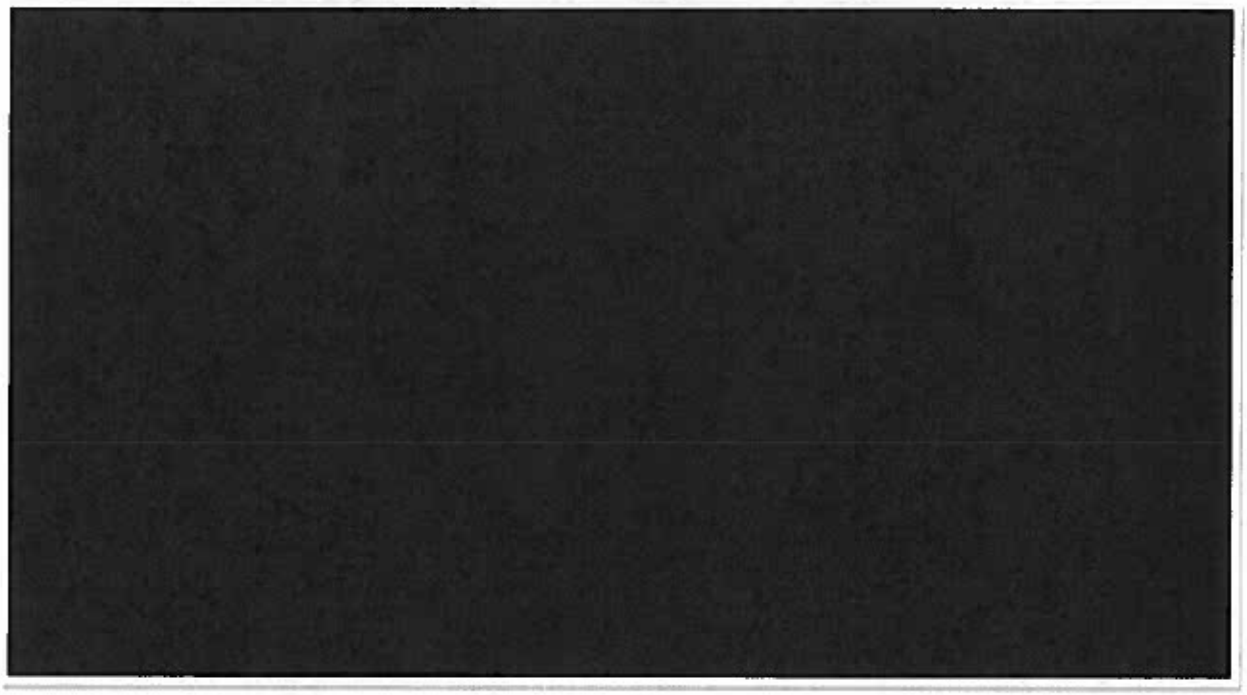


Figure 21 - Location of "On Site" TLDs

Appendix A
Table of Reportable Incidents

Date of Occurrence	Incident Number	Description	Reportability	Causes	Corrective Actions
Feb. 2, 2012	12-01	F-318 Insert Damaged Bottom plate from F-318 shielding insert detached from the body of the transport container upon receipt and inspection at Nordion.	Non-compliance with Section 19 (1)(c) of Packaging and Transport of Nuclear Substances Regulation (PTNSR)	Weld failure between the body and bottom plate of the shielding insert.	Item placed in quarantine and investigation conducted.
Jan. 16, 2012	12-02	Improper Shipping Name A Consignee reported that that the shipping paperwork incorrectly stated the shipping name for a shipment from Nordion.	Non-compliance with Class 1B site license	Template for the shipping document was incorrect.	The shipping paperwork template was corrected to include the correct proper shipping name.
Dec. 16, 2011	12-03	Very Late Delivery - Lost Package Customer notified Nordion of a very late shipment. Package was shipped in February of 2011 and was received in December 2011.	Non-compliance with Section 19 (1)(d) of PTNSR	Package was lost at the carrier depot. Customer did not report non-receipt of this package following expected delivery.	The carrier was notified.
Mar. 19, 2002	12-04	Damaged Type A Package An F-461 Type A package containing Nordion's Y-90 TheraSphere® (0, 5 GBq dose) product was observed with damage to the outer cardboard box when received in France.	Non-compliance with Section 19 (1)(b) of PTNSR	Package damaged in transit.	The carrier was notified. Nordion's technical authority assessed photographs of the damaged package and provided guidance to seal the damage to the outer cardboard box. The package was returned to Nordion.

Date of Occurrence	Incident Number	Description	Reportability	Causes	Corrective Actions
Mar. 20, 2012	12-05	Incorrect Delivery A shipment was not delivered to the correct address. The carrier delivered the package to the addressee's residential address. Local law enforcement was called to investigate.	Non-compliance with Section 19 (1)(c) of PTNSR	An error was made by the carrier.	The carrier was notified. Package was delivered to the correct package.
Mar. 27, 2012	12-06	Damaged Type A Package An F-461 Type A package containing Nordion's Y-90 TheraSphere® (3 GBq dose) product was observed with damage to the outer cardboard box en-route in Toronto.	Non-compliance with Section 19 (1)(b) of PTNSR	Package damaged in transit.	The carrier was notified. Nordion's technical authority assessed photographs of the damaged package and provided a package (F-454 Type A box) to return the package to Nordion.
Apr. 10, 2012	12-07	Cs-137 Sources not Reported within Required Timeframe The receipt of thirty-five Cs-137 sealed sources with activities exceeding 1 TBq transferred to Nordion's license was not reported to the CNSC Sealed Source Tracking System (SSTS) within 48 hours. During the course of the investigation, it was found that six sources were listed in the SSTS as under Nordion's license, but were supposed to be under a customer's license.	Non-compliance with Section 13 of Class 1B site license (Sealed Source Tracking).	Proper permissions are required for completing the required steps in the source tracking systems in a timely manner and in sequence.	• The IT Specialist revised the Nordion Source Allocation System to provide permission to the Cobalt Operations Quality Control personnel to change the source status from "Disposition" and "Quarantine" to "Returning". • EHS Compliance is to verify if there are any other old Cs-137 sources that should not be under Nordion's license, and if any are found, work with the customer to have them transferred. • The IT Specialist removed the requirement for the sources to be assigned to a device in the Cobalt Management Program (CMP).

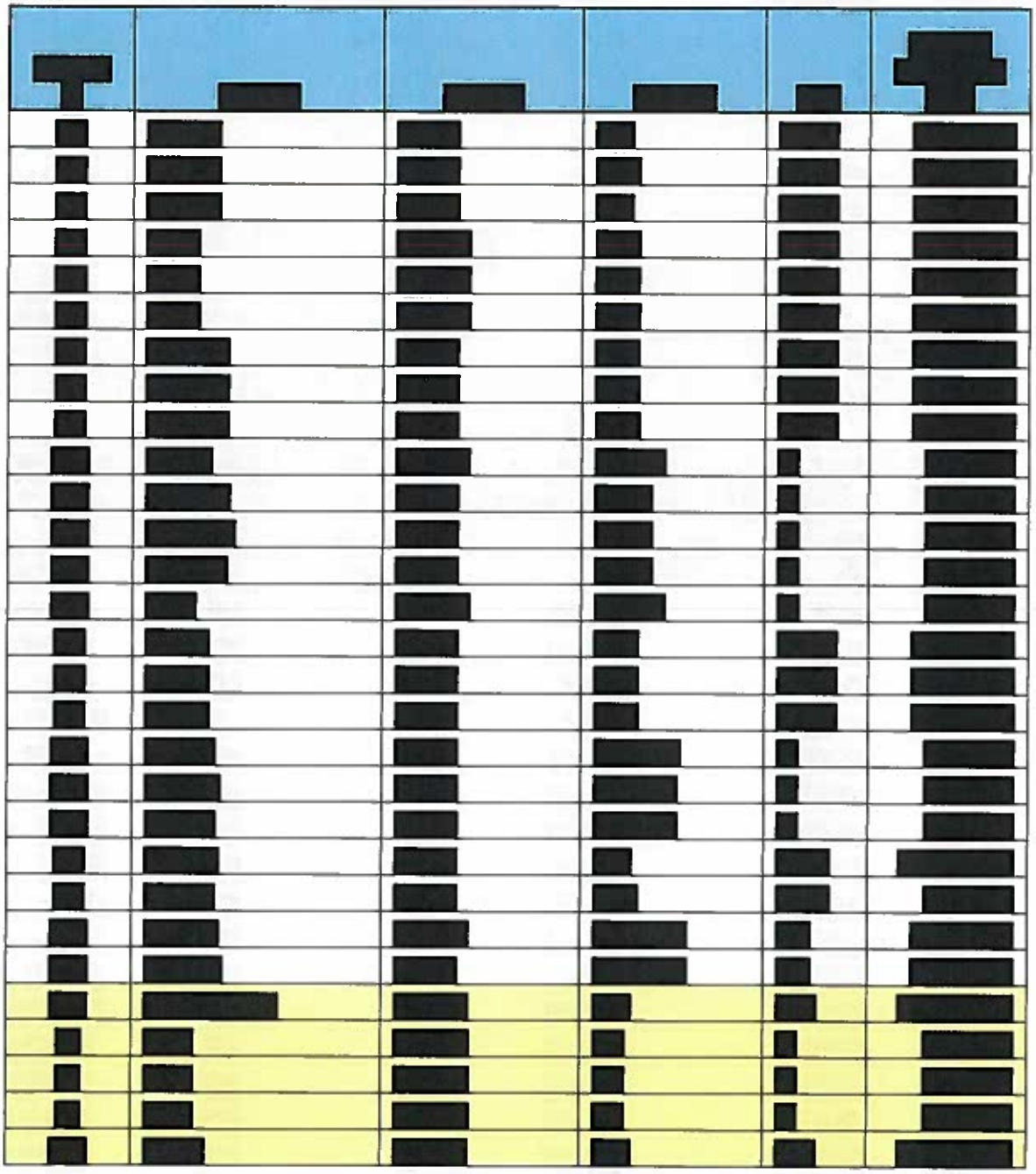
Date of Occurrence	Incident Number	Description	Reportability	Causes	Corrective Actions
Apr. 24, 2012	12-08	Category Labels not Removed on Empty Containers Two empty F-168 transport containers were returned to Nordion with the original category labels still visible.	Non-compliance with Section 19 (1)(c) of PTNSR	Consignee did not remove the labels prior to returning the containers.	Feedback was provided to the consignee.
June 13, 2012	12-09	Thermo-luminescent Dosimeter (TLD) Returned Late with 4.82 mSv Reading A lost TLD from January 2008 was found and processed for a Radiopharmaceutical QC Technologist on medical leave for the last ~12 months. The TLD was processed without a control.	Not applicable.	The TLD was returned late for processing.	No corrective actions required as the dose was consistent with what would be expected from background for the four year period and was non-personal.
July 2, 2012	12-10	Shipment Delivered to Incorrect Site A shipment of Y-90 TheraSphere® (9 GBq dose) was delivered to the wrong customer. The receiving site was not licensed to receive Y-90.	Non-compliance with Section 19 (1)(c) of PTNSR	Mix- up by carrier.	Feedback was provided to the carrier.
July 16, 2012	12-11	Total Activity Incorrect on Shipping Paperwork Five I-131 orders were dispensed with slightly greater than double the activity. The shipping paperwork indicated the target activity; however, each package contained over twice the target activity.	Non-compliance with Section 19 (1)(b) of PTNSR	Incorrect stock of I-131 was used for dispensing.	Production has clarified witness steps and line clearance requirements and added visual marks on the dispensing work sheets indicating the lot to be used.

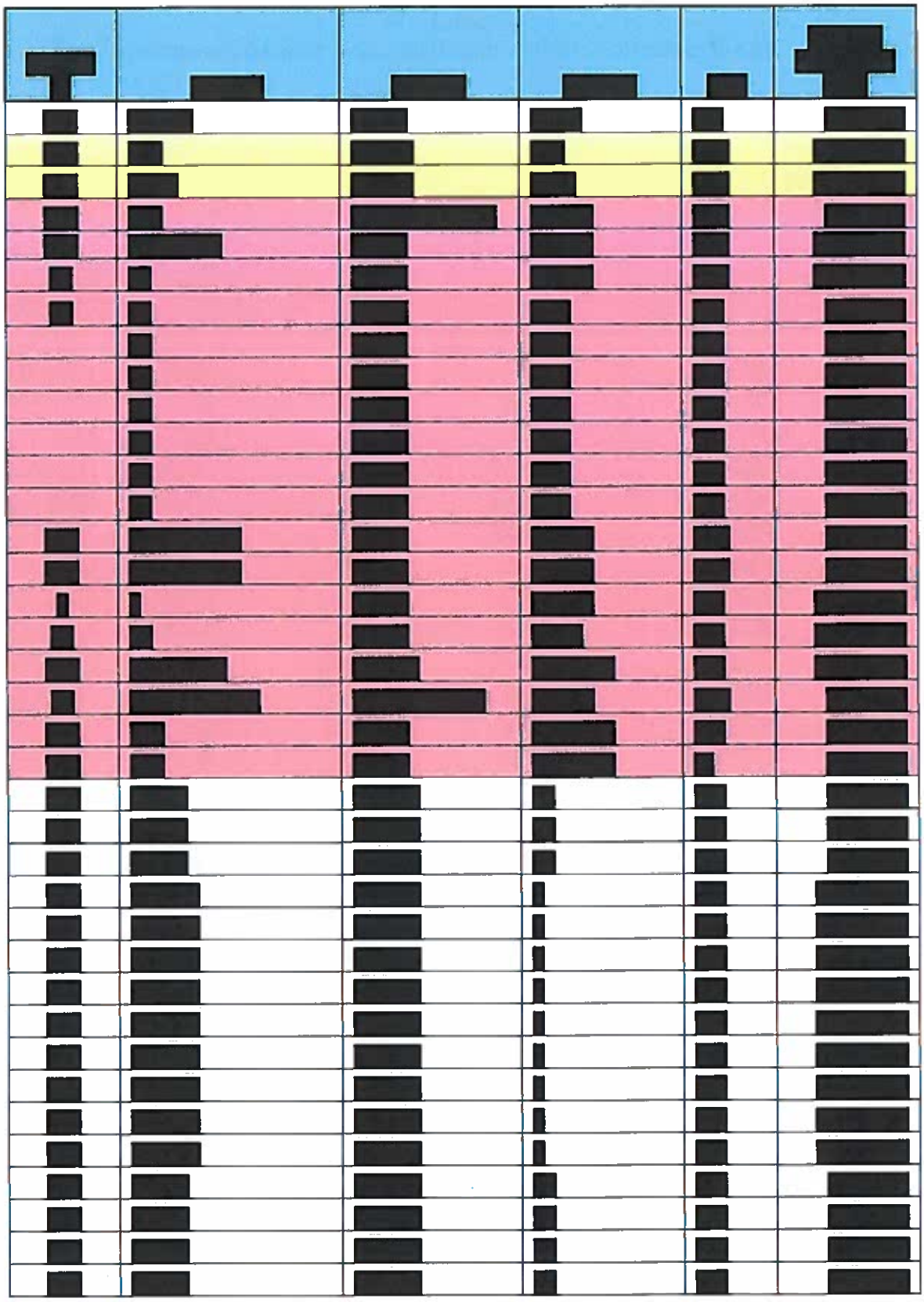
Date of Occurrence	Incident Number	Description	Reportability	Causes	Corrective Actions
Aug. 23, 2012	12-12	Loss of Containment of Xe-133 Upon opening of an F-278 flask, Nordion found that Xe-133 had escaped from the containment system.	Non-compliance with Section 19 (1)(d) of PTNSR	Inlet fill valve was found to be ¼-turn open.	The incident was communicated to the supplier.
Aug. 31, 2012	12-13	Missing Sample Package A package containing trace amounts of radioactivity went missing.	Non-compliance with Section 19 (1)(c) of PTNSR	The carrier lost the package.	The carrier located the package.
Sep. 25, 2012	12-14	2773A Package Delivered Without Dangerous Goods Markings Return shipment of 2773A Type B(U) package did not have category labels.	Section 27(b)(ii) of NSC Act	Unknown	Feedback was provided to the consignor.
Nov. 23, 2012	12-15	Type A Package Mix-up The carrier delivered a TheraSphere® shipment to a customer expecting an I-131 delivery and vice versa.	Section 27(b)(ii) of NSC Act	Mix-up by carrier.	Feedback was provided to the carrier who was responsible for the event.
Nov. 27, 2012	12-16	Damaged In-111 Type A Package Type A package containing In-111 was damaged by a forklift during handling at Edmonton Airport.	Non-compliance with Section 19 (1)(a) of PTNSR	Damage during in-transit handling.	The package was inspected, surveyed, repackaged and delivered to the customer.
Sep. 22, 1999	12-17	Incorrect C-146 Source Returned A returned C-146 source was found to be a different serial number than that expected to be returned.	Section 27(b)(ii) of NSC Act	Mix-up at time of source loading. Incorrect source delivered to customer (in 1999).	Notification of the event was provided to the end users.

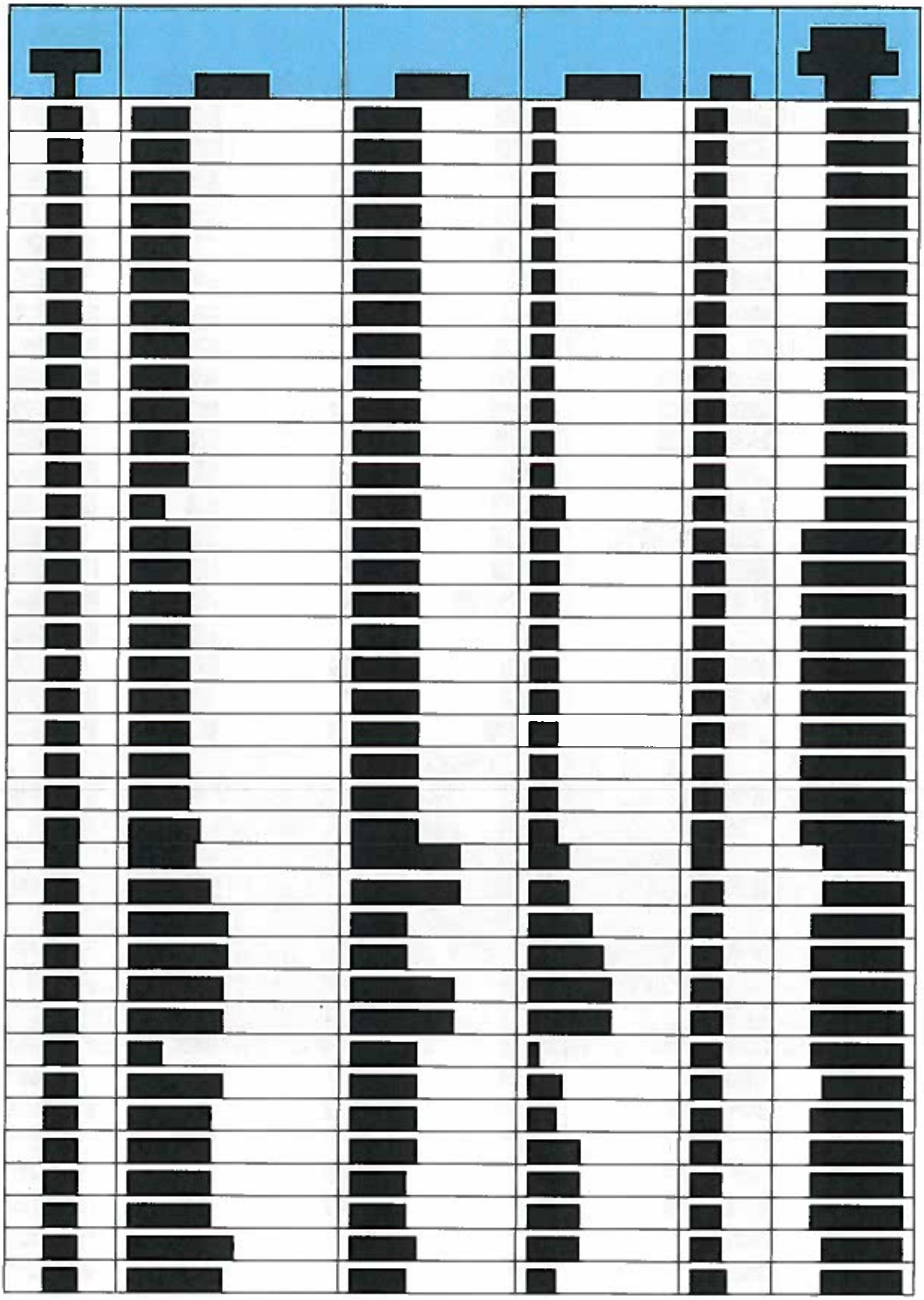
Date of Occurrence	Incident Number	Description	Reportability	Causes	Corrective Actions
Nov. 30, 2012	12-18	Pressure Build-up in I-131 Vial Customer reported a loud bang and deformation of septa when piercing the I-131 vial.	Non-compliance with Section 19 (1)(c) of PTNSR	Suspected cause is hydrogen pressure build-up in the vial. Vial was unopened at customer site for several days. Activity limits have proven to be too high for this configuration.	Nordion decreased the activity limit for the 10 mL Hypovial.
Nov. 20, 2012	12-19	License Verification Error for I-131 Customer Customer license was incorrectly assessed in 2009. Incorrect form of iodine (Radiopharmaceutical vs. Radiochemical) was listed.	Section 27(b)(ii) of NSC Act	Administrative. Error in original assessment.	Nordion is to conduct a review of all potentially affected licenses.
Dec. 17, 2012	12-20	Incorrect Isotope Listed on Category Label Category label listed Y-90 for a shipment of I-125.	Section 27(b)(ii) of NSC Act	Operator incorrectly chose a pre-printed label.	Pre-printed labels were removed from inventory.
Dec. 17, 2012	12-21	F-168 Packaging Error Packaging and documentation errors during preparation and shipment of F-168 containers with returned sources.	Section 27(b)(ii) of NSC Act	Operator error during preparation for shipment.	Installation staff were reminded of the requirements for planning and checking critical tasks and retrained on the labelling and documentation requirements.

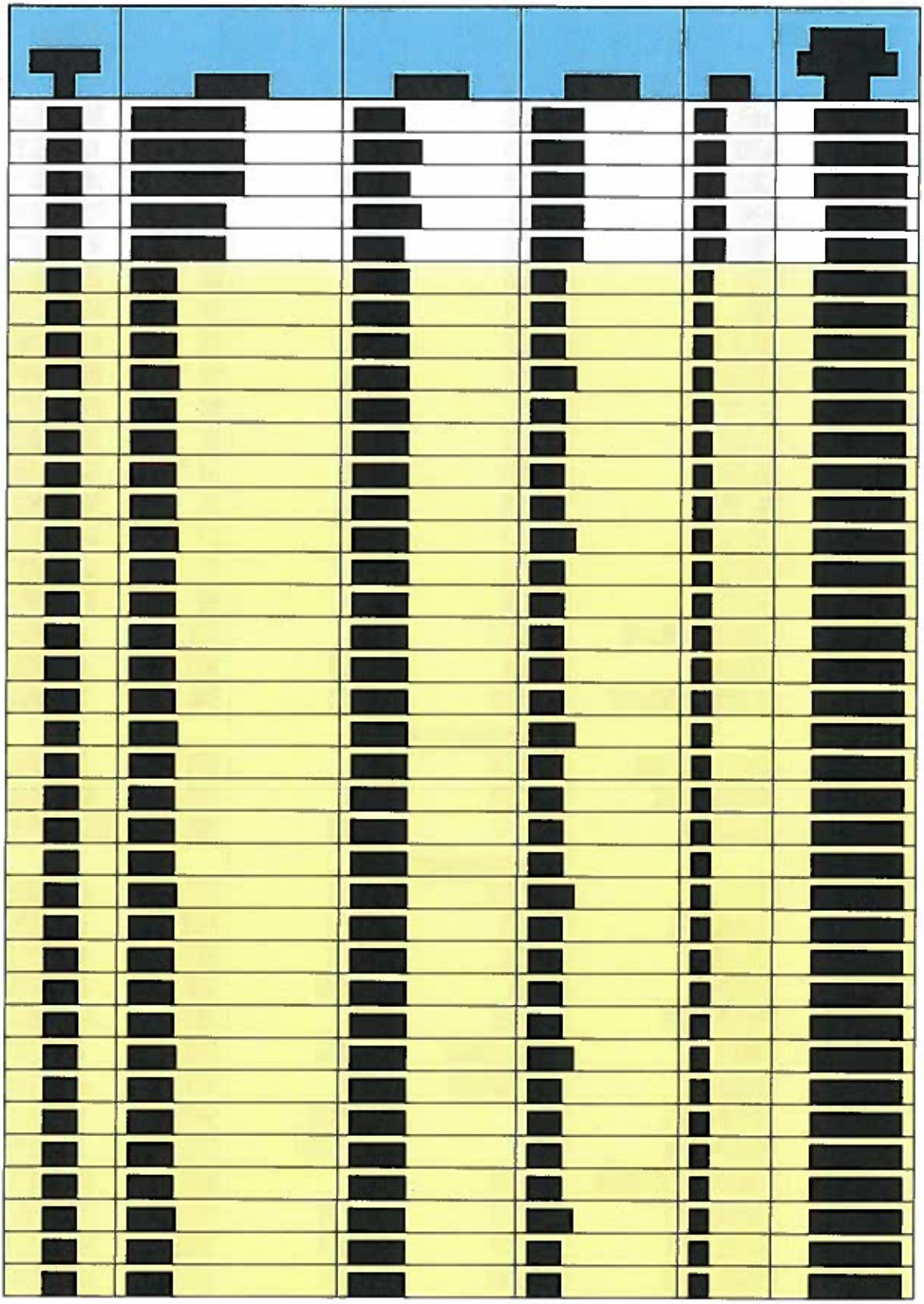
Appendix B
Non-Production Sealed and Unsealed Source Inventory

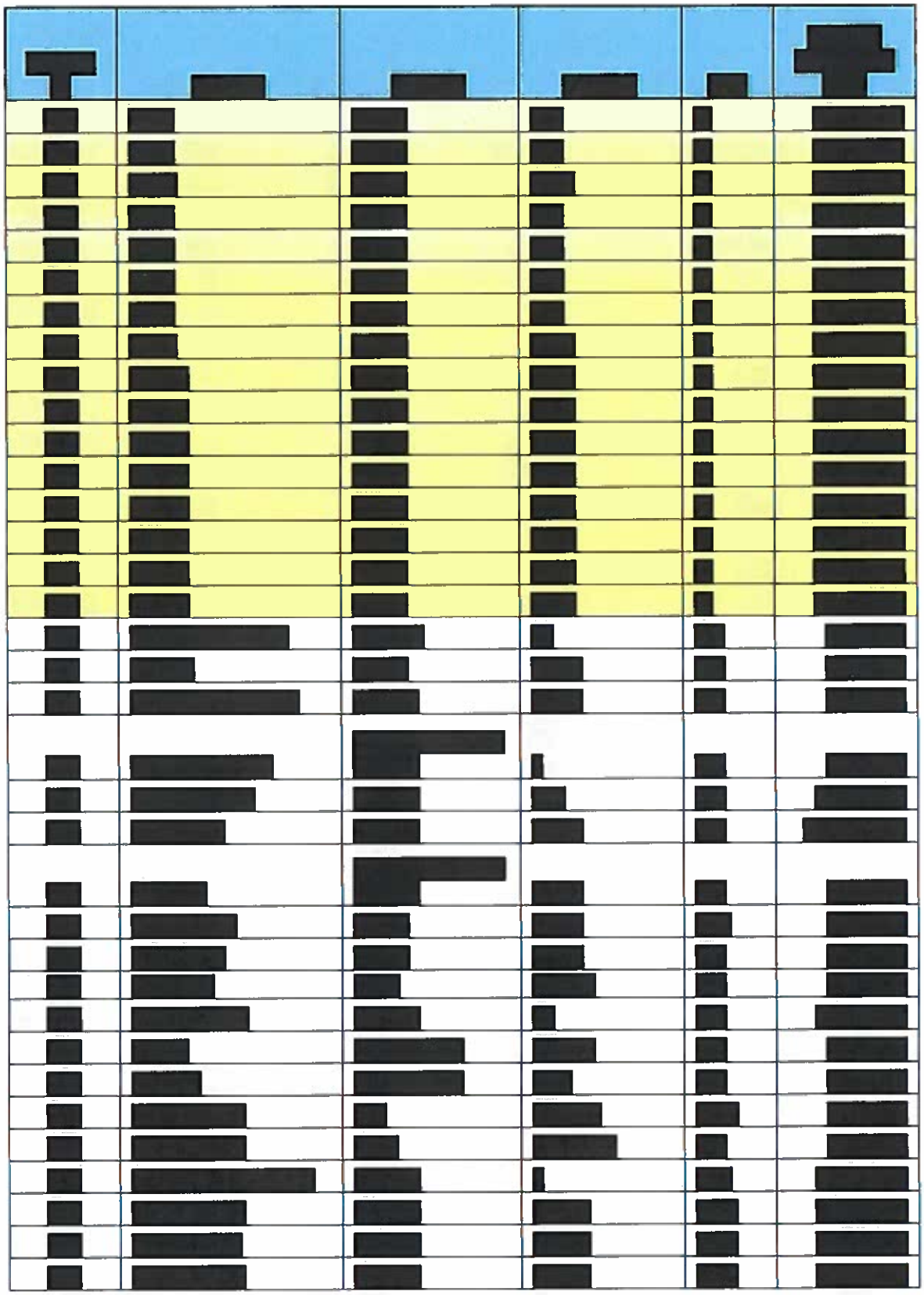
Leak Tested
Safeguarded
Exempted from Safeguards

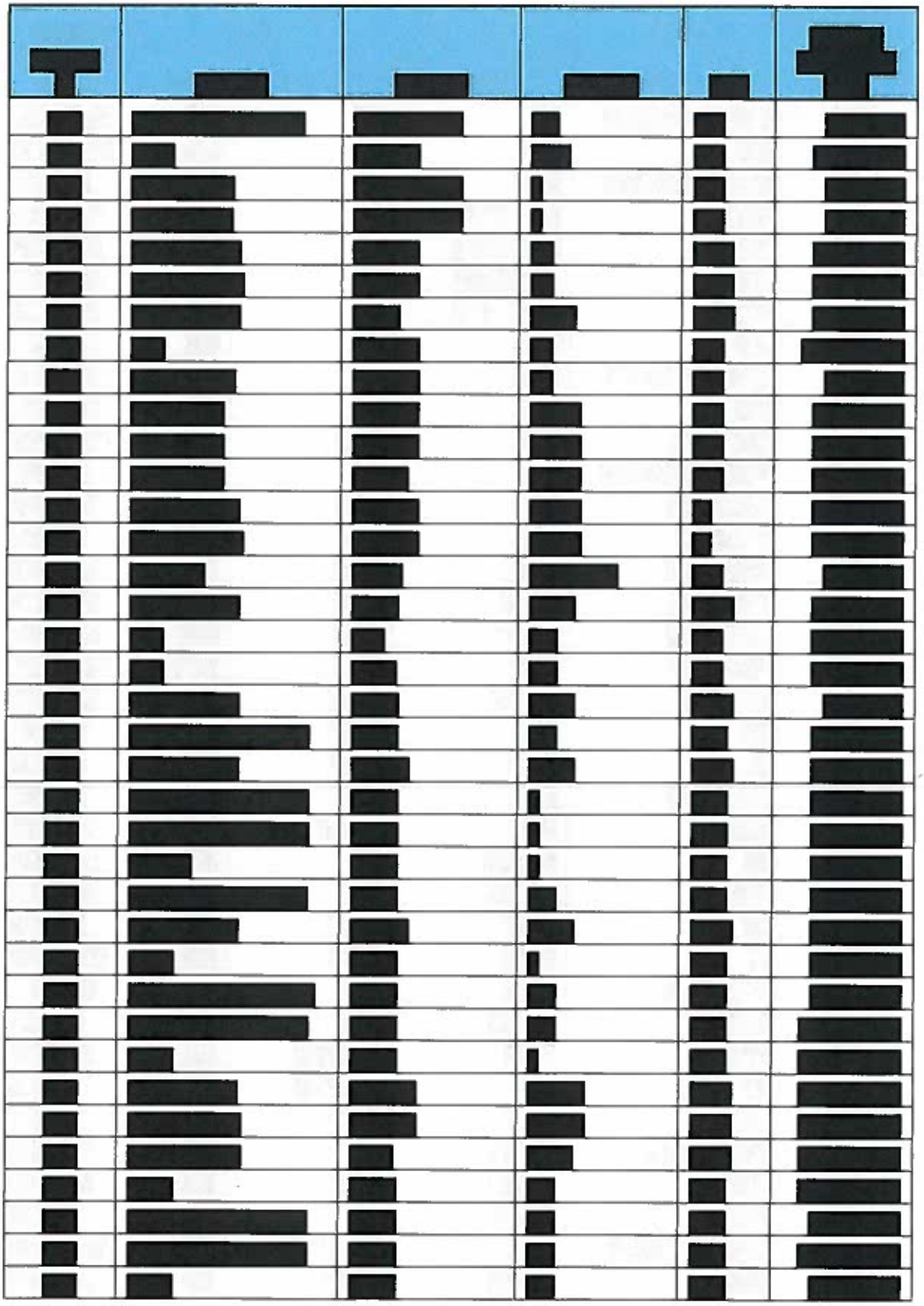


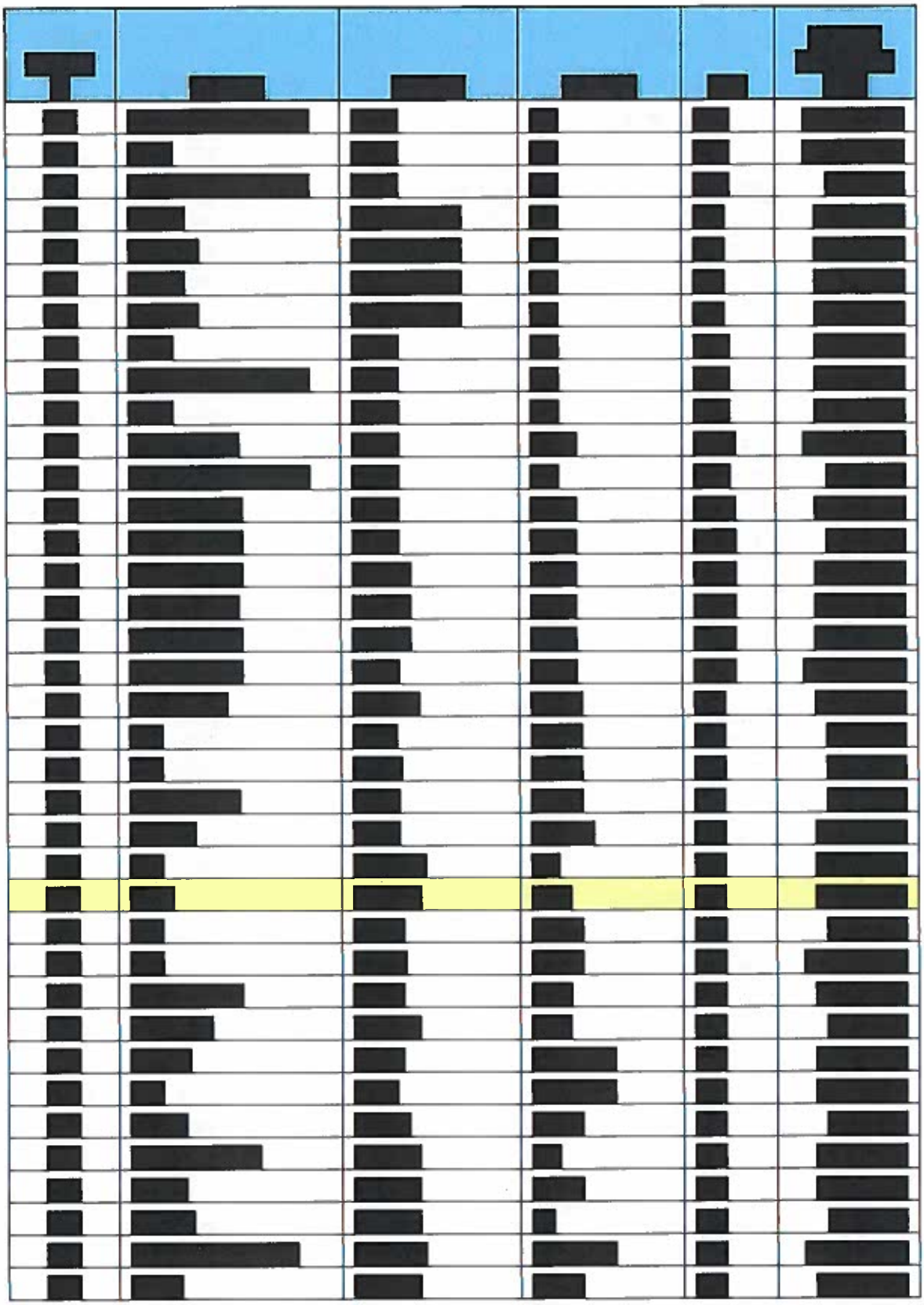


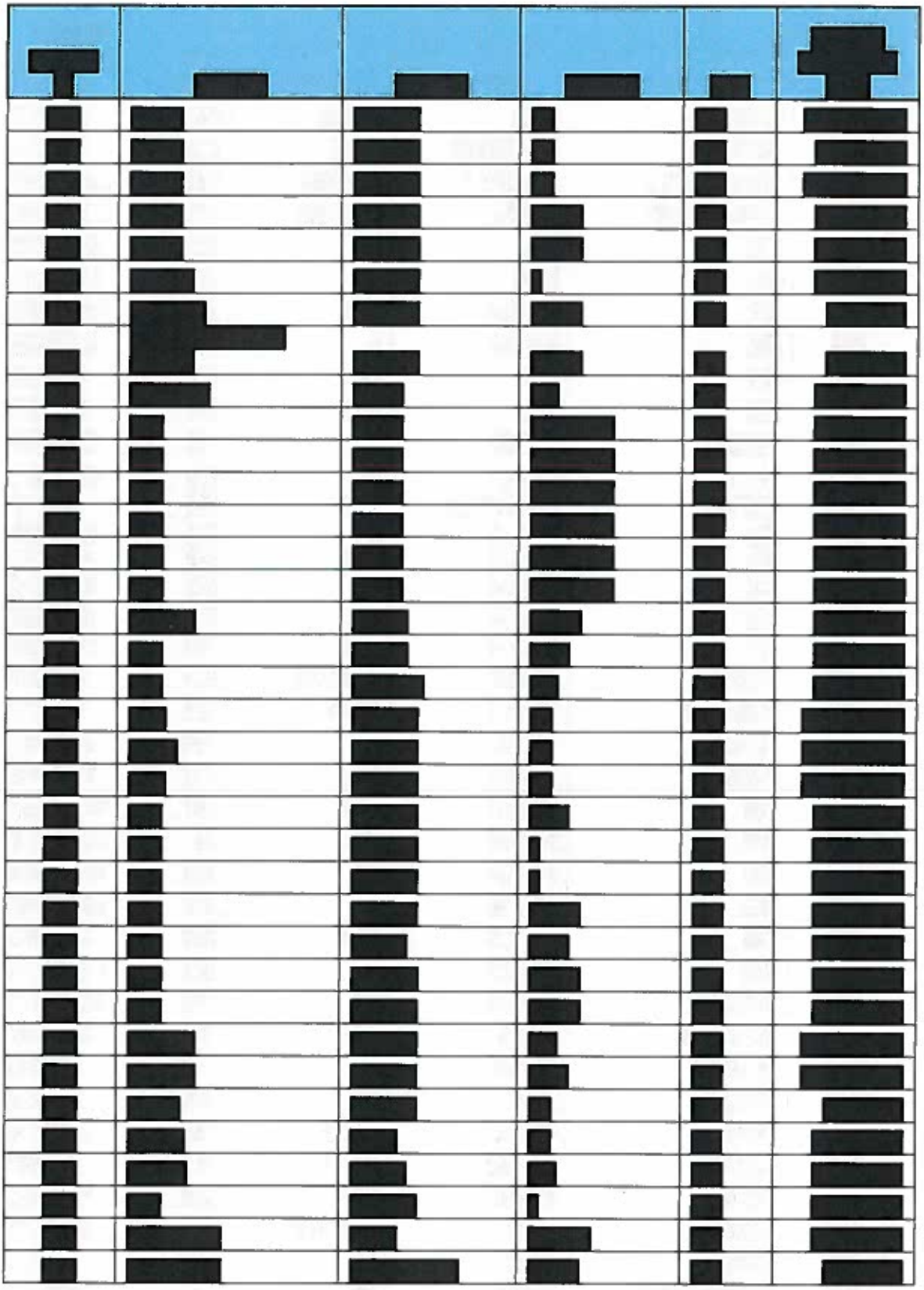


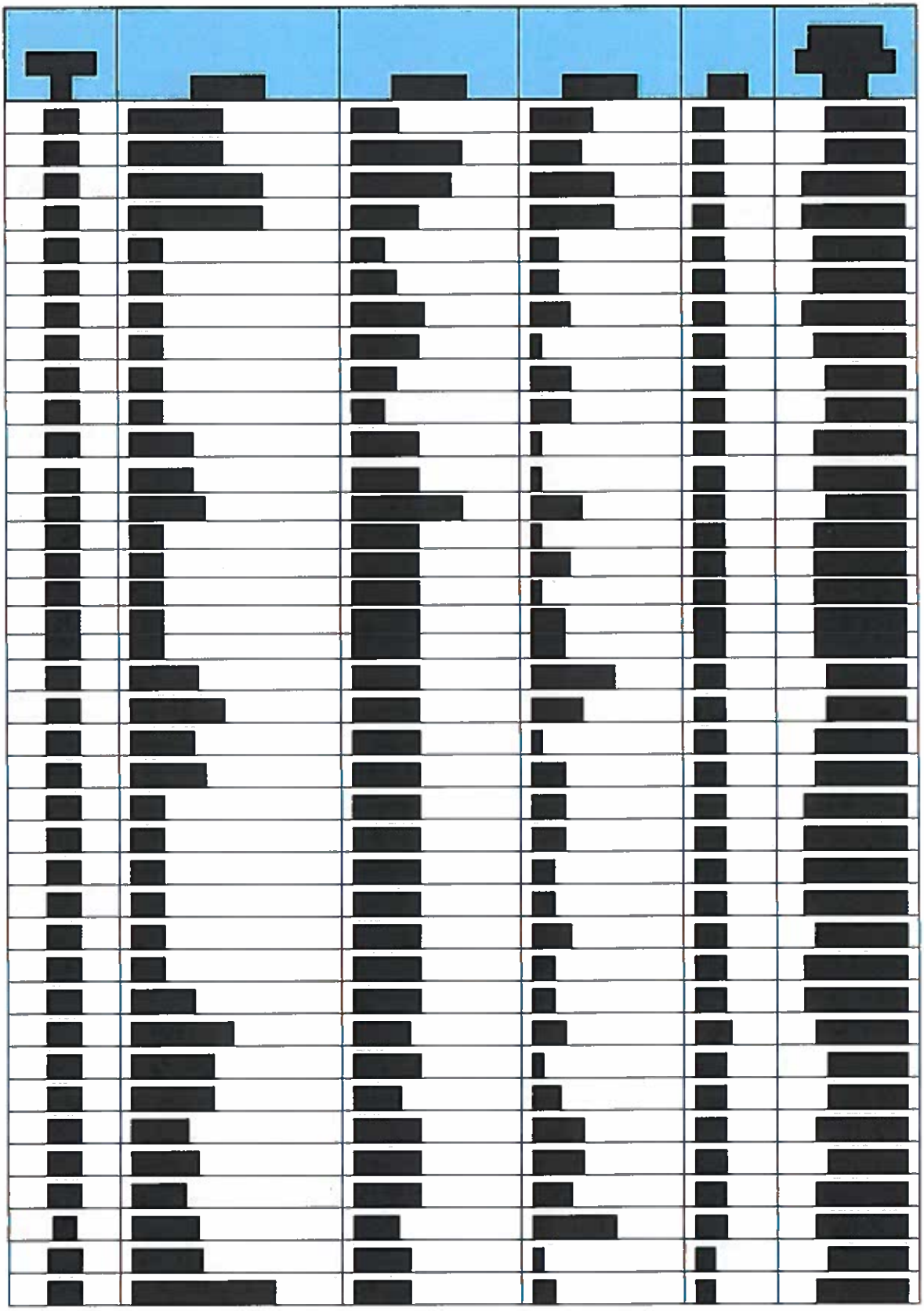


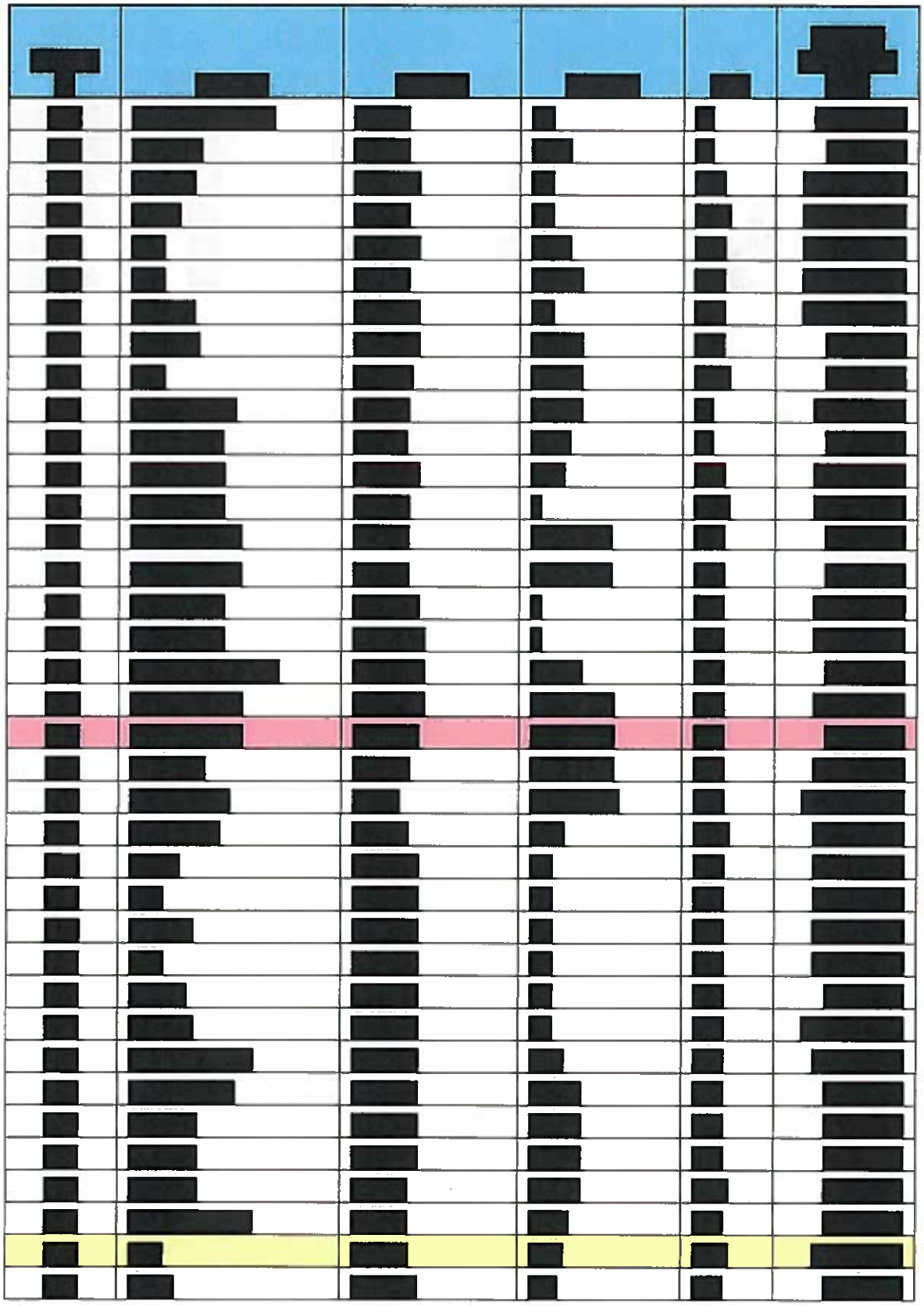


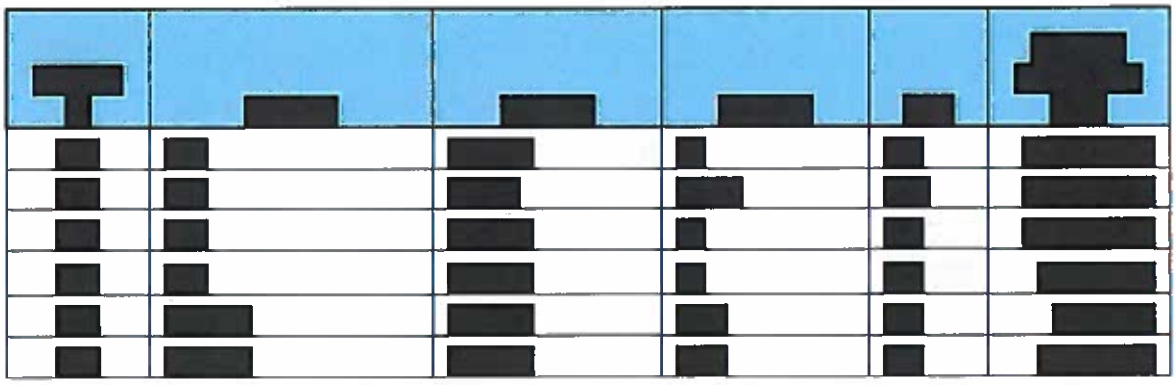












Appendix C
Groundwater Sampling (Non-radiological)

Borehole 1										
		Sample Date:	2012-11-16	2011-11-01	2010-10-18	2009-10-06	2008-10-03	2008-07-04	2005-04-07	Trend
		Sample ID:	BH1	BH1	BH 1	BH1	BH1	BH1	BH1	
Parameter	UNITS	MDL								
Alkalinity as CaCO3	mg/L	5	536	505	496	207	445	456	409	↑
Biochemical Oxygen Demand	mg/L	1	12	1	<1	3	1	2	<1	↑
Chemical Oxygen Demand	mg/L	5	25	15	15	6	5	<5	29	↔
Chloride (Cl)	mg/L	1	97	78	53	49	64	63	76	↑
Conductivity	uS/cm	5	1320	1190	1170	1200	1140	1140	1130	↑
Dissolved Organic Carbon	mg/L	0.5	6.5	3.8	3	3.5	3.1	2.7	8.8	↓
N-NH3 (Ammonia)	mg/L	0.02	0.12	0.1	0.07	0.07	0.05	0.31	0.09	↔
N-NO3 (Nitrate)	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	↔
pH			7.69	7.72	7.77	7.76	7.77	7.87	7.58	↔
Sulphate (SO4)	mg/L	1	59	62	77	86	104	102	92	↓
TDS (COND - CALC)	mg/L	5	858	774	761	780	741	741	735	↑
Total Suspended Solids	mg/L	2	51	36	52	41	37	46	1820	↓
Calcium (Ca)	mg/L	1	115	108	86	87	120	125	118	↔
Magnesium (Mg)	mg/L	1	61	52	38	40	52	57	60	↔
Sodium (Na)	mg/L	2	68	66	101	106	48	48	33	↔
Barium (Ba)	mg/L	0.01	0.08	0.07	<0.1	0.06	0.07	0.08	0.08	↔
Boron (B)	mg/L	0.01	0.1	0.09	0.1	0.07	0.07	0.09	0.12	↔
Iron (Fe)	mg/L	0.03	0.69	0.19	<0.3	0.56	0.27	0.32	<0.01	↑
CCME Total Petroleum Hydrocarbons										
F1 (C6-C10)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	↔
F2 (C10-C16)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	↔
F3 (C16-C34)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	↔
F4 (C34-C50)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	↓

Borehole 2 (Background Well)										
Sample Date:			2012-11-16	2011-11-01	2010-10-18	2009-10-06	2008-10-03	2008-07-04	2005-04-07	Trend
Sample ID:			BH2	BH2	BH2	BH2	BH2	BH2	BH2	
Parameter	**UNITS**	**MDL**								
Alkalinity as CaCO3	mg/L	5	308	309	296	304	288	299	278	↔
Biochemical Oxygen Demand	mg/L	1	8	1	<1	2	1	2	<1	↑
Chemical Oxygen Demand	mg/L	5	29	5	5	<5	8	<5	7	↑
Chloride (Cl)	mg/L	1	76	84	76	91	100	107	40	↑
Conductivity	uS/cm	5	834	828	822	887	877	920	676	↑
Dissolved Organic Carbon	mg/L	0.5	5.7	1.6	1.4	2.8	2.2	1.6	1.6	↑
N-NH3 (Ammonia)	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.02	↓
N-NO3 (Nitrate)	mg/L	0.1	0	0.24	0.52	0	0.34	0	0.53	↓
pH			7.80	7.65	7.80	7.85	7.85	7.93	7.71	↔
Sulphate (SO4)	mg/L	1	23	21	22	22	23	24	22	↔
TDS (COND - CALC)	mg/L	5	542	538	534	577	570	598	439	↑
Total Suspended Solids	mg/L	2	18	56	6	43	32	17	1390	↓
Calcium (Ca)	mg/L	1	92	94	97	96	105	106	80	↔
Magnesium (Mg)	mg/L	1	33	32	34	32	37	39	29	↔
Sodium (Na)	mg/L	2	29	25	26	22	25	24	18	↑
Barium (Ba)	mg/L	0.01	<0.01	0.02	<0.1	0.02	0.02	0.02	0.02	↓
Boron (B)	mg/L	0.01	0.03	0.02	<0.1	0.03	0.03	0.03	0.07	↓
Iron (Fe)	mg/L	0.03	0.19	<0.03	<0.3	0.25	0.24	<0.03	<0.01	↑
CCME Total Petroleum Hydrocarbons										
F1 (C6-C10)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	↔
F2 (C10-C16)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	↔
F3 (C16-C34)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	↔
F4 (C34-C50)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	↔

Borehole 3										
Sample Date:			2012-11-16	2011-11-01	2010-10-18	2009-10-06	2008-10-03	2008-07-04	2005-04-07	Trend
Sample ID:			BH3	BH3	BH3	BH3	BH3	BH3	BH3	
Parameter	UNITS	MDL								
Alkalinity as CaCO3	mg/L	5	481	484	471	479	452	463	471	↔
Biochemical Oxygen Demand	mg/L	1	>21	1	<1	3	2	5	<1	↑
Chemical Oxygen Demand	mg/L	5	61	10	13	7	8	<5	10	↑
Chloride (Cl)	mg/L	1	57	56	49	43	45	44	64	↔
Conductivity	uS/cm	5	1150	1120	1110	1110	1070	1080	1170	↔
Dissolved Organic Carbon	mg/L	0.5	9.5	3.0	3.0	3.8	3.6	3.1	3.3	↑
N-NH3 (Ammonia)	mg/L	0.02	0.06	0.03	0.13	0.07	0.10	0.84	0.09	↔
N-NO3 (Nitrate)	mg/L	0.1	0.15	0.18	0.29	0.34	0.14	0.21	<0.10	↑
pH			7.88	7.81	7.79	7.84	7.86	7.96	7.49	↔
Sulphate (SO4)	mg/L	1	78	74	83	74	78	77	81	↔
TDS (COND - CALC)	mg/L	5	748	728	722	722	696	702	761	↔
Total Suspended Solids	mg/L	2	8	6	9	16	14	11	496	↓
Calcium (Ca)	mg/L	1	104	96	104	95	97	104	121	↔
Magnesium (Mg)	mg/L	1	46	41	45	39	40	44	51	↔
Sodium (Na)	mg/L	2	87	76	84	76	75	83	63	↔
Barium (Ba)	mg/L	0.01	0.07	0.05	<0.1	0.06	0.06	0.05	0.06	↔
Boron (B)	mg/L	0.01	0.28	0.17	0.20	0.20	0.22	0.21	0.14	↑
Iron (Fe)	mg/L	0.03	<0.03	<0.03	<0.3	0.03	<0.03	<0.03	<0.01	↔
CCME Total Petroleum Hydrocarbons										
F1 (C6-C10)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	↔
F2 (C10-C16)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	↔
F3 (C16-C34)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	↔
F4 (C34-C50)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	↔

Borehole 4

Sample Date:			2012-11-16	2011-11-01	2010-10-18	2009-10-06	2008-10-03	2008-07-04	2005-04-07	Trend
Sample ID:			BH4	BH4	BH4	BH4	BH4	BH4	BH4	
Parameter	**UNITS**	**MDL**								
Alkalinity as CaCO3	mg/L	5	245	275	278	275	262	266	279	↔
Biochemical Oxygen Demand	mg/L	1	5	1	<1	5	1	<1	<1	↑
Chemical Oxygen Demand	mg/L	5	18	5	13	9	8	<5	6	↑
Chloride (Cl)	mg/L	1	15	32	27	18	15	14	15	↔
Conductivity	uS/cm	5	611	684	679	676	638	641	646	↔
Dissolved Organic Carbon	mg/L	0.5	4.7	2.9	3.4	3.0	2.3	2.2	2.1	↑
N-NH3 (Ammonia)	mg/L	0.02	0.12	0.14	0.19	0.21	0.20	0.30	0.17	↔
N-NO3 (Nitrate)	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	↔
pH			7.92	7.53	7.90	7.97	7.99	8.10	7.84	↔
Sulphate (SO4)	mg/L	1	56	52	45	58	51	54	41	↔
TDS (COND - CALC)	mg/L	5	397	445	441	439	415	417	420	↔
Total Suspended Solids	mg/L	2	10	4	<2	5	5	6	175	↓
Calcium (Ca)	mg/L	1	36	56	41	35	36	33	39	↔
Magnesium (Mg)	mg/L	1	14	21	17	16	16	14	18	↔
Sodium (Na)	mg/L	2	78	47	76	81	73	91	76	↔
Barium (Ba)	mg/L	0.01	0.05	0.08	<0.1	0.06	0.06	0.06	0.07	↓
Boron (B)	mg/L	0.01	0.24	0.11	<0.1	0.19	0.25	0.26	0.19	↔
Iron (Fe)	mg/L	0.03	0.71	0.23	<0.3	0.25	0.11	0.14	0.16	↑
CCME Total Petroleum Hydrocarbons										
F1 (C6-C10)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	↔
F2 (C10-C16)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	↔
F3 (C16-C34)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	↔
F4 (C34-C50)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	↔