



Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2014



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From left to right:

Weighing of uranium concentrate drums before processing

Fuel pellet and fuel bundle

Radiopharmaceuticals

Exit sign

Radiation cancer treatment equipment

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EXECUTIVE SUMMARY

The operating performance of the uranium and nuclear substance processing facilities regulated by the Canadian Nuclear Safety Commission (CNSC) is presented in this *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2014*. The information covers the 2014 calendar year and, when applicable, shows trends and compares information to previous years.

The report focuses on the three safety and control areas (SCAs) of radiation protection, environmental protection, and conventional health and safety using key performance indicators (KPI) as an input for each of these SCAs for these facilities. Also highlighted in the report is a discussion of public information programs, ratings for all 14 SCAs, reportable events, any significant facility modifications and areas of increased regulatory focus.

The evaluations conducted by CNSC staff identified that the uranium and nuclear substance processing facilities in Canada operated safely during 2014. This conclusion is based on assessment of licensee activities, which included site inspections, review of reports submitted by licensees, event and incident reviews with follow-up and general communication and exchange of information with the licensees.

As part of this report, an introductory section on risk-informed regulatory compliance oversight is presented. This section provides information on how CNSC uses risk informed oversight to ensure licensee's compliance with its licence, licensing basis and licence conditions handbook (LCH). There is also a section on how SCAs are rated.

CNSC staff conclude that in 2014, each of the regulated facilities discussed in this report met performance expectations for the health and safety of workers, the protection of the environment and Canada's international obligations.

REGULATORY OVERSIGHT REPORT FOR URANIUM AND NUCLEAR SUBSTANCE PROCESSING FACILITIES IN CANADA: 2014

1 OVERVIEW

1.1 Background

The *Regulatory Oversight Report for Uranium and Nuclear Substance Processing Facilities in Canada: 2014* summarizes the Canadian Nuclear Safety Commission (CNSC) staff's assessment of the safety performance of:

- uranium processing facilities
 - Cameco Corporation (Cameco): Blind River Refinery (BRR) (FFOL-3632.00/2022)
 - Cameco Corporation (Cameco): Port Hope Conversion Facility (PHCF) (FFOL-3631.00/2017)
 - Cameco Fuel Manufacturing Inc. (CFM) (FFOL-3641.00/2022)
 - GE Hitachi Nuclear Energy Canada Incorporated (GEH-C): Peterborough facility (FFOL-3620.00/2020)
 - GE Hitachi Nuclear Energy Canada Incorporated (GEH-C): Toronto facility (FFOL-3620.00/2020)
- nuclear substance processing facilities
 - SRB Technologies (Canada) Incorporated (SRB), in Pembroke, ON (NSPFOL-13.00/2022)
 - Nordion (Canada) Inc., in Ottawa, ON (NSPFOL-11A.04/2015)
 - Best Theratronics Limited (BTL), in Ottawa, ON (NSPFOL-14.00/2019)

The assessment aligns with the legal requirements of the *Nuclear Safety and Control Act* (NSCA) and the regulations made under the NSCA, the conditions of facility licences, and applicable standards and regulatory documents.

The report highlights the areas of the CNSC staff's regulatory focus – including information on regulatory requirements and expectations in selected areas – and discusses significant events, licence changes, major developments and overall performance. It provides performance data on the SCAs of radiation protection, environmental protection, and conventional health and safety.

The report is organized by industry sector, covering uranium processing facilities and nuclear substance processing facilities.

The information covers the 2014 calendar year and, where appropriate, compares information to previous years.

1.2 CNSC Regulatory Efforts

The CNSC regulates the nuclear sector in Canada, including Canada's uranium and nuclear substance processing facilities to protect the health, safety and security of Canadians and the environment; to implement Canada's international commitments on the peaceful use of nuclear energy; and to disseminate objective scientific, technical and regulatory information to the public. The CNSC regulates these facilities through licensing, reporting, verification and enforcement. For each facility, CNSC staff conduct inspections, assessments, reviews and evaluations of licensee programs, processes and safety performance reports.

CNSC staff establish compliance plans for each facility, based on risk-informed regulatory oversight of the facility's activities. Modifications to the compliance plans are made on an ongoing basis in response to events, facility modifications and changes in licensee performance.

Inspections conducted in 2014 covered various aspects of many SCAs, applying a risk-informed approach for compliance activities, commensurate with the risk associated with these facilities. Twenty-one inspections were conducted by the CNSC at uranium and nuclear substance processing facilities. While some inspections focus on specific SCAs, the inspectors strive to ensure that aspects of radiation protection, environmental protection, and conventional health and safety are covered in every inspection. This is done to continually ensure that:

- radiation protection measures are effective and radiation doses to workers remain as low as reasonably achievable (ALARA)
- the environmental protection programs are effective and releases remain ALARA
- conventional health and safety programs continue to protect workers from injuries/accidents

CNSC staff also verify compliance through desktop reviews of reports and licensee programs, which are supplemented with meetings, presentations, and facility visits.

1.3 Ratings and Performance

CNSC staff use the SCA Framework in evaluating each licensee's safety performance. The framework includes 14 SCAs. Each SCA is sub-divided into specific areas that define its key components. For a complete list of the SCAs and specific areas used in this report, see appendix A.

CNSC staff assess licensee performance in each SCA according to the following four ratings:

- FS: Fully satisfactory
- SA: Satisfactory
- BE: Below expectations
- UA: Unacceptable

A full definition of the four ratings is provided in appendix B, *Rating Methodology and Definitions*. Ratings are provided for each SCA. However, an overall rating for the whole facility is not calculated for a particular licensee.

To ensure the licensee is operating safely, CNSC staff apply a risk-informed approach to the compliance oversight of a facility. The ratings are derived from the compliance activities that CNSC staff conduct in the various SCAs.

A licensee's performance is measured by the ability to minimize all risks posed by the licensed activity and to comply with all regulatory requirements. Performance in each SCA is continually assessed by CNSC staff. It is important to understand that each SCA is evaluated individually and that every facility has different inputs into the annual rating for a specific SCA. For example, a rating may not have an input from inspections, if no inspections were conducted in the area during the year. The minimum CNSC staff rating input is the information that a licensee provides in their annual compliance reports. In some SCAs there are metrics to demonstrate a licensee's performance, such as the radiation dose to workers and the public, releases to the environment and the number of lost-time incidents (LTIs).

1.4 Risk-Informed Regulatory Compliance Oversight

As indicated in section 1.2, CNSC staff regulate through licensing, verification, enforcement and reporting to the Commission. These activities enable the CNSC to provide assurance to Canadians of the continuing compliance and safety performance of licensees.

CNSC staff verify compliance mainly through site inspections, and the review of operational activities and licensee's documentation. In some instances, CNSC staff may also conduct independent monitoring and testing. In addition, licensees are required to report to the CNSC routine performance data and unusual occurrences.

CNSC staff determine the type and level of review, inspection and testing in a manner that is consistent with the risk posed by the regulated activities. The CNSC recognizes that the level of risk must be considered to ensure that resources are appropriately allocated, and controls are applied based on the complexity of the facility, the hazards and magnitude of the potential impact (risks) associated with the activities at the facility.

CNSC staff assess the level of risk associated with each facility across all 14 SCAs. Factors considered for this assessment include:

- potential adverse impact on health, safety the environment and security from the activities
- probability of adverse incidents
- complexity of the facility and/or licensed activities
- implementation of new processes and/or technologies
- operational drivers (such as system shutdown, refurbishment, commissioning)

- performance history
- operating experience and lessons learned (e.g., the accident at Fukushima Daiichi)
- professional judgment

The level of risk is reflected in CNSC staff's compliance plan for each facility which includes the number and scope of inspections at the facility, document reviews and, as required, independent monitoring and testing activities. Areas more significant to safety, such as worker radiation dose control and effluent and emission monitoring, are the subject of more frequent and in-depth verification. Compliance plans are continuously reviewed to take into consideration unusual occurrences, licensee's performance and lessons learned.

The CNSC uses a graduated approach to enforcement to encourage and compel compliance, and deter future non-compliances.

When a non-compliance (or a continued non-compliance) has been identified, CNSC staff assess the significance of the non-compliance, and determine the appropriate enforcement action, based on the CNSC's graduated approach to enforcement.

The CNSC considers the following factors when deciding which enforcement action(s) to use:

- regulatory significance of the non-compliance
- level of associated risk of the non-compliance
- compliance history of the licensee
- urgency of required action from the licensee
- corrective/deterrent effect of the regulatory action
- industry-specific enforcement strategy

Enforcement actions can range from issuing a written notice for corrective actions for minor infractions to issuing orders, issuing administrative monetary penalties (AMPs), recommending licensing actions to the Commission, or investigation and prosecution for more serious violations.

CNSC staff provide the Commission with annual reports on the licensees' performance. In addition, significant events are reported to the Commission via event initial reports (EIRs) which, depending on the nature and severity of the event, may be followed up with additional reporting, further compliance activities, or regulatory actions taken by the CNSC as required.

PART 1: URANIUM PROCESSING FACILITIES

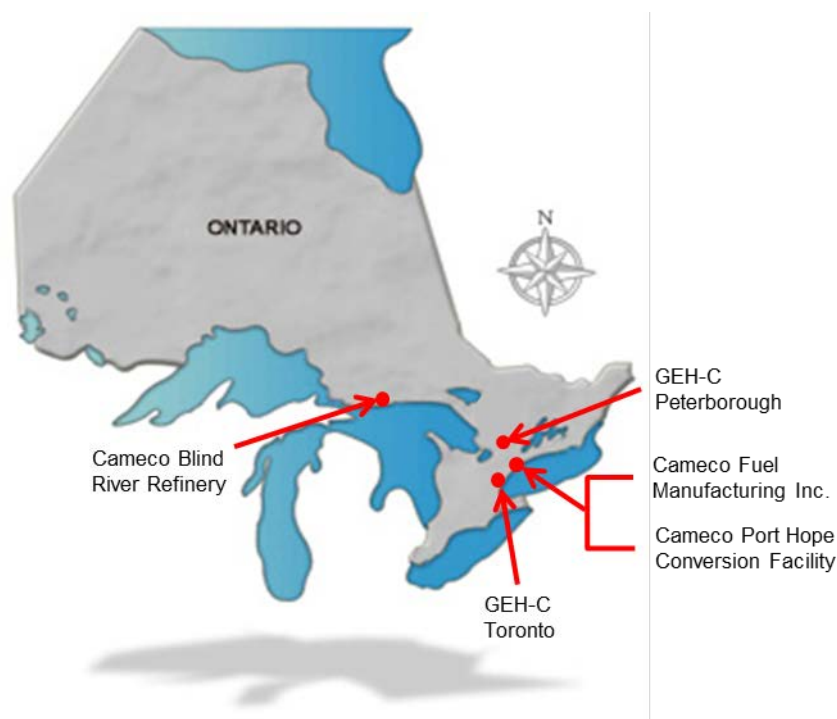
2 OVERVIEW

Part I of this report focuses on the five uranium processing facilities in Canada. They are:

- Cameco Corporation (Cameco): Blind River Refinery (BRR)
- Cameco Corporation (Cameco): Port Hope Conversion Facility (PHCF)
- Cameco Fuel Manufacturing Inc. (CFM)
- GE Hitachi Nuclear Energy Canada Incorporated (GEH-C): Peterborough facility
- GE Hitachi Nuclear Energy Canada Incorporated (GEH-C): Toronto facility

The three Cameco facilities operate under separate operating licences, issued in March 2012. The BRR and CFM facilities licences expire in February 2022, and the PHCF licence expires in February 2017. The two GEH-C facilities operate under a combined licence issued in January 2011 and expiring in December 2020. All five facilities are located in the province of Ontario, as shown in figure 2-1.

Figure 2-1: Location of uranium processing facilities in Ontario, Canada



CNSC staff provided consistent and risk-informed regulatory oversight at uranium processing facilities in 2014. The table below presents the licensing and compliance effort from CNSC staff for uranium processing facilities during the reporting period.

Table 2-1: CNSC regulatory oversight licensing and compliance activities for uranium processing facilities in 2014

	Blind River Refinery	Port Hope Conversion Facility	Cameco Fuel Manufacturing	GEH-C Toronto and Peterborough
Number of inspections	4	6	3	3
Person days for compliance	218	516	172	213
Person days for licensing activities	21	94	9	16

In 2014, CNSC staff performed 16 compliance inspections at the uranium processing facilities. All the findings resulting from these inspections were provided to the licensee in a detailed inspection report. All enforcement actions arising from the findings were recorded in the CNSC regulatory information bank to ensure all enforcement actions are tracked to completion.

Each of the uranium processing facilities is required, as per their operating licences, to submit an annual compliance report by March 31. These reports contain facility performance information such as annual production volumes, improvements to programs in all safety and control areas (SCAs), and details related to environmental, radiological and safety performance, including any events and associated corrective actions.

CNSC staff review these reports as part of their normal regulatory compliance oversight, to verify that licensees are complying with their regulatory requirements and are operating safely. The full versions of these reports are available on the licensees' websites, as provided in appendix H.

CNSC staff used quarterly and annual compliance reports, revisions to licensee programs, responses to events and incidents by licensees, as well as field observations during inspections, to compile the 2014 performance ratings for the uranium processing facilities. These ratings are provided in table 2-2.

For 2014, CNSC staff ratings for all individual SCAs were “satisfactory” for the uranium processing facilities, except for GEH-C, which was given a “fully satisfactory” rating in the SCA of environmental protection and for Cameco’s BRR which has a “fully satisfactory” rating in the SCA of conventional health and safety. Appendix C contains the ratings from 2010 to 2014 for each facility.

Table 2-2: Fuel cycle facilities – SCA performance ratings, 2014

Safety and control area	Blind River Refinery	Port Hope Conversion Facility	Cameco Fuel Manufacturing	GEH-C Toronto and Peterborough
Management system	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA
Physical design	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA
Conventional health and safety	FS	SA	SA	SA
Environmental protection	SA	SA	SA	FS
Emergency management and fire protection	SA	SA	SA	SA
Waste management	SA	SA	SA	SA
Security	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA

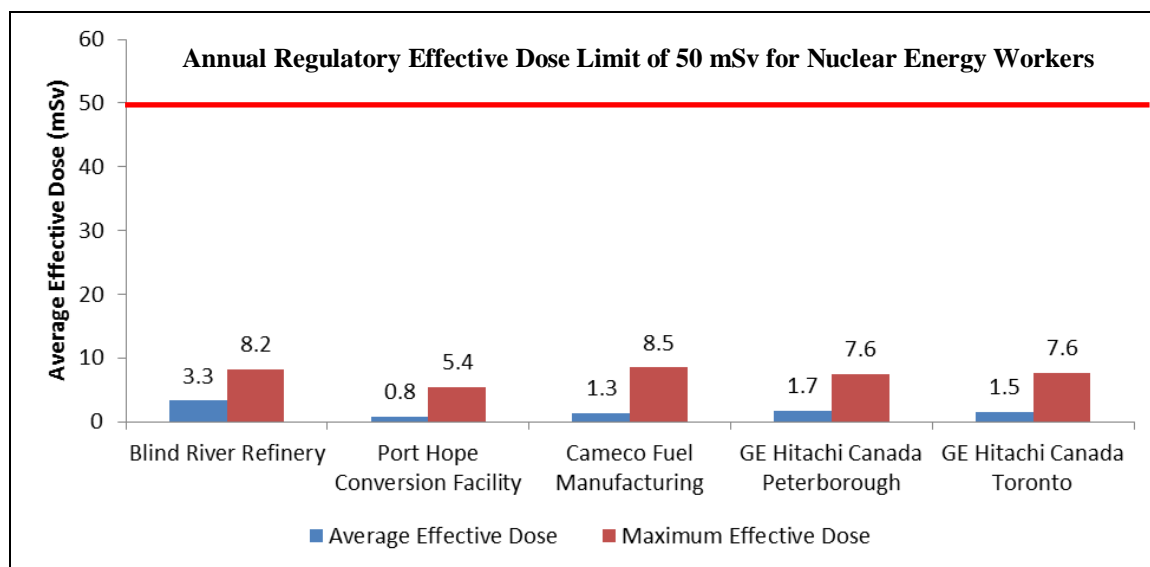
2.1 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. This program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled, and maintained ALARA.

The uranium processing facility licensees have been implementing their radiation protection programs satisfactorily during 2014, and their programs are effective in protecting the health and safety of persons working in their facilities.

The maximum and average effective doses for uranium processing facilities are provided in figure 2-2. The maximum exposure for all facilities ranged from 5.4 mSv to 8.5 mSv, well below the regulatory limit of 50 mSv/yr.

Figure 2-2: Uranium processing facilities – comparisons of average and maximum effective doses to nuclear energy workers, 2014



In 2014, no radiation exposures reported by any uranium processing facility exceeded any of the regulatory dose limits.

Annual effective doses for nuclear energy workers (NEWs) are based on complex and differing work environments. Therefore, direct comparisons of effective doses among facilities do not necessarily provide an appropriate measure of the effectiveness of a radiation protection program. Nevertheless, the CNSC requirement to apply the ALARA principle has consistently resulted in doses well below regulatory limits. Based on the review of the dose data provided above, CNSC staff are satisfied that all uranium processing licensees are controlling radiation doses below CNSC regulatory dose limits, and in accordance with the ALARA principle. Appendix E provides radiation doses of the workers at these facilities, and lists the facilities' respective regulatory limits.

Estimated Dose to the Public

The maximum dose to the public from licensed activities at each uranium processing facility is calculated using monitoring results from air emissions, liquid effluent releases and fence-line gamma monitoring. The CNSC's requirements to apply ALARA principles ensure that the licensees monitor their facilities and take corrective actions whenever action levels are exceeded.

Table 2-3 provides a comparison of estimated public doses from 2010 to 2014 for all five facilities.

Table 2-3: Fuel cycle facilities – public dose comparison table (mSv), 2010-2014

Facility	Year					Regulatory limit
	2010	2011	2012	2013	2014	
Blind River Refinery	0.006	0.006	0.012	0.012	0.005	1 mSv/yr
Port Hope Conversion Facility	0.019	0.019	0.029	0.021	0.012	
Cameco Fuel Manufacturing	0.008	0.042	0.031	0.013	0.018	
GEH-C Toronto	*0.00109	*0.00062	0.0008	0.0003	**0.0052	
GEH-C Peterborough	*<0.00001	*<0.00001	<0.001	<0.001	<0.001	

*Prior to 2012, GEH-C did not report public dose results. The values reported here are based on CNSC staff calculations of GEH-C emissions for the Derived Release Limits (DRL).

**Beginning in 2014, GEH-C Toronto implemented environmental gamma exposure monitoring using licensed dosimeters and began to include this result in the estimated annual public dose.

Estimated doses to the public from all uranium processing facilities continue to be low and well below the regulatory annual public dose limit of 1 mSv.

2.2 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and the effects on the environment from facilities or as the result of licensed activities.

The uranium processing facilities are also regulated by Ontario's Ministry of the Environment and Climate Change (MOECC). Environmental protection is, therefore, a shared federal and provincial responsibility. The CNSC avoids or minimizes any duplication of regulatory oversight including MOECC's requirements by working cooperatively and inclusively whenever possible.

The uranium processing facility licensees have been implementing their environmental programs satisfactorily during 2014, and their programs are effective in protecting the health and safety of persons working in their facilities.

State of Receiving Environment

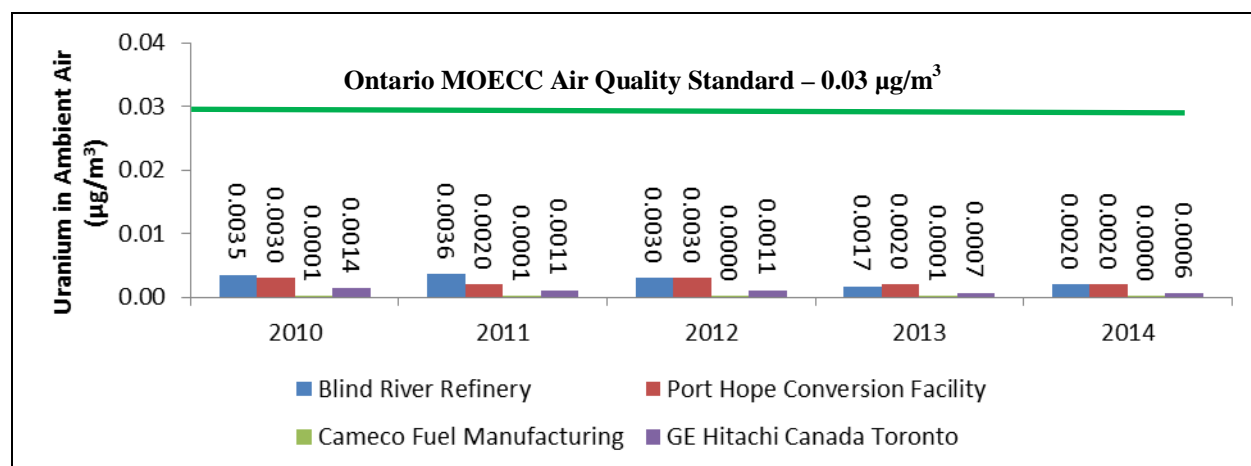
Uranium in Ambient Air

All the uranium processing facilities, except GEH-C Peterborough, operate “high-volume” air samplers at the perimeter of the facilities to confirm the effectiveness of emission abatement systems and to monitor the impact of uranium emissions on the environment. GEH-C Peterborough does not use air samplers, and stack emissions already meet MOECC air standard for uranium.

The results from high-volume air samplers with the highest values near a facility (maximum average) for 2010 through 2014 are provided in figure 2-3. These values are measured as total suspended particulate (TSP) representing the total amount of uranium in air.

As shown in figure 2-3, the maximum annual average concentration of uranium in ambient air is below the impending MOECC air standard for uranium ($0.03 \mu\text{g}/\text{m}^3$) and well below any levels that would pose a risk to human health and the environment.

Figure 2-3: Uranium concentration in ambient air (maximum annual average), 2010-2014



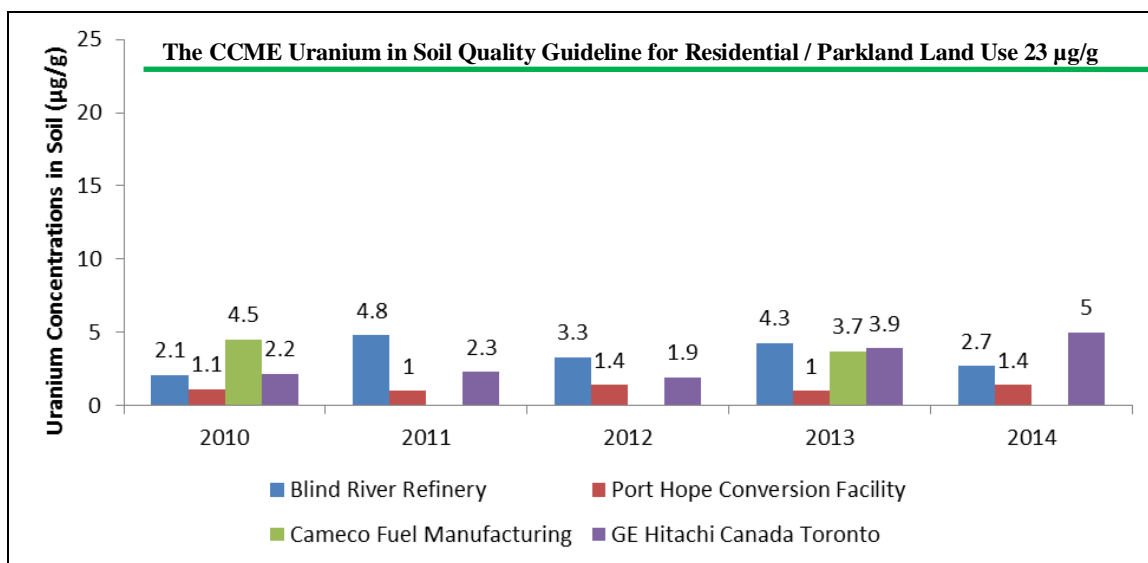
Uranium in Soil

The three Cameco facilities and GEH-C Toronto have soil monitoring programs. Uranium releases from GEH-C’s Peterborough facility are negligible because the fuel pellets received from the Toronto facility are in solid form, and uranium releases to air are very low. This is confirmed by monitoring in the stack and as such, uranium-in-soil monitoring is not warranted at GEH-C’s Peterborough facility.

Soil monitoring programs are intended to monitor the long-term effects of air emissions to show whether there is accumulation of uranium in soil in the vicinity of the facility. Soil sampling results in 2014 continue to indicate that current uranium emissions from the uranium processing facilities have no measurable impacts on soil.

Figure 2-4 provides the annual average uranium concentrations in soil results for 2010 through 2014. In Ontario, natural background levels of uranium in soil are generally below 2.5 µg/g. The annual average concentrations of uranium in soil are similar to natural background levels and well below the applicable guideline value for the land-use type, as described by the Canadian Council of Ministers of the Environment (CCME) soil quality guideline for residential and parkland land use of 23 µg/g of uranium.

Figure 2-4: Uranium concentration in soil (annual average), 2010–2014



Elevated levels of uranium in soil at CFM are due to historic uranium contamination, which is common to the Port Hope area. The sampling frequency at CFM is every three years. As such, data for 2010 and 2013 are provided.

2.3 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers and equipment.

Each licensee is responsible for developing and implementing a conventional health and safety program for the protection of its staff and contract workers, which must comply with the Part II of the *Canada Labour Code*.

The regulation of conventional health and safety at uranium processing facilities involves both the Employment and Social Development Canada (ESDC) and the CNSC. CNSC staff monitor compliance with regulatory requirements. On rare occasions when a concern is identified, ESDC staff are consulted and asked to take appropriate action. Licensees submit hazardous occurrence investigation reports to both ESDC and the CNSC, in accordance with their respective reporting requirements.

As summarized in table 2-4, the number of recordable lost-time incidents (LTIs) reported by all facilities has remained low from 2010 to 2014. Further information is provided in facility-specific sections.

Table 2-4: Fuel cycle facilities lost-time incidents (LTIs), 2010–2014

Facility	2010	2011	2012	2013	2014
Blind River Refinery	0	0	0	0	0
Port Hope Conversion Facility	1	3	1	0	1
Cameco Fuel Manufacturing	0	2	0	0	0
GEH-C Toronto and Peterborough	1	0	1	0	1

The uranium processing facility licensees have been implementing their conventional health and safety programs satisfactorily during 2014, and their programs are effective in protecting the health and safety of persons working in their facilities.

2.4 Public Information and Disclosure Programs

Uranium and nuclear substance processing facilities are required to implement public information programs, in accordance with RD/GD 99.3 *Public Information and Disclosure*. These programs are supported by disclosure protocols, which outline the type of information on the facility and its activities that will be shared with the public (e.g., incidents, major changes to operations, periodic environmental performance reports) and how that information will be shared. The objective is to ensure that timely information about the health, safety and security of persons and the environment and other issues associated with the lifecycle of the nuclear facility are effectively communicated.

Cameco's Blind River Refinery is keeping stakeholders informed about its activities and disclosing information of public interest. In 2014, BRR held meetings with the Town of Blind River and the Band Council of Mississauga First Nation to discuss issues and the performance of the facility. Cameco also made presentations on site operations and performance in neighboring communities including the Township of the North Shore, Spanish and Elliot Lake in 2014. BRR also posted on its website quarterly environmental and annual operation performance reports and provided facility tours.

In Port Hope, Cameco has robust public information programs and disclosure protocols for its PHCF and Fuel Manufacturing Facility. The programs and their implementation are almost identical; they share the same target audiences and communication activities. The Port Hope facilities have undertaken numerous activities and effort to continuously improve and maintain communication with those interested in and concerned about their facilities. In 2014, Cameco's activities included two public meetings (called Community Forums), three presentations to Port Hope town council, and three community newsletters, (mailed to all addresses in Port Hope). Cameco also disclosed information on unplanned events at PHCF and released on its website quarterly environmental and annual operation performance reports. Since 2004, Cameco has undertaken annual public opinion surveys in Port Hope to help determine the effectiveness of its public information activities. The CNSC recognizes Cameco as a leader in developing and sustaining effective public information programs that inform and engage the citizens of Port Hope.

GEH-C continues to be under increased regulatory oversight for the maintenance and implementation of its public information program. In December 2013, a Commission meeting was held in Toronto, where GEH-C's operational performance was discussed amid numerous interveners expressing their concerns about the safety of the facility and a lack of public information and awareness. Listening to those concerns, the Commission directed GEH-C to take action to improve its public information program. As result of that meeting staff also conducted an inspection of GEH-C's public information program in June 2014.

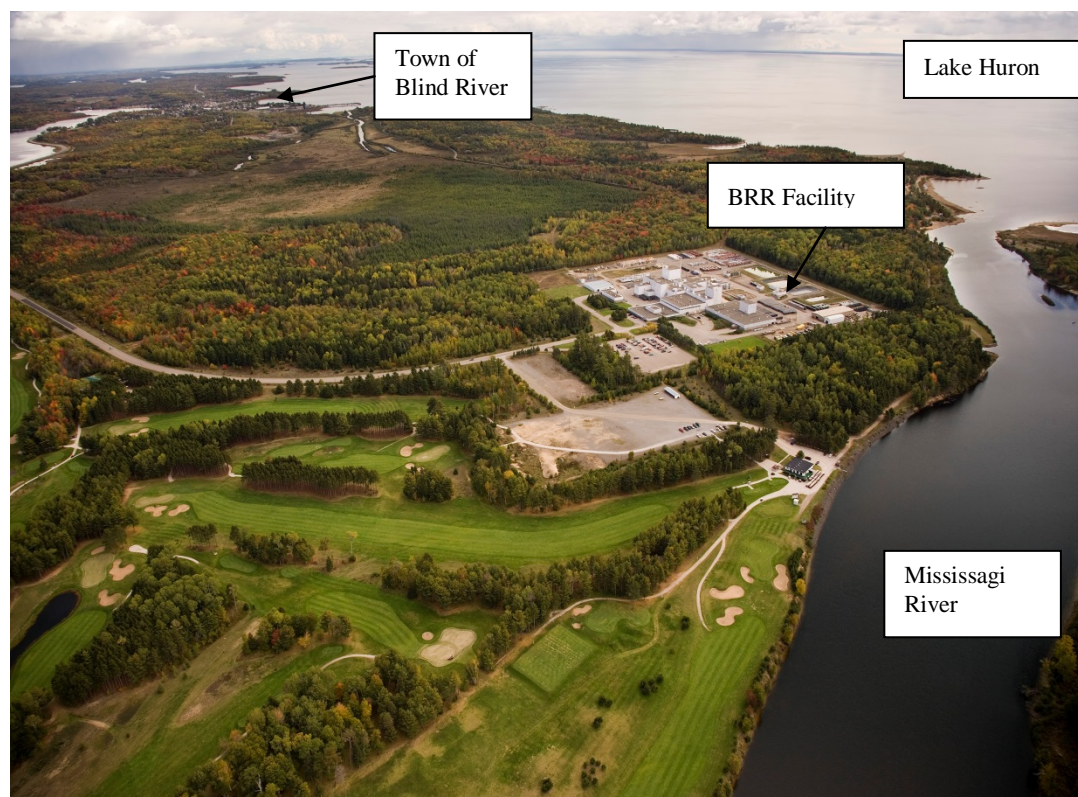
To date, GEH-C has responded to the issues raised in the meeting and the inspection, and continues to evolve and adapt its program to better inform and engage those living and working near their Toronto and Peterborough facilities. In 2014, GEH-C's activities for the Toronto facility included two meetings with their Community Liaison Committee, two community newsletters and hosting a virtual public information session. GEH-C also released on its website its annual compliance report and posted disclosed information as detailed in its disclosure protocol.

Looking ahead, GEH-C has provided the CNSC with an action plan for 2015 to further improve its communications and community engagement for both facilities. Actions include: creating a new position responsible for the public information program, annual open houses for both sites, improvements to the community newsletter (including one for the Peterborough facility), and increased outreach with target audiences. CNSC staff will monitor implementation of GEH-C's action plan and will report to the commission at the next annual report.

3 CAMECO'S BLIND RIVER REFINERY

Cameco owns and operates a Class IB nuclear fuel facility in Blind River, ON, under an operating licence that expires in February 2022. The Cameco Blind River Refinery (BRR) facility is located about five kilometers west of Blind River, as shown in figure 3-1.

Figure 3-1: Aerial view of the Cameco Blind River Refinery



The BRR facility refines uranium concentrates (yellowcake) received from uranium mines worldwide to produce uranium trioxide (UO_3), an intermediate product of the nuclear fuel cycle. The primary recipient of the product is Cameco's PHCF.

In 2014, there were no licence amendments or changes to the BRR licence conditions handbook (LCH-Cameco-BRRF-001).

3.1 Performance

Figure 3-2: Shipping totes used to transfer UO₃ from BRR to the Port Hope Conversion Facility



For 2014, CNSC staff rated BRR's performance as "satisfactory" in all SCAs, except conventional health and safety, which was rated as "fully satisfactory". The BRR facility ratings from 2010 to 2014 are provided in table C-1, appendix C.

In 2014, CNSC staff conducted three inspections at BRR to ensure compliance with the *Nuclear Safety and Control Act* and its regulations, its operating licence and the programs used to meet regulatory requirements. The SCAs inspected were fire protection, fitness for service, human performance, radiation protection, environmental protection and conventional health and safety. None of the findings from these inspections posed an immediate risk to the health, safety and security of Canadians or the environment.

In 2014, there were no major modifications to the BRR facility that required Commission approval. BRR made improvements to a storm water collection ditch by re-routing the water to a lagoon that is monitored for contaminants and treated before release from the site.

There were seven reportable action level exceedances involving worker dose. Details on these exceedances are provided below, under the heading Radiation Protection Program Performance.

On October 15, 2014, CNSC staff met with the Mississauga First Nation's Lands and Resource Committee, staff and two community elders. CNSC staff gave a presentation including background information on the CNSC, how CNSC regulates Cameco's Blind River Refinery and CNSC's approach to Aboriginal consultation. Many questions were asked with a significant focus on environmental monitoring programs, protection of health, and the future of the facility, including decommissioning. CNSC staff committed to returning to Blind River to meet again with the Mississauga First Nation on their request. At the time of writing this report, CNSC staff were working with the Mississauga First Nation to meet again to provide a discussion on CNSC's Independent Environmental Monitoring Programs. CNSC's Participant Funding Program provided financial support to the Mississauga First Nation for the meeting in October 2014.

3.2 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

RATINGS FOR RADIATION PROTECTION				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continued to rate the radiation protection SCA at Cameco's BRR as "satisfactory". Cameco has implemented and maintained a radiation protection program as required by the <i>Radiation Protection Regulations</i> .				

Application of ALARA

BRR establishes radiation protection (RP) objectives and targets with the goal to reduce worker doses and in-plant uranium-in-air concentrations. Performance against these objectives was regularly reviewed and tracked. As part of the work of the joint workplace health and safety committee at BRR, updates on the status of the RP program were discussed at monthly meetings and employees were encouraged to bring forward any questions or concerns. In addition, a separate ALARA committee is in place at BRR. This committee met regularly to review and discuss RP related issues, and make recommendations for improving RP at BRR.

Worker Dose Control

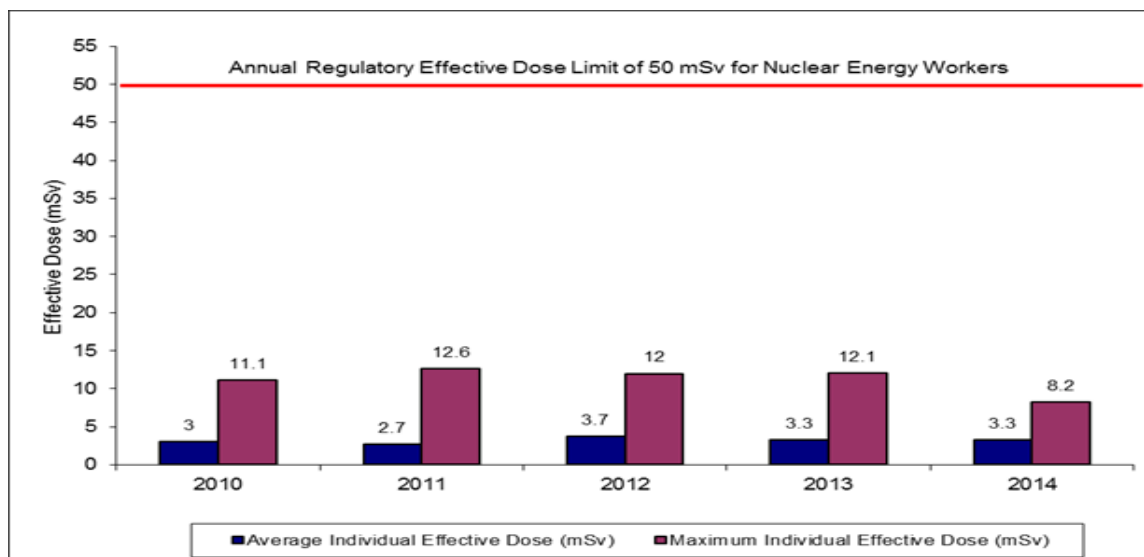
Radiation exposures are monitored to ensure compliance with CNSC regulatory dose limits and to maintain radiation doses ALARA. In 2014, no worker's radiation exposure reported by BRR exceeded CNSC regulatory dose limits.

At BRR, all Cameco employees are designated as Nuclear Energy Workers (NEWs). Contractors at BRR may also be considered as NEWs depending on the nature of their work activities and time spent on site. In 2014, there were a total of 29 contractors who were considered as NEWs. The maximum individual effective dose to a contractor NEW was 0.2 mSv. Therefore, due to the very low radiological doses received by contractor NEWs at BRR, their dosimetry data is excluded from the BRR NEW dose statistics provided in table E-2, appendix E.

The maximum effective dose received by a Cameco NEW in 2014 was 8.2 mSv, or approximately 16 percent of the regulatory effective dose limit of 50 mSv in a one-year dosimetry period.

Annual average and maximum effective and equivalent dose results from 2010 to 2014 are provided in tables E-2, E-11 and E-17, appendix E. The maximum effective dose in 2014 is notably the lowest over the last five years. This decrease is mostly attributable to a decrease in production and a corresponding decrease in operating days in 2014, compared to previous years.

Figure 3-3: Cameco Blind River – effective dose trend for nuclear energy workers



Radiation Protection Program Performance

Action levels for radiological exposures have been established as part of the BRR RP program, and include action levels for whole body and skin exposures of workers on monthly and quarterly dosimetry wearing periods. If an action level is reached, it triggers Cameco staff to establish the cause and, if applicable, restore the effectiveness of the RP program.

In 2014, seven action level exceedances related to workers' radiological exposures at BRR were reported to the CNSC. Following investigations into these exceedances, Cameco determined that three of the action level exceedances (monthly skin dose and whole body dose action levels) were not representative of the affected worker's exposures. The majority of the dose recorded on the dosimeter was received during a period of time that the dosimeter was misplaced in the refinery. Subsequently, Cameco obtained a change to the worker's radiation dose records with Canada's National Dose Registry (NDR), to remove the component of non-personal doses to the worker's whole body and skin.

Consequently, of the seven reported action level exceedances, only four were considered authentic. In all instances, Cameco reported, investigated and implemented corrective actions within a time frame accepted by CNSC staff. All action level exceedances involved workers who spent time working in the raffinate/dried raffinate area at BRR. This area has the highest radiation fields of all processing areas at the refinery. Historically, the majority of workers who have exceeded a radiological dose action level have worked at least a portion of their time in this area. Procedures and processes are in place to minimize radiation dose to individuals working in this area, and Cameco continues to investigate ways to further reduce workers' exposures.

A summary of the action level exceedances at BRR in 2014 follows. It is important to note that all workers' radiological doses were well below the corresponding CNSC regulatory dose limits, and there are no risks to their health and safety as a result of these action level exceedances.

There were two instances where the BRR skin dose action level of 10 mSv/monthly dosimetry wearing period was exceeded with radiation doses of 10.58 mSv and 12.17 mSv. These exceedances occurred in two separate months, involving one worker in the raffinate/dried raffinate area at BRR. Cameco determined that the radiation dose results were representative of the worker's skin doses for the wearing periods, due to the nature of the work being conducted.

There was one instance where the BRR whole body dose action level of 0.70 mSv/quarterly dosimetry wearing period was exceeded with a radiation dose of 0.77 mSv. This particular worker also spent more time working in the dried raffinate area during the quarter, assisting in troubleshooting operational difficulties occurring in the circuit.

Finally, there were two instances where the BRR whole body dose action level of 2.0 mSv/monthly dosimetry wearing period was exceeded with radiation doses of 2.49 mSv and 2.90 mSv. These exceedances occurred in two separate months, involving two different workers. In the first instance, the investigation could not identify any specific reason to explain the dosimeter whole body result of 2.49 mSv; and therefore, there was no change to the worker's dose. The worker rotated through a number of process areas in the refinery and completed a few shifts in the raffinate/dried raffinate area. However, for most of the month, the refinery was in its summer shutdown. In the second instance, the refinery had also entered into its December shutdown for most of the month. Cameco's investigation did reveal that dosimetry handling and storage practices could be improved on the part of the worker, and it is suspected that a portion of the dose recorded on the dosimeter is non-personal. Cameco has initiated a removal of a portion of the 2.90 mSv from the worker's radiation dose records with the NDR. This request was subsequently approved by CNSC staff.

In reviewing the action level exceedances and common causes, CNSC staff have identified potential areas for improvement regarding the proper care, storage and handling of dosimeters at BRR. CNSC staff have requested that Cameco implement a more proactive approach at BRR to ensure dosimetry handling practices are being controlled, as well as adequate oversight to ensure procedural non-conformances are limited. CNSC staff also requested that BRR benchmark its dosimetry handling practices against similar facilities and report to CNSC staff on the outcome. Cameco is currently working on a response to these requests. This topic will be included in a planned CNSC inspection focused on RP and the RP program at BRR, which will occur during the CNSC's fiscal year 2015-16.

RP program performance at BRR was assessed in 2014 through various CNSC staff compliance activities. Cameco's compliance with the *Radiation Protection Regulations* and CNSC licence requirements at BRR was satisfactory.

Radiological Hazard Control

Radiation and contamination control programs are established at BRR to control and minimize radiological hazards and the spread of radioactive contamination. Methods of control include radiological zone controls and monitoring to confirm the effectiveness of the program.

Estimated Dose to the Public

The 2010 to 2014 maximum effective dose to a member of the public are shown in table 3-1. The CNSC regulatory dose limit for a member of the public is 1 mSv/year.

Table 3-1: BRR – maximum effective dose to a member of the public – 2010–2014

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Maximum effective dose (mSv)	0.006	0.006	0.012	0.012	0.005	1 mSv/year

3.3 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities. This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public

RATINGS FOR ENVIRONMENTAL PROTECTION				
Overall Compliance Rating				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
<p>For 2014, CNSC staff continue to rate the environmental protection SCA at BRR as “satisfactory”. Uranium releases to the environment continue to be controlled and monitored in compliance with the conditions of the operating licence and regulatory requirements. The releases of hazardous substances from the facility to the environment are controlled in accordance with MOECC’s requirements. All the releases to the environment were well below regulatory limits during 2014. Groundwater monitoring, surface water monitoring, soil sampling and ambient air data indicate that the public and the environment continue to be protected from facility releases.</p>				

Effluent and Emissions Control (Releases)

Atmospheric Emissions

BRR monitors uranium, nitrogen oxides (NO_x) and particulates released from the facility stacks on a daily basis. The monitoring data in table 3-2 demonstrate that stack emissions from the facility in 2014 continue to be effectively controlled and are consistently well below their respective licence limits.

Table 3-2: Blind River Refinery – air emissions monitoring results (annual averages), 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limit
Dust collection and exhaust ventilation stack – uranium (kg/h)	0.00009	0.00010	0.00006	0.00004	0.00005	0.1
Absorber stack – uranium (kg/h)	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.1
Incinerator stack – uranium (kg/h)	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.01
Nitrogen oxides (NO_x) + nitric acid (HNO₃) (kg NO₂/h)	4.4	3.9	3.3	3.4	2.0	56.0
Particulate (kg/h)	0.030	0.027	0.024	0.014	0.009	11.0

Note: results less than detection limit are denoted as “<”

Liquid Effluent

There are three sources of liquid effluent from the BRR facility: plant effluent, storm water runoff and sewage treatment plant effluent. These effluents are collected in lagoons and treated, as required, prior to being discharged into Lake Huron. Cameco monitors uranium, radium-226, nitrates and pH to demonstrate compliance with their respective licensed limits. The average monitoring results from 2010 to 2014 are summarized in table 3-3. For 2014, the liquid discharges from the facility continue to be below their respective licensed limits.

Table 3-3: Blind River Refinery – liquid effluent monitoring results (annual averages), 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limit
Uranium (mg/l)	0.02	0.02	0.01	0.01	0.02	20
Nitrates (mg/l)	24	30	28	26	17	1,000
Radium-226 (Bq/l)	<0.01	<0.01	<0.01	0.01	0.01	11
pH	7.2-8.4	7.1-8.2	7.2-8.2	7.1-8.4	7.1-8.4	6.0-9.5

Note: Results less than detection limit are denoted as “<”.

Environmental Management System (EMS)

Cameco has developed and maintains an EMS to describe the activities associated with the protection of the environment at the BRR facility. BRR’s EMS is described in their *Environmental Management Program Manual*; it includes activities such as establishing annual environmental objectives and targets that are reviewed and assessed by CNSC staff through compliance verification activities. Cameco holds an annual safety meeting in which environmental protection issues are discussed. CNSC staff, as part of its compliance verification activities, review these minutes and follow up with BRR staff on any outstanding issues.

Assessment and Monitoring

Soil Monitoring

Cameco’s BRR continues to assess soil for potential long-term effects of air emissions, to determine whether there is accumulation of uranium in soil in the vicinity of the facility. The results in 2014 remained consistent with previous years. The maximum uranium soil concentrations observed near the facility were below 23 µg/g, which is the most restrictive CCME soil quality guideline for uranium for residential and parkland land use. Uranium soil concentrations do not appear to increase in the area surrounding the facility. Soil sampling results are provided in table F-1, appendix F.

Uranium in Ambient Air

The concentrations of uranium in ambient air as monitored by BRR’s sampling network around the facility continue to be consistently low. In 2014, the highest annual average concentration (among the sampling stations) of uranium in ambient air was 0.002 µg/m³, which is below the Ontario MOECC’s incoming standard for uranium in ambient air of 0.03 µg/m³. This new standard for uranium takes effect in 2016.

Surface Water Monitoring

Cameco's BRR continues to monitor surface water for uranium and other parameters at the location of the refinery outfall diffuser in Lake Huron. The concentration of uranium in the lake remains well below published federal and provincial guidelines. Surface water monitoring results are provided in table F-3, appendix F.

Groundwater Monitoring

Currently, a total of 43 ground water monitoring wells exist in and around BRR (17 wells are located inside the perimeter fence and 26 wells outside the fence).

Based on the groundwater sampling data presented in Cameco's annual compliance reports, the refinery operations are not causing any adverse impact to groundwater quality. The maximum sampled uranium concentration in the groundwater was 8.9 µg /L in 2014. Although the 2014 maximum was a slight increase over past years, it remains at a very low concentration. More data will be collected and analyzed as part of the routine groundwater monitoring program to show whether there is an increasing trend of uranium concentrations in the groundwater. Groundwater monitoring results are provided in table F-2, appendix F.

Protection of the Public

The CNSC requires that the licensee demonstrate that the health and safety of the public are protected from exposures to hazardous substances released from the facility. The effluent and environmental monitoring programs currently conducted by BRR are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the BRR licence and LCH. The review of BRR's hazardous (non-radiological) discharges to the environment indicates that no significant risks to the public or environment have occurred during this period.

The programs at the BRR facility, as summarized in section 3.3 Environmental Protection, indicate that the public continues to be protected from facility emissions.

3.4 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers and equipment. This SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	FS
<p>For 2014, CNSC staff rate the conventional health and safety SCA at BRR as “fully satisfactory”. Overall, the compliance verification activities conducted at BRR confirm that Cameco continues to view conventional health and safety as an important consideration. Cameco has implemented an effective occupational health and safety management program, which has resulted in the ability to keep their workers safe from occupational injuries; no LTIs have occurred for more than eight years.</p>				

Performance

A key performance measure for this SCA is the number of LTIs that occur per year. An LTI is an injury that takes place at work, and results in the worker being unable to return to work and carry out their duties for a period of time. As per table 3-4, the number of LTIs remains zero in 2014. BRR has not had an LTI in the past eight years.

Table 3-4: Lost-time injuries (LTIs) at BRR, 2010–2014

	2010	2011	2012	2013	2014
Lost-time injuries	0	0	0	0	0

Practices

In addition to the NSCA and its associated regulations, Cameco’s activities and operations are required to comply with Part II of the *Canada Labour Code*. As such, Cameco is required to report incidents resulting in an injury to ESDC. CNSC staff receive copies of these reports.

BRR’s commitment to safety is captured in a safety charter signed by each employee and displayed at the entrance of the facility. Cameco has a Facility Health and Safety Committee (FHSC) that inspects the work place and meets monthly to resolve and track any safety issues. CNSC staff frequently review the FHSC monthly meeting minutes and associated corrective actions to verify that issues are promptly resolved.

Awareness

Cameco continues to develop and maintain a comprehensive occupational health and safety management program for the BRR site. During 2014, Cameco undertook eight initiatives to improve occupational health and safety at the site. The CNSC staff will continue to monitor the effectiveness of these improvement initiatives through future inspections.

4. PORT HOPE CONVERSION FACILITY

Cameco owns and operates the Port Hope Conversion Facility (PHCF) under an operating licence that currently expires on February 28, 2017. PHCF is located in the municipality of Port Hope, ON; it is situated on the north shore of Lake Ontario, approximately 100 kilometers east of Toronto. An aerial photograph of the site is shown in figure 4-1.

Figure 4-1: Port Hope Conversion Facility Site 1 (looking north)



PHCF primarily converts uranium trioxide (UO_3) powder produced by Cameco's Blind River facility into uranium dioxide (UO_2) and uranium hexafluoride (UF_6). UO_2 is used in the manufacture of CANDU reactor fuel (natural uranium), while UF_6 is exported for further processing before being converted into fuel for light-water reactors.

In 2014, there were no licence amendments or changes to the PHCF licence conditions handbook (LCH-Cameco-PHCF-R000).

4.1 Performance

For 2014, CNSC staff continue to rate PHCF's performance as "satisfactory" in all SCAs. While a number of events have occurred at PHCF in 2014, in all cases CNSC staff are satisfied that Cameco has taken appropriate measures to ensure that the facility continues to operate safely. In response to these events CNSC staff heightened its regulatory oversight of this facility in 2014 and will continue to do so in 2015. The PHCF performance ratings for 2010 through 2014 are provided in table C-2, appendix C.

In 2014, PHCF made no significant changes to the processes it uses to ensure that the physical design of the site is maintained and made no facility modifications that affected PHCF's safety case. During the summer of 2014, the UO₂ and UF₆ plants underwent scheduled shutdowns to allow for planned maintenance activities and to allow employees to take vacation time. In addition, over the summer of 2014, PHCF successfully conducted an enhanced Clean Up program (Super Cup) to remove, decontaminate and dispose of obsolete equipment. After achieving the annual production targets, the UO₂ and UF₆ plants were safely shutdown in December 2014.

In 2014, PHCF experienced a number of events or incidents that were reported to CNSC staff. The following two events were presented to the Commission as event initial reports:

- The January 2014 event regarding the compromised control of the UF₆ plant cell room hydrogen recirculation valve was initially presented to the Commission in February 2014, and again in more detail in June 2014 (CMD 14-M36). There were no injuries and no releases within or outside the facility as a result of this event. Following this event CNSC staff heightened their regulatory oversight of the PHCF facility. CNSC staff are satisfied with and have verified the implementation of the corrective actions identified by Cameco to prevent reoccurrence.
- The November 2014 event regarding the small anhydrous hydrogen fluoride (AHF) release within the UF₆ plant was presented to the Commission in December 2014 (CMD 14-M83). Cameco has provided a corrective action plan in response to CNSC staff's December 2014 follow-up reactive inspection to this event. Cameco also completed a root cause investigation identifying additional corrective actions as a result of this event. CNSC staff are satisfied with the measures taken by Cameco and will continue to monitor the implementation of Cameco's corrective actions.

In addition to these two events, Cameco notified CNSC staff of the regulatory reports made to Environment Canada (EC), the MOECC and the Municipality of Port Hope. CNSC staff reviewed these reports and followed up with additional regulatory oversight activities, as appropriate. For example, in February, CNSC staff, along with MOECC staff, participated in a joint inspection led by EC.

Other reportable incidents that occurred at PHCF in 2014 are outlined below:

- In January, the failure of a pigtail associated with filling UF₆ cylinders was detected during a routine pressure test conducted with very dry air. There was no impact on workers or the environment. Had this failure not been detected, there would have been an increased risk of UF₆ release into the cylinder filling area. CNSC staff are satisfied with the measures taken and corrective actions identified by Cameco. CNSC staff continue to follow up with compliance oversight activities to ensure that corrective actions are completed.
- In May, while preparing to unload an International Standards Organization (ISO) container of hydrogen fluoride (HF), the unloading connection cap was seized. The same morning this occurred, a full railcar of HF arrived on site. While it is Cameco's practice to move full railcars of HF inside overnight, the full railcar of HF was left outside overnight in order to safely carry out the unloading of the ISO container in the HF unloading area the next day. The HF railcar remained within the fenced property and Cameco put in place additional monitoring of the railcar. There were no health, safety or environmental impacts related to this event. CNSC staff are satisfied with the decisions made and measures implemented by Cameco in response to this event.
- Regarding the May event, Cameco notified CNSC staff of a shortage of Potassium Hydroxide (KOH) inventory necessary to unload HF. The purpose of the KOH inventory is to maintain the capability of neutralizing HF as outlined in PHCF's emergency response plan. The reduced inventory of KOH was identified prior to unloading the HF ISO container. As such, there was no impact on either workers or the environment. Cameco carried out an investigation into the matter. CNSC staff are satisfied with the corrective actions identified by Cameco and have verified their implementation during a follow-up site visit.
- In September, a leak in a UF₆ plant heat exchanger resulted in process water coming in contact with cooling water which was discharged to the harbour. This particular event is described in more detail in section 2.3.3 Environmental Protection, under liquid effluent.

Vision in Motion (VIM) is Cameco's plan to clean up and renew the PHCF. In 2014, Cameco continued to make progress with project planning and program activities with respect to the VIM project. In late 2014, Cameco decided to combine the licensing submissions in support of the VIM project with PHCF's licence renewal application. In the interim, Cameco continues to plan for and carry out clean up and remediation work, that is within its current licensing basis (i.e., Super Cup, as described earlier; test excavations; Centre Pier work).

In 2014, CNSC staff conducted five planned compliance inspections to verify PHCF's compliance with the NSCA and its regulations, its operating licence, and the programs used to meet their regulatory requirements. CNSC staff also conducted increased oversight of the PHCF in reaction to the number of events in 2014. This resulted in numerous site visits and one focused reactive inspection conducted in 2014. None of the findings from these inspections posed an immediate or unreasonable risk to the health, safety and security of workers, Canadians, or to the environment.

4.2 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

RATINGS FOR RADIATION PROTECTION				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continue to rate the radiation protection SCA at Cameco's Port Hope Conversion Facility as "satisfactory". Cameco has implemented and maintained a radiation protection program as required by the <i>Radiation Protection Regulations</i> .				

Application of ALARA

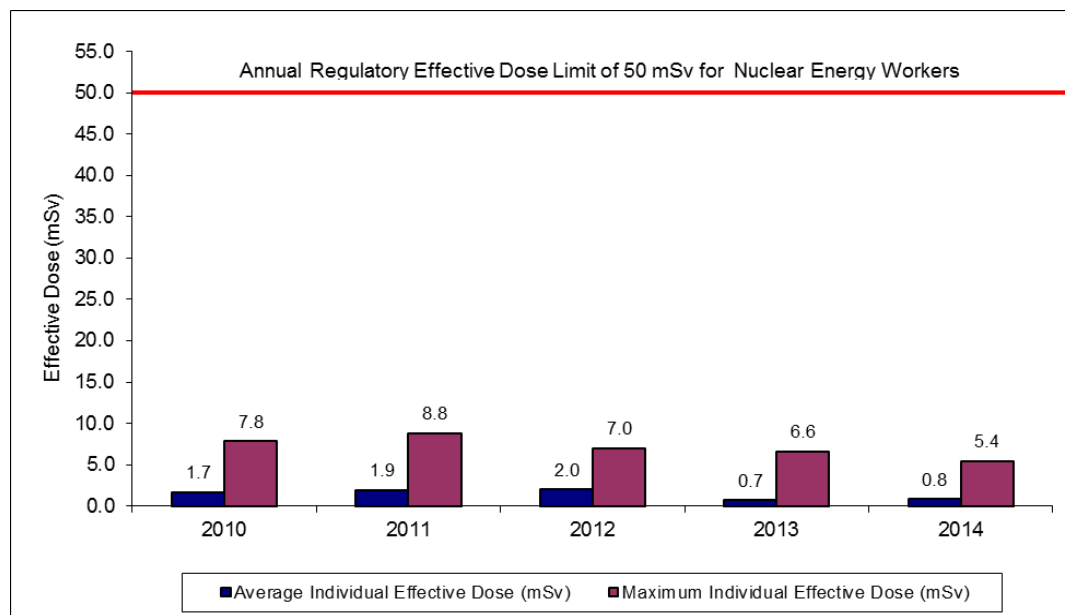
As required by the *Radiation Protection Regulations*, Cameco continued to implement radiation protection (RP) measures at PHCF in 2014 to keep radiation exposures and doses to persons ALARA, taking into account social and economic factors. Annually, RP objectives and ALARA targets are established. These objectives and targets include worker dose reduction initiatives and other projects which examine ways to reduce in-plant uranium-in-air concentrations.

Worker Dose Control

Radiation exposures are monitored to ensure compliance with the CNSC's regulatory dose limits and to keep radiation doses ALARA. In 2014, radiation exposures at PHCF, reported by Cameco, were well below CNSC regulatory dose limits.

Total effective dose was assessed for 753 NEWs at PHCF, (415 Cameco employees and 338 contractors). The maximum effective dose received by a NEW in 2014 was 5.4 mSv, or approximately 11 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. Annual average and maximum effective and equivalent dose results from 2010 to 2014 are provided in tables E-3 and E-18, appendix E. Effective dose statistics for nuclear energy workers are shown in figure 4-2.

Figure 4-2: Port Hope Conversion Facility – effective dose trend for nuclear energy workers



During the years 2010-2012 at PHCF, average effective doses were relatively stable at 2 mSv. In 2013 and 2014, Cameco began including contractor NEW dose results in their statistics, which decreased the average dose values. Maximum individual effective doses at PHCF over the years 2010-2014 were relatively stable, with a decreasing trend observed beginning in 2012.

Radiation Protection Program Performance

Action levels for radiological exposures are established as part of the PHCF RP program. If an action level is reached, it triggers Cameco staff to establish the cause and, if applicable, restore the effectiveness of the RP program. In 2014, there were no radiological exposure action level exceedances at PHCF.

RP program performance at PHCF was assessed in 2014 through various CNSC staff compliance activities. These activities included a focused CNSC inspection on RP to assess compliance with regulatory requirements and PHCF's RP program requirements. These compliance activities identified non-safety significant areas for improvement at PHCF. The majority of these areas have been addressed by Cameco, with appropriate corrective actions implemented to CNSC staff's satisfaction.

Radiological Hazard Control

Radiation and contamination control programs have been established at PHCF to control and minimize radiological hazards and the spread of radioactive contamination. Methods of control include the use of radiation zone controls and monitoring to confirm the effectiveness of the programs.

Estimated Dose to the Public

The 2010–2014 maximum effective doses to a member of the public are shown in table 4-1. Doses to the public are well below the PHCF Operating Release Level of 0.3 mSv/year. The CNSC regulatory dose limit for a member of the public is 1 mSv/year.

Table 4-1: Port Hope Conversion Facility – maximum effective dose to a member of the public, 2010–2014

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Maximum effective dose (mSv)	0.019	0.019	0.029	0.021	0.012	1 mSv/year

4.3 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities. This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public

RATINGS FOR ENVIRONMENTAL PROTECTION				
Overall Compliance Rating				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continue to rate the environmental protection SCA at Cameco's PHCF as "satisfactory". Uranium releases to the environment continue to be controlled and monitored, to comply with the conditions of the operating licence and regulatory requirements. The releases of hazardous substances from the facility to the environment are controlled in accordance with MOECC's applicable requirements. All the releases to the environment were well below regulatory limits during 2014. Fenceline gamma measurements, groundwater monitoring, soil sampling, vegetation and ambient air data indicate that the public and the environment continue to be protected from facility releases.				

Effluent and Emissions Control (Releases)

Atmospheric Emissions

PHCF monitors uranium, fluorides and ammonia released from stacks at the facility. The monitoring data in table 4-2 demonstrates that stack emissions from the facility in 2014 continued to be effectively controlled, and remained consistently below their respective licence limits. No action levels were exceeded at any time in 2014.

Table 4-2: Port Hope Conversion Facility – air emissions monitoring results (annual averages), 2010–2014

Location	Parameter	2010	2011	2012	2013	2014	Licence limit
UF₆ plant	Uranium (kg/h)	0.0044	0.0051	0.0042	0.0051	0.0012	0.290
	Fluorides (kg/h)	0.0175	0.0199	0.0160	0.0190	0.0130	0.650
UO₂ plant	Uranium (kg/h)	0.0013	0.0013	0.0012	0.0013	0.0012	0.150
	Ammonia (kg/h)	3.3	2.4	1.9	2.0	2.2	58

Liquid Effluent

For 2014, PHCF continued to evaporate rather than discharge process liquid effluent. Their licence does not allow any process liquid effluent discharge to the environment.

One event occurred in September 2014 that resulted in a discharge process liquid effluent. A leak within a heat exchanger in the UF₆ plant resulted in cooling water coming into contact with process water; the liquid effluent was then discharged to the harbour. This situation occurred between September 26 and September 29. The heat exchanger was isolated and drained to prevent further discharge to the harbour. Sampling and analysis of harbour water indicated that there was no significant impact on water quality. Cameco has conducted an apparent cause investigation into this event. CNSC staff inspected the site to observe Cameco's actions following this incident and are satisfied with the actions taken by Cameco. CNSC staff will continue to follow up with compliance oversight activities to ensure all corrective actions are completed.

Environmental Management System (EMS)

Cameco has developed and is maintaining an EMS to describe the activities associated with the protection of the environment at the PHCF. PHCF's EMS is described in their Environmental Management Program Manual and includes activities such as establishing annual environmental objectives and targets, which are reviewed and assessed by CNSC staff through compliance verification activities. The EMS is verified through the annual management review, where minutes and follow-up to outstanding issues are documented. CNSC staff, as part of their compliance verification activities, review these minutes and follow up with PHCF staff on any outstanding issues.

Assessment and Monitoring

Soil Monitoring

PHCF's soil monitoring program consists of five monitoring locations in the municipality of Port Hope, including one location (Waterworks side yard) remediated with clean soil to avoid interference from historic uranium soil contamination. Samples are taken annually at various depths within the soil profile to determine whether the concentration of uranium changes when compared to previous sample results.

The average uranium-in-soil concentrations in 2014 arising from current operations remained similar to past years. This suggests that uranium emissions from current PHCF operations have not accumulated in soil over the past few years. Soil sampling results are provided in table F-5, appendix F. These results are well below the 23 µg/g CCME soil quality guideline for residential and parkland land use.

Uranium in Ambient Air

PHCF measures uranium in the ambient air at several locations around the facility, to confirm the effectiveness of emission abatement systems and to monitor the impact of the facility on the environment. For 2014, the results from these samplers show that uranium in air as suspended particulate has consistently remained very low: the highest annual average concentration (among the sampling stations) of uranium in ambient air measured around the facility in 2014 was 0.002 µg/m³, well below MOECC's impending standard for uranium in ambient air of 0.03 µg/m³.

Groundwater Monitoring

Currently, the groundwater quality at PHCF is sampled at:

- 13 active pumping wells on a monthly basis, four of which commenced operation in October 2011
- 66 monitoring wells on a quarterly basis
- 15 bedrock wells on an annual basis

CNSC staff found that the groundwater monitoring program, including the pump-and-treat wells, has been performing as expected, and the groundwater quality across the PHCF site in 2014 has not deteriorated relative to the groundwater quality in previous years.

Table 4-3 provides the mass of Contaminants of Concern (COC) that were captured in the pump-and-treat wells and removed before they reached the harbour. From 2012 to 2014, there was an increase in the mass removed for most COC, due to the addition of four new pump-and-treat wells in October 2011. This result indicates a significant improvement to the pump-and-treat-well performance at PHCF.

Table 4-3: Port Hope Conversion Facility – mass (kg) of contaminants of concern (COC) removed by pumping wells, 2010–2014

COC (kg)	Year				
	2010	2011	2012	2013	2014
Uranium	14.0	19.7	27.7	28.9	31.0
Fluoride	43.5	38.6	60.4	51.1	53.0
Ammonia	26.1	20.9	34.7	53.0	75.0
Nitrate	27.8	41.2	37.5	41.0	53.0
Arsenic	3.5	2.6	3.1	2.8	2.5

Fluoride Monitoring

The impact of fluoride emissions from PHCF on the environment is determined each growing season (April 15 to October 15), when samples of fluoride-sensitive vegetation are collected. These samples are analyzed for fluoride content and for assessment of any leaf damage. The results in 2014 continued to be well below MOECC's upper limit of normal guideline of 35 parts per million (ppm). Details are provided in table F-6, appendix F.

Surface Water Monitoring

Surface water is sampled at two depths (just below the surface and at just above the harbour sediment layer) at each of the 13 locations in the Port Hope Harbour. Details are provided in table F-7, appendix F. In addition, there is ongoing monitoring of the PHCF's cooling water intake, located in the Port Hope Harbour near the mouth of the Ganaraska River.

The surface water quality in the harbour adjacent to the PHCF has been monitored since 1977 through the analysis of samples collected from the south cooling water intake. The trend of surface water quality over time shows improvement since 1977, as shown in figure F-4, appendix F.

Protection of the Public

The licensee is required to demonstrate that the health and safety of the public are protected from exposures to hazardous substances released from the facility. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

CNSC receives reports of discharges to the environment through the reporting requirements outlined in the PHCF licence and LCH. The review of hazardous (non-radiological) discharges to the environment for PHCF in 2014 indicates that no significant risks to the public or environment have occurred during this period.

The programs at the PHCF, as summarized in section 4.3 Environmental Protection, indicate that the public continues to be protected from facility emissions.

4.4 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers and equipment. This SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continue to rate the conventional health and safety SCA at the PHCF as “satisfactory”. Overall, compliance verification activities conducted at the facility confirm that Cameco continues to view conventional health and safety as an important consideration. Cameco has demonstrated a satisfactory ability to keep their workers safe from occupational injuries.				

Performance

A key performance measure for conventional health and safety SCA is the number of lost time injuries (LTI) that occur per year. An LTI is an injury that takes place at work and results in the worker being unable to return to work to carry out their duties for a period of time. As indicated in table 4-4, over the past five years the number of LTIs has been fairly consistent at PHCF, with one LTI occurring in 2014. A description of the 2014 LTI, and the corrective actions taken by PHCF are provided in table G-1, appendix G.

Table 4-4: Lost-time injuries (LTIs) at PHCF, 2010–2014

	2010	2011	2012	2013	2014
Lost-time injuries	1	3	1	0	1

Practices

In addition to the NSCA and its associated regulations, Cameco’s activities and operations at the PHCF site must comply with Part II of the *Canada Labour Code*.

Conventional health and safety efforts at PHCF are supported by the Conversion Safety Steering Committee (CSSC), a joint committee that was created in 2013. Cameco uses audits, inspections, evaluations, reviews, benchmarking, training and employee participation and engagement to evaluate the effectiveness of conventional health and safety practices at the PHCF site.

All the reported conventional health and safety incidents are tracked and managed as part of PHCF’s Cameco Incident Reporting System (CIRS) database.

Awareness

Cameco continues to develop and maintain a comprehensive occupational health and safety management program for the PHCF site. During 2014, Cameco advanced several initiatives to improve occupational health and safety at the site. CNSC staff will continue to monitor the effectiveness of these improvement initiatives through future inspections.

5. CAMECO FUEL MANUFACTURING INC.

Cameco Fuel Manufacturing Inc. (CFM) is a wholly-owned subsidiary of Cameco, and it operates two facilities: a nuclear fuel fabricating facility licensed by the CNSC, and a metals manufacturing facility in Cobourg, ON, which manufactures zircaloy tubes. This latter facility is not licensed by the CNSC, and is not discussed further in this report.

Figure 5-1: Aerial view of Cameco Fuel Manufacturing



The CFM facility is located in Port Hope, ON, and operates under a CNSC licence that expires in 2022. The facility manufactures nuclear reactor fuel bundles from uranium dioxide and zircaloy tubes. The finished fuel bundles are primarily shipped to Canadian nuclear power reactors.

In 2014, CFM had approximately 145 employees. The risks associated with the licensed activities at this Class IB facility are mainly due to conventional industrial hazards and radiological hazards of UO_2 .

Since relicensing in March 2012, there have been no licence amendments or changes to CFM's LCH (LCH-Cameco-CFM-R000), issued in July 2012.

5.1 Performance

For 2014, CNSC staff rated CFM's performance as "satisfactory" in all 14 SCAs. The CFM facility ratings for 2010 to 2014 are provided in table C-3, appendix C.

CFM continued to operate in a safe manner throughout 2014. The facility underwent two planned shutdowns during the course of the year to conduct routine maintenance activities and implement facility upgrades.

In 2014, CFM implemented several upgrades to the facility and its equipment, including modifications of the assembly area to accommodate the relocation of the bundle manufacturing system (BMS). Modifications also occurred in the north area of the facility to prepare for the installation of the new powder receiving/powder preparation equipment. Other improvements in 2014 included a new stacking cell that was added to the BMS and commissioned during the third quarter. Further modifications will be completed in 2015, including commissioning of the new powder receiving/powder preparation area.

All modifications to CFM's buildings, processes, equipment and procedures with a potential impact to safety are evaluated through its internal change control processes, to help identify potential impacts to the licensing basis. The 2014 modifications did not alter the licensing basis, and were within the safety case described in the licensee's safety analysis report.

Several program and procedure documents were also updated in 2014, including the following:

- Waste Management Procedure
- Integrated Management System Manual
- Facility Licensing Manual
- Safety Analysis Report

Also in 2014, Cameco renewed its Fuel Services Division's internal dosimetry licence to perform in-vivo lung counting to ascertain the internal dose of CFM workers. This change to the dosimetry licence is the main corrective action taken by CFM to address the findings from its investigation into internal dose calculation errors reported to the Commission at the February 20, 2013 Commission Meeting. As a result of this change, CFM is assigning internal dose for 2014 using lung counting as further discussed in section 5.2 of this report.

In 2014, there were two reportable action level exceedances related to workers' internal dose and one action level exceedance related to environmental protection. Details are provided in section 5.2.

In 2014, CNSC staff conducted three Type II inspections to verify CFM's compliance with the NSCA and its regulations, its operating licence and the programs used to meet regulatory requirements. The inspections focused on radiation protection, waste management and criticality safety. None of the findings from these inspections posed an immediate risk to the health, safety and security of workers, Canadians or the environment.

5.2 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

RATINGS FOR RADIATION PROTECTION				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continue to rate the radiation protection SCA at CFM as “satisfactory”. Cameco has implemented and maintained a radiation protection program as required by the <i>Radiation Protection Regulations</i> .				

Application of ALARA

Annually, Cameco establishes ALARA initiatives and dose targets at CFM. Performance against these initiatives and targets were regularly reviewed and tracked during 2014. In addition, CFM has a joint worker-management ALARA Committee, whose main goal is to implement initiatives to lower worker radiological exposures.

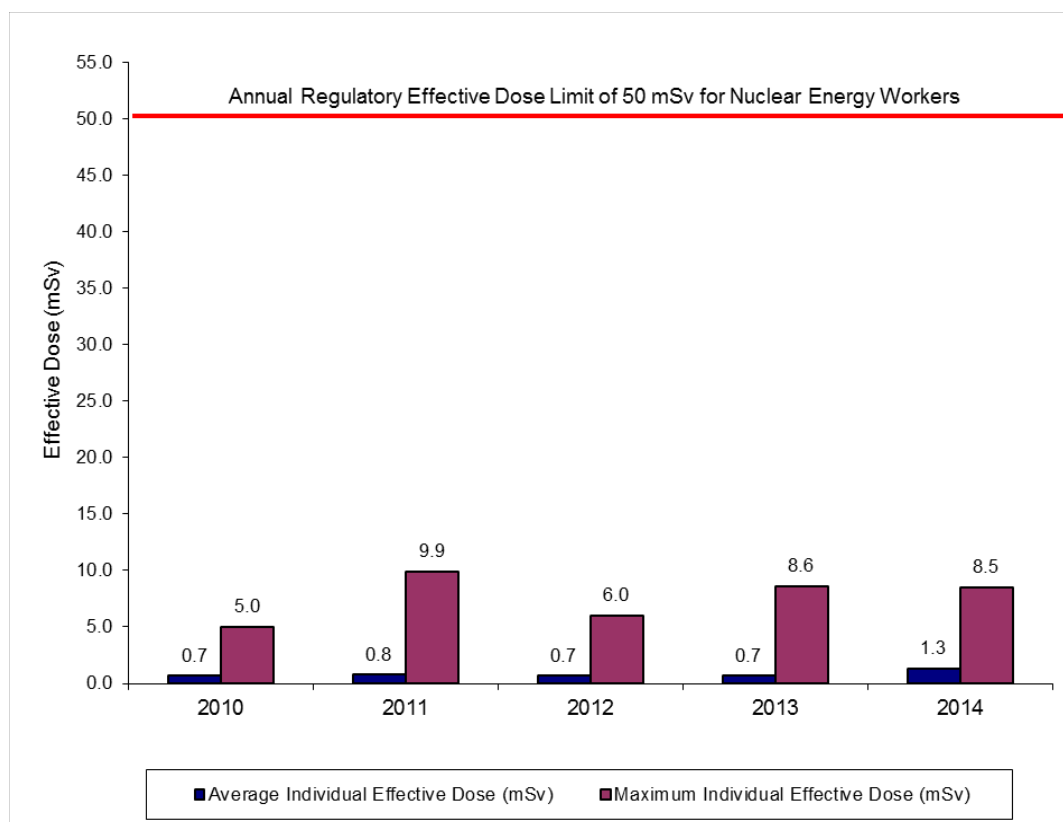
Worker Dose Control

At CFM, all employees and contractors working more than 80 hours per year are considered as NEWs. Radiation exposures are monitored to ensure compliance with CNSC’s regulatory dose limits and to keep radiation doses ALARA.

In 2014, no worker’s radiation exposure at CFM, reported by Cameco, exceeded CNSC regulatory dose limits. The maximum effective dose received by a NEW in 2014 was 8.5 mSv, or approximately 17 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. Annual average and maximum effective and equivalent dose results from 2010 to 2014 are provided in tables E-4, E-12 and E-19, appendix E.

In 2014, Cameco incorporated CFM as part of their approved, CNSC-licensed internal dosimetry program for Cameco's Fuel Services Division (FSD). Therefore, the workers' internal doses at CFM are now ascertained using the CNSC-licensed lung counting method. Previously, internal doses at CFM were calculated based on workers' uranium-in-urine concentrations. When examining total effective doses over the years 2010–2014, the maximum individual effective dose in 2014 is consistent with the 2013 result. There is an increase in the average in 2014 due to differences in techniques for ascertaining internal doses.

Figure 5-2: Cameco Fuel Manufacturing – effective dose trend for nuclear energy workers



Radiation Protection Program Performance

Action levels for radiological exposures are established as part of the CFM RP program. If an action level is reached, it triggers Cameco staff to establish the cause and, if applicable, restore the effectiveness of the RP program.

In 2014, there were two action level exceedances at CFM related to workers' internal doses. On two separate occasions, two workers, in separate work groups with different job functions, were determined to have received quarterly internal doses of 2.94 mSv and 1.74 mSv respectively, which exceeded CFM's internal dose action level of 0.8 mSv/quarter. Both exceedances were reported to the CNSC as required, and appropriately investigated. In both cases, corrective measures were implemented to help prevent recurrences. CNSC staff are satisfied with the corrective measures taken by Cameco in response to these action level exceedances.

Radiation protection (RP) program performance at CFM was assessed in 2014 through various CNSC staff compliance activities. This included a focused CNSC inspection on RP, to assess compliance with regulatory requirements and CFM's RP program requirements. The CNSC RP inspection revealed administrative deficiencies in the RP program and identified programmatic areas that were not adequately implemented or executed at CFM. However, the findings do not pose risks to the health and safety of workers. Cameco continues to implement corrective actions to address areas requiring improvements identified during the CNSC RP inspection.

Radiological Hazard Control

Radiation and contamination control programs have been established at CFM to control and minimize radiological hazards and the spread of radioactive contamination.

Methods of control include radiological zone controls and monitoring to confirm the effectiveness of the program.

Estimated Dose to the Public

The 2010-2014 annual doses to the critical receptor are shown in the following table. The public dose to the critical receptor is well below the CNSC regulatory dose limit for a member of the public of 1 mSv/year.

As reported previously, the relatively higher maximum effective dose to a member of the public for 2011 and 2012 was attributed to the storage of radioactive material in the north area of the CFM property. Improved storage practices at the facility have effectively mitigated this situation.

Maximum Effective Dose to a Member of the Public						
Dose data	2010	2011	2012	2013	2014	Regulatory limit
Maximum effective dose (mSv)	0.008	0.042	0.031	0.013	0.018	1 mSv/year

5.3 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities. This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public

RATINGS FOR ENVIRONMENTAL PROTECTION				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
<p>For 2014, CNSC staff continue to rate the environmental protection SCA at the CFM facility as “satisfactory”.</p> <p>Uranium and hazardous substance releases from CFM to the environment continue to be controlled and monitored, in compliance with the conditions of the operating licence and regulatory requirements. Groundwater monitoring, soil sampling and high-volume air sampler data indicate that the public and the environment continue to be protected from facility releases.</p>				

Effluent and Emissions Control (Releases)

Atmospheric Emissions

CFM continues to monitor uranium released as gaseous emissions from the facility. The monitoring data in table 5-1 demonstrate that stack emissions from the facility in 2014 continued to be effectively controlled, and remained consistently well below their licence limits. No action levels were exceeded at any time in 2014.

Table 5-1: Cameco Fuel Manufacturing – air emissions monitoring results, 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limits
Total uranium discharge through stacks (kg/year)	0.03	0.02	0.02	0.03	0.01	14

Liquid Effluent

CFM also continues to monitor uranium released as liquid effluent from the facility. The monitoring data in table 5-2 demonstrates that liquid effluent from the facility in 2014 continued to be effectively controlled, and remained consistently well below its licence limits.

There was one action level exceedance in the first quarter of 2014. The action level for the uranium concentration in sewer emissions discharged to the municipal sewer system is 0.2 parts per million (ppm) for a weekly composite. Samples from the composite sewer sample for the week of January 13-20 were analyzed by CFM's external laboratory. The results indicated that the uranium concentration was 0.624 ppm. Cameco conducted an investigation that determined that the probable cause of the incident was maintenance work performed to clear the furnace sanitary sewer lines. This maintenance work caused a release of historical uranium that had collected in the lines. The results from the investigation were detailed with corrective actions identified, and submitted to the CNSC. The corrective actions implemented by CFM were reviewed by CNSC staff and found to be adequate.

In March 2015, CFM reported that the total uranium discharged to the sanitary sewer had been under reported since 2007. Following an internal review, CFM determined that the groundwater releases to the sanitary sewer starting in 2007 had not been included in the total volume of liquid effluent used to calculate the amount of uranium discharged to the sanitary sewer.¹

As result, the amounts of uranium to the sanitary sewer for the years 2007 to 2014 were recalculated taking into account the revised effluent volumes. Corrected uranium discharges to the sewer from 2010 to 2014 are provided in table 5-2. As shown in the table, the corrected values remain a small fraction (at less than 0.5%) of the licence limit.

CNSC staff have requested that CFM provide the CNSC with the results of its investigation in this event by identifying: (1) the causes, (2) the factors that allowed the occurrence to continue for several years, and (3) the actions taken by CFM to prevent similar occurrences. CNSC staff have also recommended that lessons learned from this occurrence and its investigation be shared between Cameco's FSD facilities.

¹ In November 2000, CFM initiated the operation of a groundwater collection and treatment system to treat groundwater impacted by chlorinated solvents. The treated groundwater was initially released to an infiltration gallery. However in May 2007, after obtaining approvals from the Municipality of Port Hope, CFM diverted the treated groundwater to the sanitary sewer.

Table 5-2: Cameco Fuel Manufacturing – liquid effluent monitoring results, 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limit
Total uranium discharge to sewer (kg/year)	2.00	1.18	0.95	0.83	1.58	475

Environmental Management System (EMS)

Cameco has developed and maintains an EMS to describe the activities associated with the protection of the environment at CFM. The EMS is described in the Radiation & Environmental Protection Manual and includes activities such as establishing annual environmental objectives and targets, which are reviewed and assessed by CNSC staff through compliance verification activities. Cameco holds an annual management review meeting during which environmental protection issues are discussed. CNSC staff, as part of their compliance verification activities, review these minutes and follow up with CFM staff on any outstanding issues.

Assessment and Monitoring

Soil Monitoring

CFM collects soil samples from 23 locations surrounding the facility, on a three-year sampling frequency. Soil samples were last collected in 2013 and analyzed for uranium content. The results for all samples were below 23 µg/g, which is the CCME soil quality guideline for uranium for residential and parkland use. A comparison of 2013 results with previous years indicates that there is no increasing trend in uranium concentration in soil.

CFM did not monitor soil in 2014. The next soil sampling round is scheduled for 2016. Soil sampling results are provided in table F-8, appendix F.

Uranium in Ambient Air

CFM operates high-volume air samplers to measure the airborne concentrations of uranium at points of impingement of stack plumes. The samplers are located on the east, north, southwest and northwest sides of the facility. In 2014, the results from these samplers show that the highest annual average concentration of uranium in ambient air measured around the facility was 0.000037 µg/m³, which is well below the MOECC's standard for uranium in ambient air of 0.03 µg/m³.

Groundwater Monitoring

As of the end of 2014, CFM has a network of 75 groundwater monitoring wells located onsite (59) and offsite (16) within the immediate area of the facility. These wells are screened within the overburden (soil) and some are within the underlying bedrock. The monitoring wells have a dual purpose. Their primary purpose is to investigate the extent of historical uranium in groundwater on the licensed property. They also serve to confirm that current operations are not contributing to the concentrations of uranium in groundwater on the licensed property. The monitoring results indicate that there is no increasing trend in uranium concentration in groundwater.

Surface Water Monitoring

In 2014, Cameco collected surface water samples at four locations in May, eight locations in August and eight locations in November. The sample locations were on, and adjacent to, the facility and were analyzed for uranium.

Uranium concentrations in all surface water samples collected in 2014 met the interim Provincial Water Quality Objectives (PWQO) of 0.005 mg/L, with the exception of the samples collected at SW-2 (0.0062 mg/L) in May, SW-4 (0.0895 mg/L, 0.0447 mg/L and 0.0660 mg/L) in May, August and November, and SW-9 (0.0093 mg/L and 0.0122 mg/L) in August and November. Sampling stations SW-4 and SW-9 are both located in the drainage ditch leading to the creek. Sampling station SW-2 is located in the creek directly downstream of the drainage ditch connection.

Uranium concentrations measured in samples collected from two offsite locations (i.e., downstream of CFM) were below the PWQO for uranium of 0.005 mg/L.

CNSC staff will continue to oversee Cameco's monitoring at these locations, to confirm whether there are elevated uranium concentrations in surface water.

Protection of the Public

The licensee shall demonstrate that adequate provisions are made for protecting the health and safety of the public from exposures to hazardous substances released from the facility. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the CFM licence and LCH. The review of CFM's hazardous (non-radiological) discharges to the environment for CFM in 2014 indicates that no significant risks to the public or environment have occurred during this period.

The programs at the CFM facility, as summarized in section 5.3 Environmental Protection, indicate that the public continues to be protected from facility emissions.

5.4 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage non-radiological workplace safety hazards and to protect workers and equipment. This SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continue to rate the conventional health and safety SCA at Cameco Fuel Manufacturing Inc. as “satisfactory”. CFM has implemented and maintained a conventional health and safety program as required by the NSCA and Part II of the <i>Canada Labour Code</i> .				

Performance

CFM uses a variety of key performance indicators (KPIs) to measure the effectiveness of their conventional health and safety program. Among these KPIs, CNSC staff review the number of LTIs that occur per year and their severity. An LTI is an injury that takes place at work and results in the worker being unable to return to work for their scheduled shift or carry out their regular duties for a period of time.

As per table 5-3, no LTIs were reported in 2014.

Table 5-3 Lost-time injuries (LTIs) at CFM, 2010–2014

	2010	2011	2012	2013	2014
Lost-time injuries	0	2	0	0	0

Practices

CFM’s activities and operations shall comply with the NSCA and Part II of the *Canada Labour Code*. CFM achieves this through a comprehensive Environmental and Occupational Health and Safety (E/OH&S) program that is consistent with Cameco’s corporate policy and is modeled on the OHSAS 18001 standard.

CFM maintains a Joint Health and Safety Committee (JH&SC). The committee investigates all safety-related incidents in the facility - not only events which resulted in injuries, but also all near misses. All reported conventional health and safety incidents are tracked and managed as part of CFM's Cameco Incident Reporting System database. In addition, the committee conducts monthly inspections of the workplace and provides input into all new and revised health and safety policies, procedures and programs. The JH&SC emphasizes proactive safety measures by regularly performing risk analyses of various operations throughout the facility by implementing alternate strategies to reduce the risk to the workers.

Awareness

CFM continues to develop and maintain a comprehensive Occupational Health and Safety Management program and tracks both leading and lagging safety indicators, such as safety meeting attendance, percentage of monthly safety inspections completed, performance of the JH&SC and a variety of other safety statistics.

CNSC staff continue to monitor CFM's changes to the Health and Safety programs during onsite inspections.

6. GE HITACHI NUCLEAR ENERGY CANADA INCORPORATED (GEH-C)

GE Hitachi Nuclear Energy Canada Inc. (GEH-C) operates under a class 1B licence (FFOL 3620.00/2020), two separate sites that manufacture CANDU (CANadian Deuterium Uranium) nuclear reactor fuel bundles for use at Ontario Power Generation's (OPG) Pickering and Darlington nuclear power stations. One site in Toronto produces uranium dioxide (UO₂) fuel pellets, and the other site in Peterborough manufactures the fuel bundles using the pellets from Toronto. The Peterborough site also operates a fuel services business involved with the manufacture and maintenance of equipment for use in nuclear power plants.

The primary hazard at these facilities is the inhalation of airborne UO₂ particles apart from conventional industrial hazards. The Peterborough facility also processes Beryllium that poses inhalation hazards. Apart from various safety features in place to prevent any occupational exposure to employees, all workers in potentially hazardous areas are monitored for exposure with CNSC staff accepted action levels to ensure safe operation. The facility operations have low environmental releases. All releases are controlled, monitored and reported with CNSC staff accepted action levels. Additional details are provided in section 6.2 and section 6.3.

Figure 6-1: Aerial view of the GEH-C Toronto facility



In 2014, there were no amendments to GEH-C's licence and LCH. The current licence expires on December 31, 2020.

6.1 Performance

For 2014, CNSC staff rated GEH-C's performance as "satisfactory" in all safety and control areas except environmental properties, which was rated "fully satisfactory". The SCA ratings for GEH-C facilities for 2010 to 2014 are provided in table C-4, appendix C.

GEH-C management ensured production operations at both GEH-C facilities continued to operate in a safe manner through a total of 28 internal audits and 14 self-assessments at their two facilities. GEH-C also embarked on a significant change to its training methods by starting implementation of a Systematic Approach to Training (SAT) to define, design, develop, implement, evaluate, record and manage worker training.

In 2014, there were several improvements to plant equipment and processes including lead shielding added to bundle assembly, new de-ionized water system for fuel process, a rearrangement of the bundle rework area and upgrades to fire sprinkler systems, all completed at the Peterborough facility. Lead shielding on carts, a new distribution panel for certain equipment, and security and monitoring upgrades were completed at the Toronto facility. Most improvements were made in response to a review of ALARA initiatives and to enhance the safety performance of the plant. All changes were made through GEH-C's change control system to ensure they are within the licensing basis and have no impact to the health and safety of workers and the environment. Both facilities also transitioned to new maintenance management software that allows GEH-C to identify critical-to-safety assets and parts for a more efficient preventive maintenance regime. The CNSC maintains oversight of changes in the facility through planned compliance verification inspections to ensure compliance with the NSCA and its regulations, the current licence, and the LCH.

All changes at GEH-C's facilities were minor in nature and did not alter the licensing basis, and no changes were made to the facility safety analysis reports.

In 2014, there was one reported action level exceedance related to whole body dose from the Peterborough facility and one reported lost-time injury (LTI) from the Toronto facility; details are provided in sections 6.2 and 6.4 of this report, respectively. There were no action level exceedances related to environmental protection.

In January 2014, one transport incident was reported in which a drum containing grinder sludge from GEH-C was observed to have a puncture at the Cameco PHCF. Trace contamination was noted on the outside of the drum with no contamination detected on the floor of the trailer. GEH-C conducted an investigation and implemented preventive actions as a result of this incident.

In 2014, CNSC staff conducted three compliance inspections of GEH-C's Management Systems, training program, fire protection program and public information and disclosure program to verify GEH-C's compliance with the NSCA and its regulations, the operating licence, and the LCH. GEH-C has addressed the majority of the enforcement actions from these inspections in 2014 and has submitted acceptable plans to address the remaining open enforcement actions. None of the findings made during these inspections posed an immediate or unreasonable risk to the health, safety and security of workers, Canadians or the environment.

6.2 Radiation Protection

RATINGS FOR RADIATION PROTECTION				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continue to rate the radiation protection SCA at GEH-C as “satisfactory”. GEH-C has implemented and maintained a radiation protection program as required by the <i>Radiation Protection Regulations</i> .				

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

In 2014, CNSC staff continued to rate GEH-C’s radiation protection SCA as “satisfactory”.

Application of ALARA

As required by the *Radiation Protection Regulations*, GEH-C continued to implement radiation protection (RP) measures in 2014 to keep radiation exposures and doses to persons ALARA, taking into account social and economic factors. Annually, GEH-C establishes RP Program goals and initiatives, and the ALARA Committee meets quarterly at a minimum to discuss dose and internal audit results, as well as employee RP related concerns. The Committee also sets annual ALARA goals, such as worker dose reductions.

Worker Dose Control

At GEH-C, employees are classified as either NEWs or non-NEWs, depending on the potential for radiation exposure. All contractors are classified non-NEWs. Radiation exposures are monitored to ensure compliance with CNSC regulatory dose limits and to maintain radiation doses ALARA. In 2014, no worker's radiation exposure reported by GEH-C exceeded CNSC regulatory dose limits. The maximum effective dose received by a worker in 2014 at the Peterborough facility was 7.55 mSv, while the maximum effective dose received by a worker at the Toronto facility was 7.62 mSv. Both dose results represent approximately 15 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. Annual average and maximum effective and equivalent dose results from 2010 to 2014 are provided in tables E-5 and E-6, E-13, E-14, E-20, and E-21, appendix E. During these years, average effective doses have been relatively stable at around 2 mSv for both facilities. The maximum dose over these years has ranged from 7 mSv to 12 mSv for both facilities.

Figure 6-2: GEH-C Peterborough – effective dose trend for nuclear energy workers

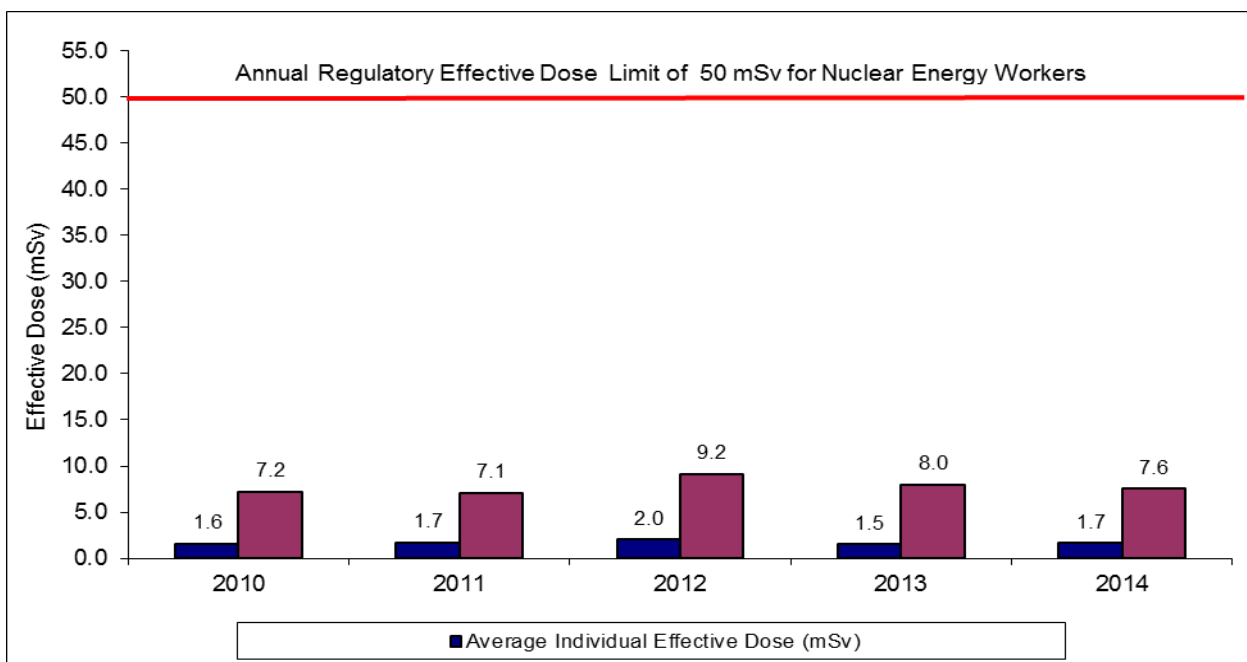
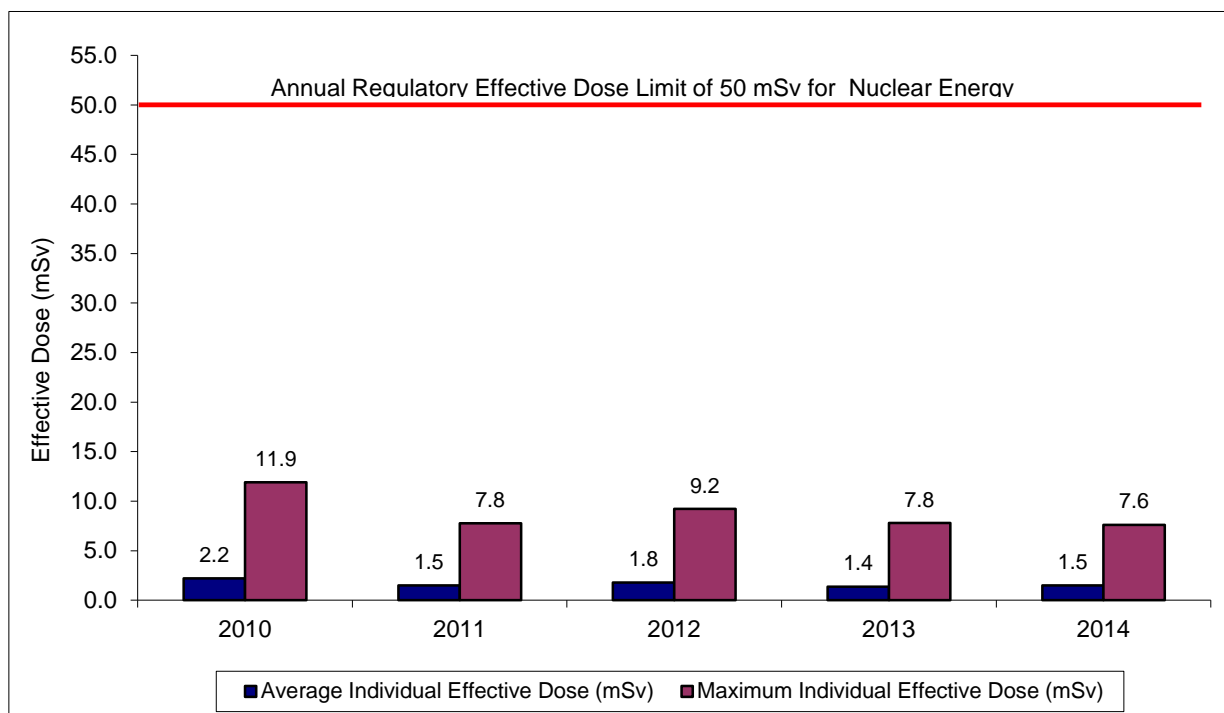


Figure 6-3: GEH-C Toronto – effective dose trend for nuclear energy workers



Radiation Protection Program Performance

Action levels for radiological exposures, urinalysis results and contamination control are established as part of the GEH-C RP program. If reached, it triggers GEH-C staff to establish the cause for reaching the action level and, if applicable, restore the effectiveness of the RP program. In 2014, there was one action level exceedance reported by GEH-C, pertaining to a quarterly whole body licensed dosimetry measurement of 6.24 mSv at the Peterborough facility, which was above the action level of 4 mSv per quarter. However, once the investigation into the incident concluded, it was determined that the action level was not exceeded and that the majority of the dose was non-personal and due to improper storage of the dosimeter in an area of elevated dose rate instead of the designated badge rack. A dose change request from 6.24 mSv to 0.9 mSv has since been approved by CNSC staff.

Radiological Hazard Control

Radiation contamination controls have been established at GEH-C to control and minimize the spread of radioactive contamination. Methods of contamination control include the use of a radiation zone control program and monitoring using surface contamination swipes to confirm the effectiveness of the program. In 2014, GEH-C increased the number of swipe locations in the unclassified areas at both facilities in order to better characterize and control contamination.

Estimated Dose to the Public

The 2010–2014 annual doses to the critical receptor are shown in the following table. The doses are for the Toronto facility. The Peterborough facility reported doses of 0.00000 mSv for 2012, 2013 and 2014. The public dose to the critical receptor is well below the CNSC regulatory dose limit for a member of the public of 1 mSv/year.

Maximum Effective Dose to a Member of the Public - Toronto						
Dose data	2010	2011	2012	2013	2014	Regulatory limit
Maximum effective dose (mSv)	0.0011*	0.0006*	0.0008	0.0004	0.0052**	1 mSv/year

* Prior to 2012, GEH-C did not report public dose results. Values reported here are based on CNSC staff calculations of GEH-C emissions for the DRL.

** Beginning in 2014, GEH-C Toronto implemented environmental gamma exposure monitoring using licensed dosimeters and began to include this result in the estimated annual public dose.

Maximum Effective Dose to a Member of the Public - Peterborough						
Dose data	2010	2011	2012	2013	2014	Regulatory limit
Maximum effective dose (mSv)	<0.00001*	<0.00001*	<0.00001	<0.00001	<0.00001	1 mSv/year

* Prior to 2012, GEH-C did not report public dose results. Values reported here are based on CNSC staff calculations of GEH-C emissions for the DRL.

6.3 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities. This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public

RATINGS FOR ENVIRONMENTAL PROTECTION				
Overall Compliance Rating				
2010	2011	2012	2013	2014
FS	FS	FS	FS	FS
<p>For 2014, CNSC staff continue to rate the environmental protection SCA at the GEH-C facilities as “fully satisfactory”.</p> <p>GEH-C warrants a fully satisfactory rating due to its industry leading practices related to emissions systems that ensure all uranium emissions from the facilities are controlled and monitored resulting in very low releases of uranium into the environment. In addition, hazardous substance releases from the GEH-C facilities to the environment continue to be controlled and monitored, in full compliance with the conditions of the operating licence and regulatory requirements.</p>				

Effluent and Emissions Control (Releases)

Atmospheric Emissions

To ensure compliance with licence limits, air from the GEH-C facilities is filtered and sampled prior to its release to the atmosphere. In 2014 the annual releases of uranium from the GEH-C facilities in Toronto and Peterborough were 0.006 kg and 0.000003 kg, respectively. GEH-C’s annual uranium emissions from the Toronto and Peterborough facilities from 2010 to 2014 are provided in table F-9 and table F-13, appendix F. The annual uranium emissions remained well below the licence limits for both facilities. A decrease in uranium releases at the Toronto facility in 2013–14 is due to implementation of new improvements to the air pollution control technology in 2012. The results demonstrate that air emissions of uranium are being controlled effectively at the GEH-C facilities. No action levels were exceeded at any time in 2014.

Liquid Effluent

To ensure compliance with licence limits, waste water from the GEH-C facilities is collected, filtered and sampled prior to its releases to the sanitary sewers in Toronto and Peterborough. In 2014, the annual release of uranium from the GEH-C Toronto and Peterborough facilities were 0.7 kg and 0.0001 kg, respectively. GEH-C’s annual uranium effluent releases from the GEH-C Toronto and Peterborough facilities for 2010 to 2014 are provided in table F-9 and table F-13, appendix F. In 2014, the releases continued to be well below the licence limit. The results demonstrate that liquid effluent releases are being controlled effectively at the GEH-C facilities. No action levels were exceeded at any time in 2014.

Environmental Management System (EMS)

GEH-C staff have developed and are maintaining an EMS in order to describe the integrated activities associated with the protection of the environment at the GEH-C facility. GEH-C's EMS is described in their Environmental Management Program Manual and includes activities such as establishing annual environmental objectives and targets, which are reviewed and assessed by CNSC staff through compliance verification activities.

GEH-C holds an annual safety meeting during which environmental protection issues are discussed. CNSC staff, as part of its compliance verification activities, reviews these minutes and follows up on any outstanding issues with GEH-C staff.

Assessment and Monitoring

Soil Monitoring

GEH-C conducts soil sampling at its Toronto facility as part of its environmental protection program. In 2013 and 2014, samples were taken from 49 locations and analyzed for uranium content. The samples were collected on the GEH-C site, on commercial property located along the south border of the site, and in the nearby residential neighbourhood. In 2014, the average soil concentration of uranium for residential locations was 0.6 µg/g, while the maximum concentration of uranium in soil for these locations was 2.1 µg/g. These values are well below the most restrictive CCME soil quality guidelines for uranium of 23 µg/g for residential and parkland land use. Soil sampling results are provided in tables F-11 and F-12, appendix F.

Uranium in Ambient Air

GEH-C Toronto operates five high-volume air samplers to measure the airborne concentrations of uranium at points of impingement of stack plumes. The results from these samplers show that the annual average concentration of uranium in ambient air measured around the facility in 2014 was 0.0006 µg/m³, well below the impending MOE standard for uranium in ambient air of 0.03 µg/m³. Air monitoring results for GEH-C Toronto are provided in tables F-9 and F-10, appendix F.

Protection of the Public

The licensee shall demonstrate that the health and safety of the public are protected from exposures to hazardous substances released from the facility. CNSC licensees are required to ensure that adequate provisions are made for protecting the health and safety of the public. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

CNSC receives reports of discharges to the environment through the reporting requirements outlined in the GEH-C licence and LCH. Review of hazardous (non-radiological) discharges to the environment for GEH-C in 2014 indicates that these discharges would not pose significant risks to the public or the environment during this period.

The programs at the GEH-C facility, as summarized in section 6.3 Environmental Protection above, indicate that the public continues to be protected from facility emissions.

6.4 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage non-radiological workplace safety hazards and to protect workers and equipment. This SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
FS	FS	SA	SA	SA
For 2014, CNSC staff continue to rate the conventional health and safety SCA at GEH-C as “satisfactory”.				

Performance

GEH-C has several key performance measures for this SCA with oversight maintained by the Workplace Safety Committee at each facility. For 2014, the Toronto facility reported one LTI. The Peterborough facility reported zero LTIs. CNSC requires the licensee to report an LTI as a reportable event. An LTI is an injury that takes place at work and results in the worker being unable to return to work and carry out their duties for a period of time. The one recorded LTI for GEH-C at its Toronto facility was due to a foot injury by an operator carrying fuel pellets (more details are provided in table G-2, appendix G). GEH-C performed a tap root analysis of the event to identify root causes and implemented corrective actions. CNSC staff are satisfied with the corrective actions in place and consider actions related to this event closed.

Table 6-1: Lost-time injuries (LTIs) for GEH-C – Toronto

	2010	2011	2012	2013	2014
Lost-time injuries	0	0	1	0	1

Table 6-2: Lost-time injuries (LTIs) for GEH-C – Peterborough

	2010	2011	2012	2013	2014
Lost-time injuries	1	0	0	0	0

Practices

GEH-C's activities and operations shall comply with the NSCA and its regulations and Part II of the *Canada Labour Code*. GEH-C maintains three committees under its Conventional Health and Safety Program, which include the Health and Safety Policy Committee, the Workplace Safety Committee (WSC) and the Ergonomics Committee. Each committee meets at least nine times annually to review facility performance with several KPIs identified and tracked on a regular basis. GEH-C's Health and Safety programs are also internally certified by GE corporate requirements, which include certifications such as GE Global Star site for Health and Safety program excellence. Internal certification ensures that a 21-element program is implemented that includes training, housekeeping, personal protective equipment, respirator, contractor safety, fall protection, electrical safety, hot work, cranes and hoists, and chemical management.

Awareness

In 2014, GEH-C conducted a total of 40 self-inspections and investigations at its Toronto facility and a total of 65 self-inspections and investigation at its Peterborough facility. Such self-assessments help to ensure compliance and continuous improvement of its conventional health and safety program. The top five categories from these inspections were chemical, equipment, housekeeping, radiation and unsafe conditions. CNSC staff will continue to monitor the effectiveness of these improvement initiatives through onsite inspections.

PART II: NUCLEAR SUBSTANCE PROCESSING FACILITIES

7 OVERVIEW

Part II of this report deals with three nuclear substance processing facilities located in Ontario:

- SRB Technologies (Canada) Incorporated (SRB), in Pembroke, ON
- Nordion (Canada) Inc. (Nordion), in Ottawa, ON
- Best Theratronics Limited (BTL), in Ottawa, ON

The operating licences for both SRB and Nordion are scheduled for renewal in 2015. Licence renewal applications were received from SRB and Nordion in 2014 to provide CNSC staff with a suitable review period. The licensing hearing was completed in May 14, 2015 for SRB, and in August 2015 for Nordion.

The BTL Class 1B licence was issued in July 2014 after a Commission hearing held on May 8, 2014. BTL manufactures medical equipment including cobalt-60 (Co60) radiation cancer treatment units, as well as caesium-137 (Cs137) blood irradiators under this licence.

CNSC staff provided consistent and risk informed regulatory oversight at nuclear substance processing facilities in 2014. The table below presents the licensing and compliance effort from CNSC staff for nuclear substance processing facilities during 2014.

Table 7-1: CNSC regulatory oversight licensing and compliance activities for nuclear substance processing facilities in 2014

	SRB	Nordion	BTL
Number of inspections	1	3	1**
Person days for compliance	142	115	21
Person days for licensing activities	118	123	213

**note BTL received its current licence in July 2014. This inspection was performed under its previous Nuclear Substance and Radiation Device Licence (14127-1-14.0). The first inspection under the new licence was in March 2015 and is not reported here.

For 2014, CNSC staff performed three inspections at Nordion, one inspection at SRB, and one inspection at BTL. All issues identified during these inspections were minor deficiencies and have been addressed by the licensees.

CNSC staff used annual compliance reports, revisions to licensee's programs, and licensee's responses to events and incidents, as well as field observations during inspections, to compile the 2014 performance ratings for the nuclear substance processing facilities, as presented in table 7-2.

Licensees are also required to submit annual reports on the operations of their facilities by March 31 of each year. The reports contain all environmental, radiological and safety-related information, including events and associated corrective actions taken.

The full versions of these reports are available on the licensees' websites and are provided in appendix H.

Figure 7-1: Location of nuclear substance processing facilities in Ontario, Canada



CNSC staff rated most SCAs for SRB, BTL and Nordion as “satisfactory”, with the exception of the conventional health and safety and fitness for service for SRB rated as “fully satisfactory”, and environmental protection and security rated as “fully satisfactory” for Nordion. The 2014 performance ratings for the nuclear substance processing facilities are presented in table 7-2.

Table 7-2: Nuclear substance processing facilities – SCA performance ratings, 2014

Safety and control area	SRB Technologies Inc.	Nordion (Canada) Inc.	Best Theratronics
Management system	SA	SA	SA
Human performance management	SA	SA	SA
Operating performance	SA	SA	SA
Safety analysis	SA	SA	SA
Physical design	SA	SA	SA
Fitness for service	FS	SA	SA
Radiation protection	SA	SA	SA
Conventional health and safety	FS	SA	SA
Environmental protection	SA	FS	SA
Emergency management and fire protection	SA	SA	SA
Waste management	SA	SA	SA
Security	SA	FS	SA
Safeguards	N/A	SA	SA
Packaging and transport	SA	SA	SA

7.1 Radiation Protection

The *Radiation Protection Regulations* require each licensee to implement a radiation protection program that keeps radiation doses ALARA, social and economic factors taken into consideration. The *Radiation Protection Regulations* also require licensees to ascertain dose as a result of the licensed activity. This includes effective dose and equivalent dose. Effective dose refers to the sum of all radiation exposures, internal and external, to the whole body. Equivalent dose is a measure of dose to a tissue or an organ (such as the skin, extremities and lens of the eye).

Radiological exposures to workers at SRB primarily result from inhalation, ingestion or skin absorption of tritium. Consequently, internal doses are ascertained by a urine bioassay.

Radiological exposures to workers at BTL primarily result from exposure to sealed sources in shielded containers. There is a potential for contamination during depleted uranium handling tasks but the potential is low. BTL ascertains external doses using whole body and extremity dosimetry.

Nordion's workers may be exposed to alpha, beta and gamma radiation emitted from the radioisotopes processed for medical diagnostic and radiopharmaceuticals, the production of sealed sources for industrial applications, and medical therapy. Nordion ascertains external doses using whole body and extremity dosimetry. For internal radiological exposures, Nordion has a bioassay program for routine thyroid monitoring of workers working with iodine-125 and iodine-131. There are also provisions for the whole body counting or urine analysis if elevated air and/or contamination monitoring indicate a need.

CNSC staff evaluate each licensee's radiation protection program through several methods, including desktop reviews, inspections and review of licensee annual compliance reports.

Nordion, BTL, and SRB have implemented and continue to maintain radiation protection programs to control the radiological hazards present in their facilities, and have ascertained and recorded doses for each worker performing duties in connection with their licensed activities. In 2014, no radiation exposures reported exceeded the regulatory dose limit of 50 mSv in a one-year dosimetry period.

CNSC staff reviewed licensee dose data, provided in appendix E, and are satisfied that the nuclear substance processing facilities are adequately controlling radiation doses to levels well below the regulatory limits and keeping doses in accordance with the ALARA principle.

Protection of the Public

The licensee is required to demonstrate and ensure that adequate provisions are made for protecting the health and safety of the public from exposures to hazardous substances released from the facility. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that any releases of hazardous substances do not result in environmental concentrations that may affect public health.

CNSC staff receives reports of discharges to the environment through the reporting requirements outlined in the Nordion licence and the SRB LCH. BTL's activities involve the use of sealed sources; therefore, there are no discharges to the environment as a result of its activities. The review of hazardous (non-radiological) discharges to the environment indicate that no significant risks to the public or environment have occurred during this period.

The programs, as summarized above, indicate that the public continues to be protected from facility emissions from all nuclear substance processing facilities. Nordion, BTL and SRB maintain estimated doses to the public well below 1 mSv in a one year period.

7.2 Environmental Protection

The environmental protection SCA covers programs that identify and monitor all releases of nuclear and hazardous substances as a result of licensed activities and their effects on the environment. Licensees are required to develop and implement policies, programs and procedures that comply with all applicable federal and provincial regulatory requirements, to control the release of radioactive and hazardous substances into the environment, and to protect the environment. Licensees are also expected to have suitably trained and qualified staff to effectively develop, implement and maintain their environmental protection programs. There were no exceedances of licence limits for any nuclear substance processing facilities in 2014.

7.3 Conventional Health and Safety

The regulation of conventional health and safety at these facilities involves ESDC and the CNSC. CNSC staff monitor compliance with CNSC regulatory reporting requirements. On occasion, when a concern is identified, ESDC staff are consulted and asked to take appropriate action. The licensees submit hazardous occurrence investigation reports to both ESDC and the CNSC, in accordance with their respective reporting requirements.

Licensees are required to report unsafe occurrences to the CNSC as directed by section 29 of the *General Nuclear Safety and Control Regulation*. These reports include serious illness or injury incurred or possibly incurred as a result of licensed activity. The number of recordable LTIs reported by all facilities has remained low from 2010 to 2014.

CNSC staff conclude that the nuclear substance processing facility licensees' programs related to the conventional health and safety SCA were effective in protecting the health and safety of persons working in those facilities.

Table 7-3: Nuclear substance processing facilities lost-time incidents (LTIs), 2010–2014

Facility	2010	2011	2012	2013	2014
SRB	0	1	0	0	0
Nordion	2	0	0	1	3
BTL					1

7.4 Public Information and Disclosure Programs

In 2014, SRB successfully revised its public information program to reflect the new requirements of RD/GD 99.3 *Public Information and Disclosure*. Through its program and disclosure protocol, SRB is keeping stakeholders informed about its activities and disclosing information of public interest. SRB's communications activities in 2014 included numerous facility tours, a presentation to Pembroke city council about the facility and the licensing process, a revamped website, a news release concerning their licensing hearing in May 2015, and distribution of an information brochure and public opinion survey to those living and working near the facility.

Nordion has also successfully revised its public information program to reflect the new requirements of RD/GD 99.3 *Public Information and Disclosure*. Nordion's program and disclosure protocol is keeping stakeholders informed about the facility's activities and disclosing information of public interest. Nordion's communications activities in 2014 included placing advertisements in the local community newspaper, updating its website, and hosting a public information session called Nordion's Community Café. Nordion also used its Twitter and Facebook accounts to inform and engage target audiences, and launched a public opinion survey.

As part of its re-licensing process in 2014, BTL submitted a public information and disclosure program that complies with the requirements of RD/GD 99.3 *Public Information and Disclosure*. BTL has engaged the public through open houses, facility tours, an updated website with current information about its operations and postings about its public disclosure protocol.

8 SRB TECHNOLOGIES (CANADA) INCORPORATED

SRB Technologies (Canada) Incorporated is a gaseous tritium light source manufacturing facility located in Pembroke, ON, approximately 150 km northwest of Ottawa.

Figure 8-1: Aerial view of SRB, Pembroke, ON



The facility has been in operation since 1990. It processes tritium gas to produce gaseous tritium light sources (GTLS) and manufactures radiation devices containing the GTLS.

Figure 8-2: GTLS sign produced at SRB



In 2014, SRB's staff increased from 36 to 43; this includes new staff with varied relevant experience. SRB's quality manual, waste management program, licence limits, action levels and administrative limits, and EMS objectives and targets were all revised in 2014. SRB has started work on updating its training program in 2014 to address CNSC REGDOC-2.2.2, *Personnel Training*. Completion is expected in 2015.

8.1 Performance

For 2014, CNSC staff rated SRB's performance as "fully satisfactory" in the conventional health and safety and fitness for service SCAs, and "satisfactory" in all other SCAs.

In 2014, SRB processed a total of 28,714,118 GBq of tritium, and approximately 1,100 shipments of GTLS products were produced and shipped out. SRB received 20,363 expired signs in 2014. The GTLS from the expired signs were re-used or packaged, secured and sent to a Canadian Nuclear Laboratories (CNL) licensed waste management facility, located in Chalk River, ON.

There was one action level exceedance in 2014. The release occurred between October 28 and November 4, and represents 3.7% of the annual release limit for total tritium. This is further described in section 8.3 in the Effluent and Emissions Control section.

8.2 Radiation Protection

RATINGS FOR RADIATION PROTECTION				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continue to rate the radiation protection SCA at SRB as "satisfactory". SRB has implemented and maintained a radiation protection program as required by the <i>Radiation Protection Regulations</i> .				

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

In 2014, CNSC staff rated SRB's radiation protection SCA as "satisfactory".

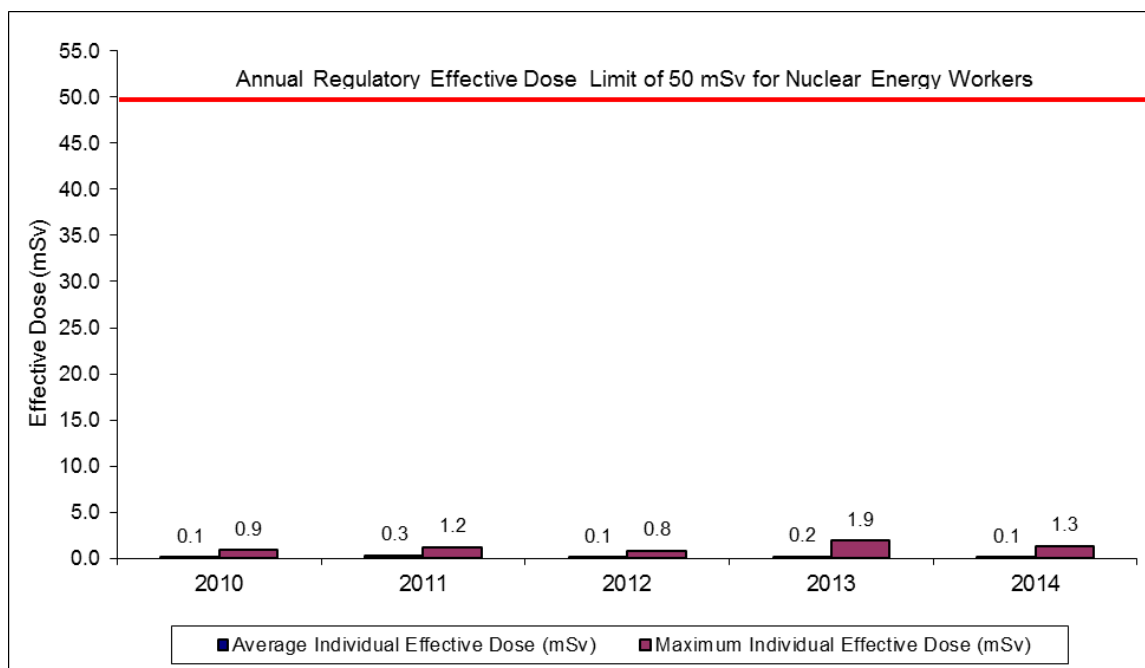
Application of ALARA

As required by the *Radiation Protection Regulations*, SRB continued to implement radiation protection (RP) measures in 2014 to keep radiation exposures and doses to persons ALARA, taking into account social and economic factors. Annually, SRB establishes RP Program improvements and the Health Physics Committee meets regularly to discuss various aspects of the radiation protection program including worker doses, radiological hazard monitoring results and internal audit results. The Committee also sets annual ALARA targets for the average and maximum effective doses to workers, to continuously work towards reducing workers doses even though production increases are expected and doses are already very low. In 2014, SRB met its established occupational dose target.

Worker Dose Control

At SRB, all employees are classified as NEWs. All contractors are classified non-NEWs. Radiation exposures are monitored to ensure compliance with CNSC regulatory dose limits and to maintain radiation doses ALARA. In 2014, no worker's radiation exposure reported by SRB exceeded CNSC regulatory dose limits. The maximum effective dose received by a worker in 2014 was 1.29 mSv, or approximately 3 per cent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. Annual average and maximum effective dose results from 2010 to 2014 are provided in table E-8, appendix E. During these years, average doses have been relatively stable, ranging between 0.10 mSv to 0.25 mSv. The maximum dose over these years ranged from 0.80 mSv to 1.93 mSv.

Figure 8-3: SRB – effective dose trend for nuclear energy workers



Radiation Protection Program Performance

Action levels for effective doses to workers and urine bioassay are established as part of the SRB's RP program. If reached, SRB must establish the cause and, if applicable, restore the effectiveness of the RP program. There were no action level exceedances reported by SRB in 2014.

Radiological Hazard Control

Contamination controls have been established at SRB to control and minimize the spread of radioactive contamination. Methods of contamination control include the use of a radiation zone control program and monitoring of surface and airborne tritium concentrations to confirm the effectiveness of the program. In 2014, SRB reviewed and made improvements to its surface contamination monitoring procedures to ensure that sampling locations are representative of actual and changing conditions in the facility.

Estimated Dose to the Public

The 2009 to 2014 annual doses to the critical receptor are shown in the following table. In 2014, the public dose to the critical receptor is well below the regulatory dose limit for a member of the public.

Maximum Effective Dose to a Member of the Public						
Dose data	2010	2011	2012	2013	2014	Regulatory limit
Maximum effective dose (mSv)	0.0050	0.0050	0.0049	0.0068	0.0067	1 mSv/year

8.3 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities. This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public

RATINGS FOR ENVIRONMENTAL PROTECTION				
Overall Compliance Rating				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
<p>For 2014, CNSC staff continue to rate the environmental protection SCA at SRB as “satisfactory”. SRB’s radioactive releases continue to be effectively controlled and consistently well below the release limits prescribed in its operating licence. There were no releases of hazardous substances (non-radiological) to the environment from SRB that would pose a risk to the public or environment. SRB continues to maintain an environmental monitoring program. The principal monitoring activities focus on monitoring the air and groundwater around the facility. The program provides data for estimates of annual dose to the public. The calculated maximum dose to a member of the public from licensed activities remains very low; approximately 0.7% of the public dose limit of 1 mSv/year.</p>				

Effluent and Emissions Control (Releases)

Atmospheric Emissions

SRB’s releases to the atmosphere continue to be effectively controlled and are consistently well below the release limits prescribed in its operating licence. This information is provided in appendix F.

The relative increase in total tritium released to air between 2012 (29.9 TBq) and 2013 (78.9 TBq) is due to a three-fold increase in tritium processing at SRB (10,224 TBq/year and 30,544 TBq/year) during the same period. Nevertheless, calculated maximum dose to a member of the public from licensed activities remains very low, approximately 0.7% of the public dose limit of 1 mSv/year as discussed in the radiation protection SCA, section 3.2.2. See table F-14, appendix F for SRB atmospheric emission monitoring results, 2010–2014.

There was a gaseous tritium action level exceedance of the weekly action level for total tritium of 7.75 TBq from October 28 to November 4 2014. The release represents 3.7% of the annual release limit for total tritium. SRB conducted an investigation into this exceedance to identify contributing causes and root causes. SRB's investigation concluded that the higher tritium emissions were related to a gaseous tritium light source leakage and a manifold gauge leak. CNSC staff reviewed SRB's investigation report and proposed corrective actions and found both to be acceptable.

Liquid Effluent

SRB continues to monitor and control tritium released as liquid effluent from the facility. The monitoring data for 2010 through 2014, provided in table F-15, appendix F, demonstrate that liquid effluent from the facility continues to be effectively controlled and that tritium releases are consistently well below the licence limit.

Environmental Management System

SRB continues to maintain an EMS that describes the integrated activities associated with the protection of the environment at the facility. SRB's EMS includes activities such as establishing annual environmental objectives and targets that are reviewed and assessed by CNSC staff through compliance verification activities. SRB staff holds an annual safety meeting during which environmental protection issues are discussed. CNSC staff, as part of their compliance verification activities, review the minutes of these meetings and follow up on any outstanding issues with SRB's staff.

Assessment and Monitoring

SRB's radiological environmental monitoring program serves to demonstrate that the site emissions of nuclear materials are properly controlled. The program provides data for estimates of annual dose to the public, and ensures public dose is in compliance with the regulatory dose limit and doses are ALARA. The principal monitoring activities, described below, are focused on monitoring the air and groundwater around the facility.

Air Monitoring

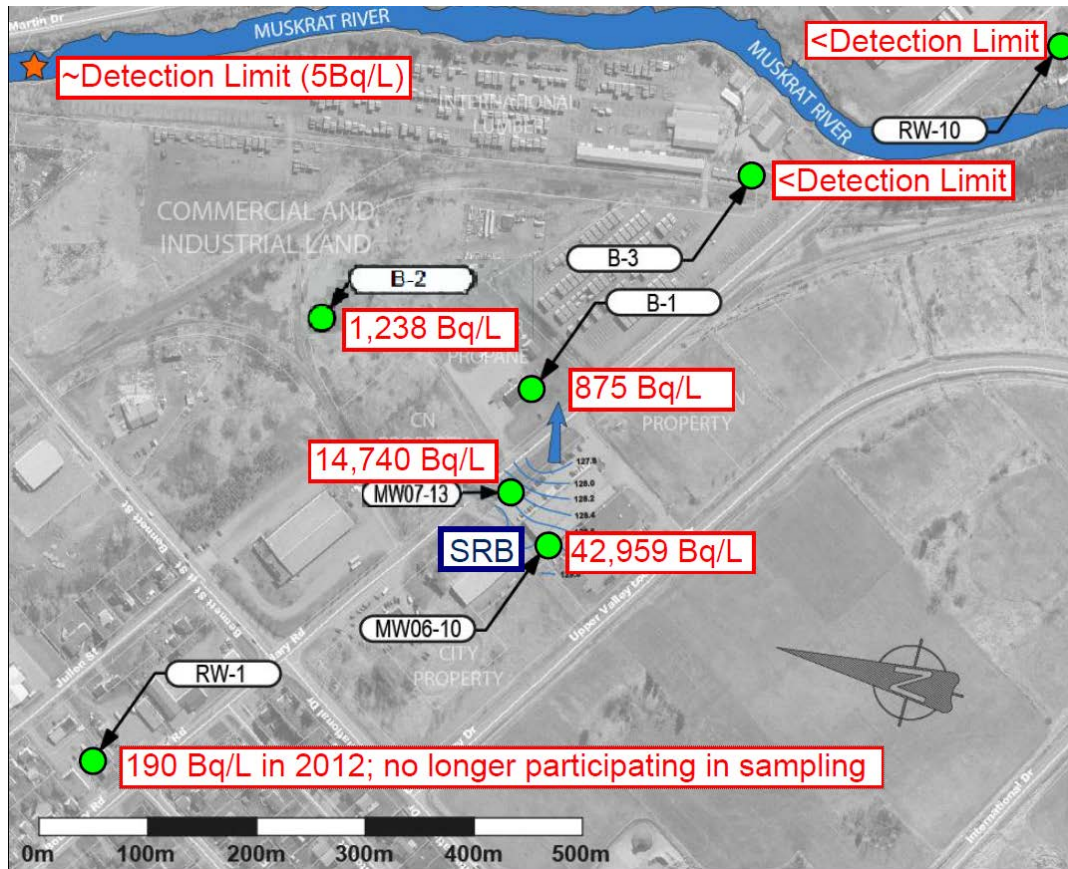
SRB has a total of 40 passive air samplers located within a two-kilometre radius of the facility. The passive air samplers represent tritium exposure pathways for inhalation and skin absorption and are used in the calculations to determine public dose. The samples are collected and analyzed by a qualified third-party laboratory. The results from these samplers demonstrate that tritium levels in air are low which is consistent with the atmospheric emissions measured in 2014 that are well below SRB's licence limits. Air monitoring confirms that public exposure to tritium is very low.

Groundwater Monitoring

Groundwater is currently sampled in 46 monitoring wells, including 11 residential wells. The highest tritium concentration was found in well MW06-10, which is located near the SRB stacks, averaging 42,959 Bq/L in 2014. At the end of 2014, only two wells showed tritium concentrations above 7,000 Bq/L. These values are restricted to a small area adjacent to the SRB building and none of them are used for drinking water. Tritium concentrations decrease significantly at locations further away from SRB.

Figure 8-4 shows examples of the spatial distribution of annual average tritium concentrations in groundwater in the area in 2014. The blue lines are the interpreted groundwater table contours near the SRB facility. The blue arrow indicates the general groundwater flow direction.

Figure 8-4: 2014 annual average tritium concentrations in groundwater



Since 2010, SRB has conducted a groundwater study, which confirmed that the residential wells (with highest tritium concentration of 217 Bq/L for 2014) and the Muskrat River (with tritium concentrations below the minimum detection limit, 5 Bq/L, for 2014) are not at risk of exceeding the Ontario Drinking Water Quality Standard of 7,000 Bq/L. The highest tritium concentration in a potential drinking water well was found in business well B-2, averaging 1,238 Bq/L in 2014. SRB continues to provide bottled drinking water to the business, even though the tritium concentrations were well below the Ontario drinking water standard.

CNSC staff's independent modeling assessment in 2010 was in agreement with SRB's conclusion that the elevated tritium concentrations at MW06-10 is mainly caused by high tritium concentrations in the soil due to historical practices. Overall, CNSC staff conclude that the tritium inventory in the groundwater system around the facility has been decreasing since 2006.

Other Monitoring

SRB engages a qualified third party to perform monitoring and analysis of precipitation, runoff, surface water, produce, milk and wine. This monitoring complements the principal monitoring activities, which focus on air and groundwater.

In 2013 and 2014, CNSC staff collected and analyzed a number of environmental samples in publicly accessible areas outside the perimeter of the facility under the CNSC's Independent Environmental Monitoring Program (IEMP). Results obtained by the CNSC are consistent with SRB's third party results and confirm that the public and the environment in the vicinity of SRB are protected from the releases from the facility.

Protection of the Public

The licensee shall demonstrate that adequate provisions are made for protecting the health and safety of the public from exposures to hazardous substances released from the facility.

There were no releases of hazardous substances (non-radiological) to the environment in 2014 from SRB that would pose a risk to the public or environment.

The programs at the SRB facility, as summarized in section 8.3 Environmental Protection, indicate that the public continues to be protected from facility emissions.

8.4 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers and equipment. This SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	SA	FS	FS	FS
For 2014, CNSC staff rate the conventional health and safety SCA at SRB as “fully satisfactory”. Overall, the compliance verification activities conducted at SRB confirm that SRB continues to view conventional health and safety as an important consideration. SRB has demonstrated the ability to keep their workers safe from occupational injuries.				

Performance

A key performance measure for this SCA is the number of LTIs that occur per year. An LTI is an injury that takes place at work, and results in the worker being unable to return to work and carry out their duties for a period of time. As per table 8-1, the number of LTIs remains zero in 2014.

Table 8-1: Lost-time injuries (LTIs) at SRB, 2010–2014.

	2010	2011	2012	2013	2014
Lost-time injuries	0	1	0	0	0

Practices

In addition to the NSCA and its associated regulations, SRB’s activities and operations must comply with Part II of the *Canada Labour Code*. As such, SRB is required to report to ESDC incidents resulting in an injury.

SRB has a Workplace Health and Safety Committee (WHSC) that inspects the workplace and meets monthly to resolve and track any safety issues. In 2014 the committee added two more members; one management representative and one worker representative. SRB’s WHSC met 17 times in 2014. CNSC staff frequently review the WHSC monthly meeting minutes and associated corrective actions to ensure issues are promptly resolved.

Awareness

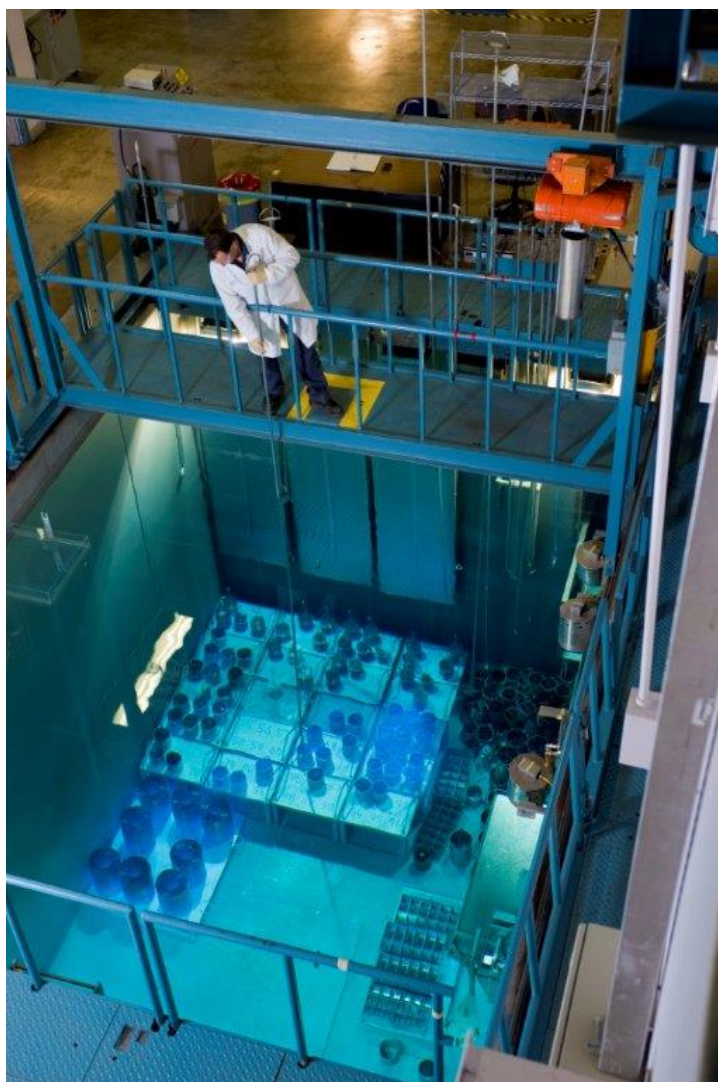
SRB continues to maintain a comprehensive conventional health and safety program. CNSC staff will continue to monitor the effectiveness of this program through future inspections.

9 NORDION (CANADA) INC.

Nordion (Canada) Inc. (Nordion), located adjacent to industrial and residential property in Ottawa, ON, is licensed to operate a Class IB nuclear substance processing facility.

At this facility, Nordion processes unsealed radioisotopes, such as iodine-131, for the health and life sciences, and manufactures sealed radiation sources for industrial applications. Nordion was acquired by STHI Holding Corp. (Sterigenics) in 2014, and the operating licence was transferred to Nordion (Canada) Inc. with a new corporate number. Nordion did not have a licence conditions handbook (LCH) in 2014. Nordion's application to renew the Class IB nuclear substance processing facility operating licence will have been heard by the Commission in August 2015. CNSC staff has prepared an LCH to accompany the licence.

Figure 9-1: Nordion employee working above a cobalt storage pool



9.1 Performance

CNSC staff rated all of Nordion's SCAs as "satisfactory" for the year 2014, with the exception of environmental protection, and security, which were rated as "fully satisfactory". The Nordion facility ratings for 2010 to 2014 are provided in table C-6, appendix C. The rating for conventional health and safety was lowered in 2014 to "satisfactory" from "fully satisfactory". The rating decreased to "satisfactory" in 2014 due to three lost-time injuries resulting in back injuries, for a total of 18 days of lost time. This indicated a need for improvement.

For 2014, the facility operated according to the original design and no physical design changes were made to any of its structural areas. Nordion made several improvements to the radiation protection program, conventional health and safety program, environmental protection program, emergency management program and fire protection program. Nordion continued to implement its SAT program for safety-related positions.

There were no instances in which there was potential to exceed a regulatory limit or to reach or exceed an action level in 2014. All measurable doses received by workers and the public were within the regulatory limits and no internal dose levels or limits were exceeded.

As part of its public information and disclosure program, Nordion hosted a public awareness information session to explain the facility and operations and to obtain stakeholder feedback. In November 2014, Nordion applied for renewal of its operating licence. The public hearing was held in August 2015.

9.2 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

RATINGS FOR RADIATION PROTECTION				
Overall Compliance Rating				
2010	2011	2012	2013	2014
SA	SA	SA	SA	SA
For 2014, CNSC staff continued to rate the radiation protection SCA at Nordion as “satisfactory”. Nordion has implemented and maintained a radiation protection program as required by the <i>Radiation Protection Regulations</i> .				

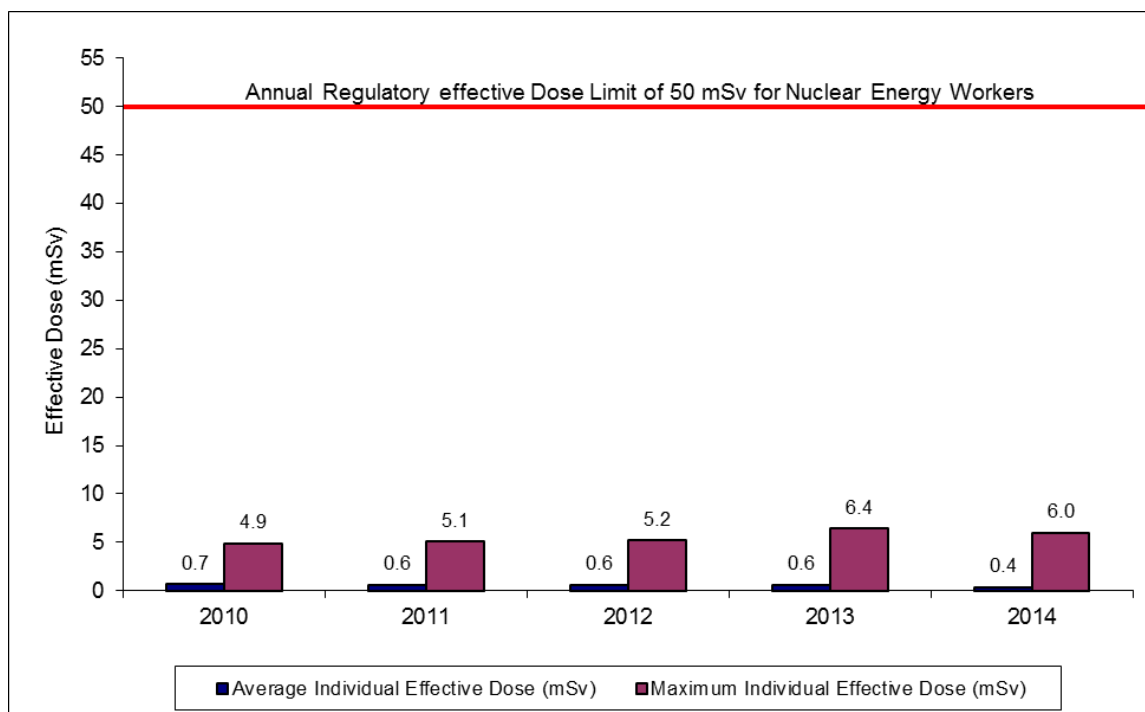
Application of ALARA

As required by the *Radiation Protection Regulations*, Nordion continued to implement radiation protection (RP) measures in 2014 to keep radiation exposures and doses to persons ALARA, taking into account social and economic factors. Annually, Nordion establishes RP program improvements and the Environmental Health and Safety Committee meets regularly to discuss various aspects of the radiation protection program including worker doses, radiological hazard monitoring results and internal audit results. The Committee also sets annual performance targets to maintain doses to workers ALARA. Nordion met their established occupational dose targets over the reporting period.

Worker Dose Control

At Nordion, all employees whose work may result in a dose in excess of 1 mSv are classified as NEWs. All contractors are classified non-NEWs. Radiation exposures are monitored to ensure compliance with CNSC regulatory dose limits and to maintain radiation doses ALARA. In 2014, no worker’s radiation exposure reported by Nordion exceeded CNSC regulatory dose limits. The maximum effective dose received by a worker in 2014 was 6.0 mSv, or approximately 12 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. Annual average and maximum effective and equivalent dose results from 2010 to 2014 are provided in tables E-9, E-15, and E-22, appendix E. During these years, average doses have been relatively stable at approximately 0.4 mSv. The maximum dose over these years ranged from 4.9 mSv to 6.4 mSv.

Figure 9-2: Nordion – effective dose trend for nuclear energy workers



Radiation Protection Program Performance

Action levels for effective doses to workers are established as part of Nordion's RP program. If reached, Nordion must establish the cause and, if applicable, restore the effectiveness of the RP program. There were no action level exceedances reported by Nordion during the reporting period.

Radiological Hazard Control

Radiation and contamination control programs have been established at Nordion to control and minimize radiological hazards and the spread of radioactive contamination. Methods of control include radiological zone controls and monitoring to confirm the effectiveness of the program.

Estimated Dose to the Public

The 2010 to 2014 maximum effective doses to a member of the public are shown in the following table. In 2014, the public dose to a member of the public is well below CNSC regulatory dose limit for a member of the public of 1 mSv/yr.

Maximum Effective Dose To a Member of the Public						
Dose data	2010	2011	2012	2013	2014	Regulatory limit
Maximum effective dose (mSv)	0.006	0.015	0.020	0.022	0.010	1 mSv/year

* The dose to the public was calculated using the % of Derived Release Limits for air emissions and liquid effluent releases. It is not based on environmental monitoring results.

9.3 Environmental Protection

The Environmental Protection SCA covers programs that identify, control and monitor all releases of nuclear and hazardous (non-radiological) substances and effects on the environment from facilities or as the result of licensed activities. This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public

TRENDS FOR ENVIRONMENTAL PROTECTION				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	FS	FS	FS	FS
<p>For 2014, CNSC staff continue to rate the environmental protection SCA at Nordion as “fully satisfactory”.</p> <p>Nordion continues to implement and maintain an effective environmental protection program to control and monitor gaseous and liquid releases of radioactive substances from the facility into the environment. For the last five years, the gaseous emissions and liquid effluents were well below the derived release limits (DRLs) and no action levels were exceeded. Groundwater monitoring, soil sampling and gamma exposure measurements indicate that the public and the environment continue to be protected from facility releases.</p>				

Effluent and Emissions Control (Releases)

CNSC licensees are required to develop and implement policies, programs and procedures that comply with all applicable federal and provincial regulatory requirements, to control the release of radioactive and hazardous substances into the environment, and to protect the environment. Licensees are also expected to have suitably trained and qualified staff to effectively develop, implement and maintain their environmental protection programs.

Atmospheric Emissions

Nordion continues to monitor and control the releases of radioactive materials from the facility. The radiological air emissions from the facility in 2014 continued to be effectively controlled and are consistently well below the DRLs prescribed in its operating licence. No action levels were exceeded at any time in 2014. See table F-16, appendix F for Nordion radiological air emissions monitoring results, for the period 2010 to 2014.

In 2007, Nordion began monitoring three additional radiological atmospheric parameters including carbon-14 gas, Xenon-135, and Xenon-135m. Nordion recently submitted a revised version of the “Derived Release Limits” document for review by CNSC staff to align with the new Canadian Standard Association (CSA) standard N288.1-08. Pending acceptance by CNSC staff, updated DRLs for all radiological atmospheric parameters will be included in Nordion’s LCH.

Liquid Effluent

Nordion continues to monitor all liquid effluent releases prior to discharging them into the municipal sewer system. The monitoring data provided in table F-17, appendix F show that the radiological liquid effluent releases from the facility in 2014 continued to be effectively controlled and that releases are consistently well below the DRLs prescribed in its operating licence. No action levels were exceeded at any time in 2014. See appendix F for Nordion radiological liquid effluent monitoring results, 2010-2014.

Environmental Management System

Nordion has developed and maintains an EMS to describe the integrated activities associated with the protection of the environment at the facility. Nordion’s EMS is described in their EMS manual and includes activities such as establishing annual environmental objectives and targets, which are reviewed and assessed by CNSC staff through compliance verification activities.

The EMS is verified through Nordion’s annual management review, which involves the evaluation of actions from the previous meeting, the Environmental Health & Safety Policy, adequacy of resources, environmental health and safety objectives and targets, changing circumstances and recommendations for improvement. CNSC staff, as part of their compliance verification activities, review the results of the annual review and follows up with Nordion staff on any outstanding issues.

Assessment and Monitoring

Nordion conducts groundwater monitoring and soil sampling, and monitors environmental gamma radiation using thermoluminescent dosimeters (TLD) deployed on and offsite to demonstrate that emissions from the facility do not pose risks to the public health and to the environment. The monitoring results since 2010 are further described below.

Groundwater Monitoring

Currently, a total of nine monitoring wells exist around the Nordion site. Four of the wells are sampled for non-radiological parameters, and the other five wells are sampled for radiological parameters.

Nordion has been monitoring groundwater for hazardous substances such as ammonia, nitrate, dissolved organic carbon, total dissolved solids, iron and total petroleum hydrocarbons since 2005. The monitoring is done at least once per year to ensure that there are no significant changes in results relative to 2005. For 2010 through 2014, the monitoring results showed that there were no significant changes for concentrations of hazardous substances in the ground water relative to 2005, which were actually all near the background levels or the detection limit.

Nordion began radiological sampling for groundwater in 2013. The 2013 and 2014 results showed that only naturally occurring radionuclides were detected, and these are not processed at the Nordion facility. The results indicate that releases of nuclear and hazardous substances from Nordion's facility have had no measurable impact on groundwater quality.

Soil Sampling

Nordion conducts soil sampling every two years to monitor concentrations of radiological constituents in the soil. Soil sampling was performed in 2012 and 2014, and no nuclear substances attributable to Nordion licensed activities were detected.

Environmental TLD Program

Nordion monitors environmental gamma radiation using TLDs. The TLDs are deployed at locations 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 annual monitoring results showed the levels of gamma radiation at those monitoring locations are in the range of natural background. The results indicated that it is highly unlikely that Nordion is contributing significantly to dose at – and beyond – the perimeter of the facility.

Protection of the Public

The licensee shall demonstrate that the health and safety of the public are protected from exposures to hazardous substances released from the facility. There are no releases of non-radiological hazardous substances to the environment from Nordion that would pose a risk to the public or environment.

The programs at Nordion, as summarized in section 9.3 Environmental Protection, indicate that the public continues to be protected from facility emissions.

9.4 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers and equipment. This SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2010	2011	2012	2013	2014
SA	FS	FS	FS	SA
<p>For 2014, CNSC staff rate the conventional health and safety SCA at Nordion as “satisfactory”. The rating was lowered from “fully satisfactory” to “satisfactory” for 2014 due to the increase in lost time injuries. Compliance verification activities confirm Nordion continues to view conventional health and safety as an important consideration for all activities.</p>				

Performance

A key performance measure for this SCA is the number of LTIs that occur per year. An LTI is an injury that takes place at work and results in the worker being unable to return to work to carry out their duties for a period of time. As per table 9-3, there were three LTIs at Nordion in 2014. The injuries resulted in 18 days of lost time. Details are provided in table G-3, appendix G. There were also five injuries involving medical treatment, but no time lost.

Table 9-3: Lost-time injuries (LTI) at Nordion, 2010–2014

	2010	2011	2012	2013	2014
Lost-time injuries	2	0	0	1	3

Practices

In addition to complying with the NSCA and its regulations, Nordion’s activities and operations must also comply with Part II of the *Canada Labour Code*. Nordion’s conventional health and safety program is under the oversight of the Workplace Safety Committee, which met nine times in 2014. The Health and Safety Policy Committee met five times in 2014. Nordion continues to develop and maintain a comprehensive conventional health and safety management program. As operational ergonomics are important to their operations, the Policy Committee has made ergonomics a standing agenda item at each of their meetings.

Awareness

Nordion continues to develop and maintain a comprehensive conventional health and safety management program. Nordion sets EHS objectives yearly, including targets for occupational incidents and LTIs. In 2014, the number of occupational incidents (eight) was above Nordion's Environment, Health and Safety (EHS) target of six. The majority of the incidents were back injuries and/or ergonomics related. As a result, Nordion updated the Back Safety Training and began its delivery in 2015. Additional initiatives focusing on back safety are planned for fiscal year 2015.

In 2014, Nordion made several additional improvements to the conventional health and safety program, including improvement initiatives for near-miss event reporting and improvement to their crane safety program.

10 BEST THERATRONICS

BTL owns and operates a facility in Ottawa under a Class 1B operating licence that expires in 2019. The BTL Class 1B licence was issued in July 2014 after a Commission hearing held on May 8, 2014. BTL was issued a Class 1B licence to manufacture and test cyclotrons over 1 MeV, as well as to consolidate three of the existing CNSC licences it held for development and testing Class II equipment, storage and device manufacturing. BTL manufactures medical equipment including cobalt-60 (Co60) radiation cancer treatment units, as well as caesium-137 (Cs137) blood irradiators. Licensed activities include operation of a cyclotron(s)/accelerator, a nuclear substance processing facility, and a radioactive source teletherapy machine.

Figure 10-1: Image of a radiation cancer treatment unit (a cobalt-60 teletherapy unit) manufactured by Best Theratronics Ltd.



There has been one licence amendment since the licence was issued in July 2014. BTL's LCH (LCH-Best-BTL-R001) was also revised to reflect a new date for implementing its financial guarantee. The LCH was later revised to include a funding schedule for the financial guarantee.

10.1 Performance

For 2014, CNSC staff rated BTL's performance as "satisfactory" in all SCAs. The BTL facility ratings from 2014 are provided in table C-7, appendix C. BTL had no changes in operations, organization or operating policies in 2014.

There were no reportable action level exceedances in 2014. There was one lost-time injury in 2014.

In 2014, CNSC staff conducted one Type II compliance inspection to verify BTL's compliance with the NSCA and its regulations, its operating licence, and programs used to meet its regulatory requirements. None of the findings made during the inspection posed an immediate or unreasonable risk to the health, safety, and security of Canadians, and to the environment.

10.2 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

In 2014, CNSC staff rated BTL's radiation protection SCA as "satisfactory".

RATINGS FOR RADIATION PROTECTION
Overall Compliance Ratings
2014
SA
For 2014, CNSC staff rated the radiation protection SCA at BTL as "satisfactory". BTL has implemented and maintained a radiation protection program as required by the <i>Radiation Protection Regulations</i> .

Application of ALARA

As required by the *Radiation Protection Regulations*, BTL continued to implement radiation protection (RP) measures in 2014 to keep radiation exposures and doses to persons ALARA, taking into account social and economic factors. BTL has documented expectations for their ALARA program including a clear substantiation for the existence of the program, clearly delineated management control over work practices, and dose trend analysis.

Worker Dose Control

At BTL, employees are classified as either NEWs or non-NEWs, depending on the potential for radiation exposure. Radiation exposures are monitored to ensure compliance with CNSC regulatory dose limits and to maintain radiation doses ALARA. In 2014, no worker's radiation exposure reported by BTL exceeded CNSC regulatory dose limits. The maximum effective dose received by a NEW worker in 2014 at BTL was 0.46 mSv, or approximately 0.9 percent of the regulatory limit for effective dose of 50 mSv in a one-year dosimetry period. Other workers identified as non-NEWs did not receive any reportable doses during the same period. Annual average and maximum effective and equivalent dose results from 2010 to 2014 are provided in tables E-10 and E-16, appendix E. During these years, average doses have been relatively stable at between 0.1 mSv and 0.2 mSv. The maximum dose over these years has ranged from 0.5 mSv to 2.5 mSv. Radiation doses before 2014 were the result of activities under Best Theratronics Limited's other CNSC licences.

Radiation Protection Program Performance

Action levels for effective dose for various categories of workers have been established in order to alert BTL management of a potential loss of control of the radiation protection program. If reached, it triggers BTL staff to establish the cause for reaching the action level and, if applicable, restore the effectiveness of the RP program. In 2014, there were no action level exceedances at BTL.

Radiological Hazard Control

BTL's RP program ensures that measures are in place to monitor and control radiological hazards. This includes contamination and radiation dose rate monitoring and controls.

The majority of the radioisotopes in use at BTL are sealed sources; therefore the potential for contamination is very low. Notwithstanding, the licensee has implemented a thorough surface contamination monitoring procedure to monitor any potential contamination at its facility. Contamination checks are performed monthly in designated areas where radioactive materials may be handled, or following work where the potential for contamination exists. Over the last five years, there has been no indication of contamination from routine contamination swipes at the BTL facility.

Monthly dose rate measurements are also performed in all radiation areas. In addition, fixed dose rate monitors are in place with alarm threshold in a variety of designated locations within the BTL facility. These measurements and alarm thresholds help to ensure a safe work place.

Estimated Dose to the Public

There are no activities that occur inside the BTL facility that result in the release of radioactive material to the environment. In addition, gamma radiation is kept ALARA to protect staff within the BTL facility. Consequently, there is insignificant and unmeasurable dose impact to members of the public due to BTL's current and proposed licensed activities.

10.3 Environmental Protection

The environmental protection SCA covers programs that identify control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities. This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public

RATINGS FOR ENVIRONMENTAL PROTECTION	
Overall Compliance Rating	
2014	
SA	
<p>For 2014, CNSC staff rate the environmental protection SCA at the BTL facility as “satisfactory”. BTL received its licence in July 2014; therefore, the assessment and rating is limited to 2014 only.</p> <p>BTL does not release radioactive substance to the environment. The risk of radiation exposure to members of the public from normal operations is very low. There were no releases of hazardous substances (non-radiological) to the environment that would pose a risk to the public or the environment. Environmental monitoring is not conducted around the facility. BTL had until July 1, 2015 to review and revise the Environmental Management System to conform to REGDOC-2.9.1: <i>Environmental Protection Policies, Programs and Procedures</i>.</p>	

Effluent and Emissions Control (Releases)

There are no radiological releases (liquid or airborne) that require controls or monitoring. The radioactive material used at the Best Theratronics facility is limited to sealed sources and depleted uranium that is used as shielding for the sealed sources.

There are no hazardous liquid releases that require controls. Hazardous liquid effluents from routine operations are collected, temporarily stored on-site and removed for disposal by a certified third-party contractor.

Airborne hazardous emissions from Best Theratronics are related to the exhausting of the lead pouring area, paint booth, fire torching areas and sand blasting. Engineering controls are in place to reduce or eliminate emissions generated during operations (e.g., filters and ventilation).

Environmental Management System (EMS)

The current EMS consists of an Environmental Health and Safety Policy Document and an Environmental Health and Safety Responsibilities and Committees Document in addition to other operational procedures.

According to the Licence Conditions Handbook, Best Theratronics is expected to review and revise the EMS to conform to REGDOC-2.9.1: *Environmental Protection Policies, Programs and Procedures* by July 1, 2015. CNSC staff will review the EMS once it has been submitted.

Assessment and Monitoring

There is no environmental monitoring conducted around the Best Theratronics facility.

Waste water released to the sewer system is monitored by the City of Ottawa approximately twice a year.

Protection of the Public

The licensee must demonstrate that the health and safety of the public are protected from exposures to hazardous substances released from the facility.

The Best Theratronics facility only uses sealed sources. Therefore, the risk of radiation exposure to members of the public from normal operations is very low.

Emissions from the BLT facility do not result in changes to local air quality that would impact the health and safety of the public or the environment

10.4 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers and equipment. This SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY
Overall Compliance Ratings
2014
SA
For 2014, CNSC staff rate the conventional health and safety SCA at Best Theratronics Limited as “satisfactory”. Overall, the compliance verification activities conducted at Best Theratronics Limited confirms that conventional health and safety is viewed as an important consideration. Best Theratronics Limited has demonstrated the implementation of an effective occupational health and safety management program, which has resulted in the ability to keep their workers safe from occupational injuries. One LTI occurred in 2014.

Performance

A key performance measure for this SCA is the number of LTIs that occur per year. An LTI is an injury that takes place at work, and results in the worker being unable to return to work and carry out their duties for a period of time. As per table 10-1, the number of LTIs is listed as 1 in 2014. The injury resulted in six days of lost time. Details are provided in table G-4, appendix G.

Table 10-1: Lost-time injuries (LTIs) at Best Theratronics Limited, 2014

	2014
Lost-time injuries	1

Practices

In addition to complying with *Nuclear Safety and Control Act* and its associated regulations, BTL’s activities and operations must comply with Part II of the *Canada Labour Code*.

Best Theratronics Limited has a Health and Safety Committee (HSC) that inspects the workplace and meets monthly to resolve and track any safety issues. CNSC staff review the monthly meeting minutes and associated corrective actions to ensure issues are promptly resolved.

Awareness

Best Theratronics Limited continues to develop and maintain a comprehensive occupational health and safety management program for the site. CNSC staff will continue to monitor the effectiveness of these improvement initiatives through future inspections.

GLOSSARY

Commission

A corporate body of not more than seven permanent members, established under the NSCA and appointed by the Governor in Council, to perform the following functions:

- regulate the development, production and use of nuclear energy and the production, possession, use and transport of nuclear substances
- regulate the production, possession and use of prescribed equipment and prescribed information
- implement measures respecting international control of the development, production, transport and use of nuclear energy and nuclear substances, including those respecting the non-proliferation of nuclear weapons and nuclear explosive devices
- disseminate scientific, technical and regulatory information concerning the activities of the CNSC and the effects – on the environment and on the health and safety of persons – of the development, production, possession, transport and uses referred to above

Commission member document (CMD)

A document prepared for Commission hearings and meetings by CNSC staff, proponents and interveners. Each CMD is assigned a specific identification number.

derived release limit (DRL)

A limit imposed by the CNSC on the release of a radioactive substance from a licensed nuclear facility, such that compliance with the derived release limit gives reasonable assurance that the regulatory dose limit is not exceeded.

effective dose

The sum of the products, in sieverts, obtained by multiplying the equivalent dose of radiation received by and committed to each organ or tissue set out in column 1 of an item of schedule 1 of the *Radiation Protection Regulations*, by the weighting factor set out in column 2 of that item.

equivalent dose

The product, in sieverts, obtained by multiplying the absorbed dose of radiation of the type set out in column 1 of an item of schedule 2 of the *Radiation Protection Regulations*, by the weighting factor set out in column 2 of that item.

lost-time injury

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

root-cause analysis

An objective, structured, systematic and comprehensive analysis designed to determine the underlying reason(s) for a situation or event, which is conducted with a level of effort consistent with the safety significance of the event.

A. SAFETY AND CONTROL AREA FRAMEWORK

SAFETY AND CONTROL AREA FRAMEWORK			
FUNCTIONAL AREA	SAFETY AND CONTROL AREA	DEFINITION	SPECIFIC AREAS
Management	Management system	Covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.	<ul style="list-style-type: none"> ▪ Management system ▪ Organization ▪ Performance assessment, improvement and management review ▪ Operating Experience (OPEX) ▪ Change management ▪ Safety culture ▪ Configuration management ▪ Records management ▪ Management of contractors ▪ Business continuity
	Human performance management	Covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.	<ul style="list-style-type: none"> ▪ Human performance program ▪ Personnel training ▪ Personnel certification ▪ Initial certification examinations and requalification tests ▪ Work organization and job design ▪ Fitness for duty
	Operating performance	Includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.	<ul style="list-style-type: none"> ▪ Conduct of licensed activity ▪ Procedures ▪ Reporting and trending ▪ Outage management performance ▪ Safe operating envelope ▪ Severe accident management and recovery ▪ Accident management and recovery

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SAFETY AND CONTROL AREA FRAMEWORK			
FUNCTIONAL AREA	SAFETY AND CONTROL AREA	DEFINITION	SPECIFIC AREAS
Facility and equipment	Safety analysis	Covers maintenance of the safety analysis that supports the overall safety case for the facility. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards.	<ul style="list-style-type: none"> ▪ Deterministic safety analysis ▪ Hazard analysis ▪ Probabilistic safety analysis ▪ Criticality safety ▪ Severe accident analysis ▪ Environmental risk assessment ▪ Management of safety issues (including R&D programs)
	Physical design	Relates to activities that impact the ability of structures, systems and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.	<ul style="list-style-type: none"> ▪ Design governance ▪ Site characterization ▪ Facility design ▪ Structure design ▪ System design ▪ Component design
	Fitness for service	Covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.	<ul style="list-style-type: none"> ▪ Equipment fitness for service / equipment performance ▪ Maintenance ▪ Structural integrity ▪ Aging management ▪ Chemistry control ▪ Periodic inspection and testing
Core control processes	Radiation protection	Covers the implementation of a radiation protection program in accordance with the Radiation Protection Regulations. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA.	<ul style="list-style-type: none"> ▪ Application of ALARA ▪ Worker dose control ▪ Radiation protection program performance ▪ Radiological hazard control ▪ Estimated dose to public
	Conventional health and safety	Covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.	<ul style="list-style-type: none"> ▪ Performance ▪ Practices ▪ Awareness

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SAFETY AND CONTROL AREA FRAMEWORK			
FUNCTIONAL AREA	SAFETY AND CONTROL AREA	DEFINITION	SPECIFIC AREAS
	Environmental protection	Covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.	<ul style="list-style-type: none"> ▪ Effluent and emissions control (releases) ▪ Environmental management system (EMS) ▪ Assessment and monitoring ▪ Protection of the public

B. RATING METHODOLOGY AND DEFINITIONS

Performance ratings used in this report are defined as follows:

Fully Satisfactory (FS)

Safety and control measures implemented by the licensee are highly effective. In addition, compliance with regulatory requirements is fully satisfactory, and compliance within the SCA or specific area exceeds requirements and CNSC expectations. Overall, compliance is stable or improving, and any problems or issues that arise are promptly addressed.

Satisfactory (SA)

Safety and control measures implemented by the licensee are sufficiently effective. In addition, compliance with regulatory requirements is satisfactory. Compliance within the area meets requirements and CNSC expectations. Any deviation is only minor, and any issues are considered to pose a low risk to the achievement of regulatory objectives and CNSC expectations. Appropriate improvements are planned.

Below Expectations (BE)

Safety and control measures implemented by the licensee are marginally ineffective. In addition, compliance with regulatory requirements falls below expectations. Compliance within the area deviates from requirements or CNSC expectations to the extent that there is a moderate risk of ultimate failure to comply. Improvements are required to address identified weaknesses. The licensee or applicant is taking appropriate corrective action.

Unacceptable (UA)

Safety and control measures implemented by the licensee are significantly ineffective. In addition, compliance with regulatory requirements is unacceptable and is seriously compromised. Compliance within the overall area is significantly below requirements or CNSC expectations, or there is evidence of overall non-compliance. Without corrective action, there is a high probability that the deficiencies will lead to an unreasonable risk. Issues are not being addressed effectively, no appropriate corrective measures have been taken, and no alternative plan of action has been provided. Immediate action is required.

C. TREND IN SAFETY AND CONTROL AREA RATINGS

Table C-1: Blind River Refinery – safety and control area summary

Safety and control areas	2010 rating	2011 rating	2012 rating	2013 rating	2014 rating
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	FS	FS
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	BE	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table C-2: Port Hope Conversion Facility – safety and control area summary

Safety and control areas	2010 rating	2011 rating	2012 rating	2013 rating	2014 rating
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table C-3: Cameco Fuel Manufacturing – safety and control area summary

Safety and control areas	2010 rating	2011 rating	2012 rating	2013 rating	2014 rating
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table C-4: GEH-C Toronto and Peterborough – safety and control area summary

Safety and control areas	2010 rating	2011 rating	2012 rating	2013 rating	2014 rating
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	FS	FS	SA	SA	SA
Environmental protection	FS	FS	FS	FS	FS
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

* Not separately assessed in the past.

Table C-5: SRB Technologies – safety and control area summary

Safety and control areas	2010 rating	2011 rating	2012 rating	2013 rating	2014 rating
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	FS
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	FS	FS	FS
Environmental protection	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA
Safeguards*	N/A	N/A	N/A	N/A	N/A
Packaging and transport	SA	SA	SA	SA	SA

*N/A: There are no safeguard verification activities associated with this facility.

Table C-6: Nordion (Canada) Inc. – safety and control area summary

Safety and control areas	2010 rating	2011 rating	2012 rating	2013 rating	2014 rating
Management system	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA
Fitness for service	SA	SA	SA	SA	SA
Radiation protection	SA	SA	SA	SA	SA
Conventional health and safety	SA	FS	FS	FS	SA
Environmental protection	SA	FS	FS	FS	FS
Emergency management and fire protection	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA
Security	SA	SA	FS	FS	FS
Safeguards	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

Table C-7 Best Theratronics – safety and control area summary

Safety and control areas	2014 rating
Management system	SA
Human performance management	SA
Operating performance	SA
Safety analysis	SA
Physical design	SA
Fitness for service	SA
Radiation protection	SA
Conventional health and safety	SA
Environmental protection	SA
Emergency management and fire protection	SA
Waste management	SA
Security	SA
Safeguards	SA
Packaging and transport	SA

D. FINANCIAL GUARANTEES

The following tables outline the current financial guarantees for the uranium processing facilities, tritium processing facilities, and Nordion.

Table D-1: Uranium processing facilities – financial guarantees

Facility	Canadian dollar amount
Blind River Refinery	\$38,600,000
Port Hope Conversion Facility	\$101,700,000
Cameco Fuel Manufacturing	\$19,500,000
GEH-C Peterborough	\$3,027,000
GEH-C Toronto	\$30,052,000

Table D-2: Nuclear substance processing facilities – financial guarantees

Facility	Canadian dollar amount
SRB Technologies	\$652,488
Nordion (Canada) Inc.	\$15,400,000
Best Theratronics Limited	\$4,005,963

E. WORKER DOSE DATA

Uranium processing facilities

The following table compares the maximum and average individual effective doses in 2014 for all five uranium processing facilities.

Table E-1: Radiation dose data for nuclear energy workers at the uranium processing facilities

Facility	Maximum individual effective dose in 2014 (mSv/yr)	Average individual effective dose in 2014 (mSv/yr)	Regulatory limit
Blind River Refinery	8.2	3.3	50 mSv/yr
Port Hope Conversion Facility	5.4	0.8	
Cameco Fuel Manufacturing Inc.	8.5	1.3	
GEH-C Peterborough	7.55	1.67	
GEH-C Toronto	7.62	1.53	

The following tables provide a five-year trend (2010 through 2014) of average and maximum effective annual doses received at the various uranium processing facilities. In 2014, no radiation dose at a uranium processing facility exceeded regulatory dose limits.

Table E-2: Blind River Refinery – effective dose statistics for nuclear energy workers

Dose statistics	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	176	170	173	162	150	n/a
Average effective dose (mSv)	3.0	2.7	3.7	3.3	3.3	n/a
Maximum individual effective dose (mSv)	11.1	12.6	12.0	12.1	8.2	50 mSv/year

Table E-3: Port Hope Conversion Facility – effective dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	422	442	450	823	753	n/a
Average effective dose (mSv)	1.7	1.9	2.0	0.7	0.8	n/a
Maximum individual effective dose (mSv)	7.8	8.8	7.0	6.6	5.4	50 mSv/year

*The number of persons monitored, beginning in 2013, includes contractor NEWs and PHCF NEWs. Contractor NEWs are not included in the 2010–12 effective dose statistics.

Table E-4: Cameco Fuel Manufacturing – effective dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	355*	359	365	330	317	n/a
Average effective dose (mSv)	0.7	0.8	0.7	0.7	1.3	n/a
Maximum individual effective Dose (mSv)	5.0	9.9	6.0	8.6	8.5	50 mSv/year

*The number of persons monitored in 2010 has been corrected from 351 to 355, as reported in the CNSC Staff Report on the Performance of Uranium and Nuclear Substance Processing Facilities: 2013.

Table E-5: GEH-C Peterborough – effective dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	73	80	76	82	78	n/a
Average effective dose (mSv)	1.57	1.71	1.97	1.51	1.67	n/a
Maximum individual effective dose (mSv)	7.20	7.06	9.16	7.96	7.55	50 mSv/year

Table E-6: GEH-C Toronto Facility – effective dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	56	59	61	67	67	n/a
Average effective dose (mSv)	2.20	1.50	1.78	1.37	1.53	n/a
Maximum individual effective dose (mSv)	11.90	7.78	9.22	7.80	7.62	50 mSv/year

Nuclear substance processing facilities

The following table compares the maximum and average individual effective doses for Nordion and SRB Technologies.

Table E-7: Radiation dose data for nuclear energy workers at tritium and nuclear substance processing facilities

Facility	Maximum individual effective dose 2014 (mSv/yr)	Average individual effective dose 2014 (mSv/yr)	Regulatory limit
Nordion	6.0	0.44	50 mSv/yr
SRB Technologies	1.29	0.10	
BTL	0.46	0.09	

The following tables provide a five-year trend (2010 through 2014) of average and maximum effective annual doses received at the tritium processing facilities. In 2014, no radiation dose at a tritium processing facility exceeded regulatory dose limits.

Table E-8: SRB Technologies – effective dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	17	18	24	38	48	n/a
Average effective dose (mSv)	0.11	0.25	0.11	0.21	0.10	n/a
Maximum individual effective dose (mSv)	0.88	1.15	0.80	1.93	1.29	50 mSv/year

Table E-9: Nordion (Canada) Inc. – effective dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	324	311	293	284	269	n/a
Average effective dose (mSv)	0.4	0.4	0.4	0.4	0.4	n/a
Maximum individual effective dose (mSv)	4.9	5.1	5.2	6.4	6.0	50 mSv/year

Note : In previous years, this table presented data for Nuclear Energy Workers (NEWs) working only in the Active Areas at Nordion. For 2014, data for all NEWs at Nordion is included, resulting in some small changes in the “Total Persons Monitored” and “Average Dose (mSv)” from previous years.

Table E-10: Best Theratronics Limited – effective dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	70	80	81	86	74	n/a
Average effective dose (mSv)	0.18	0.13	0.18	0.07	0.09	n/a
Maximum individual effective dose (mSv)	1.34	0.91	2.01	2.47	0.46	50 mSv/year

Note the data from 2010 to 2013 was data from BTLs activities under the previous licence. BTL obtained its Class 1B licence in 2014, the activities performed were similar to that of 2014.

Extremity doses

Uranium processing facilities

The following tables provide the average and maximum annual equivalent extremity dose for each uranium processing facility.

Table E-11: Blind River Refinery – equivalent (extremity) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average extremity dose (mSv)	8.5	10.2	11.4	14.1	5.4	n/a
Maximum individual extremity dose (mSv)	44.4	49.0	47.6	35.1	48.2	500 mSv/year

Table E-12: Cameco Fuel Manufacturing – equivalent (extremity) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average extremity dose (mSv)	17.6	23.4	16.5	14.3	15.5	n/a
Maximum individual extremity dose (mSv)	103.4	111.3	107.5	87.6	88.4	500 mSv/year

Table E-13: GEH-C Peterborough – equivalent (extremity) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average effective dose (mSv)	12.57	9.36	11.56	10.47	18.64	n/a
Maximum individual effective dose (mSv)	60.16	56.12	58.82	76.03	98.98	500 mSv/year

Table E-14: GEH-C Toronto – equivalent (extremity) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average equivalent dose (mSv)	50.60	40.02	46.41	32.92	31.96	n/a
Maximum individual equivalent dose (mSv)	209.10	160.64	357.29	143.59	102.44	500 mSv/year

The following table provides the average and maximum annual equivalent extremity dose statistics for workers at Nordion.

Table E-15: Nordion (Canada) Inc. – equivalent (extremity) dose statistics for nuclear energy workers

Dose statistic	2010	2011	2012	2013	2014	Regulatory limit
Average equivalent dose (mSv)	0.9	0.7	0.5	0.5	0.7	n/a
Maximum individual equivalent dose (mSv)	18.0	12.3	10.3	7.4	9.5	500 mSv/year

Table E-16: Best Theratronics Limited – equivalent (extremity) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Total persons monitored	17	32	28	30	30	n/a
Average equivalent dose (mSv)	0.26	0.19	0.23	0.36	0.37	n/a
Maximum individual equivalent dose (mSv)	1.2	0.9	2.9	6.1	3.7	500 mSv/year

Skin doses

Uranium processing facilities

Table E-17: Blind River Refinery – equivalent (skin) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average skin dose (mSv)	5.8	5.5	6.0	6.8	5.4	n/a
Maximum individual skin dose (mSv)	45.3	48.8	39.2	41.4*	41.2	500 mSv/year

*The maximum individual skin dose in 2013 is 41.4 mSv, which is a correction to the result of 41.2 mSv reported in the *CNSC Staff Report on the Performance of Uranium and Nuclear Substance Processing Facilities: 2013*.

Table E-18: Port Hope Conversion Facility – equivalent (skin) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average skin dose (mSv)	0.8	0.8	0.7	1.7	0.6	n/a
Maximum individual skin dose (mSv)	29.1	181.4	16.3	28.6	10.3	500 mSv/year

Table E-19: Cameco Fuel Manufacturing – equivalent (skin) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average skin dose (mSv)	6.6	6.9	6.5	7.3	8.1	n/a
Maximum individual skin dose (mSv)	72.1	95.4	93.2*	88.4	108.4	500 mSv/year

*The maximum individual skin dose in 2012 was 93.2 mSv, which is a correction to the result of 93 mSv reported in the *CNSC Staff Report on the Performance of Uranium and Nuclear Substance Processing Facilities: 2013*.

Table E-20: GEH-C Peterborough – equivalent (skin) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average equivalent dose (mSv)	4.44	4.54	5.04	3.8	4.75	n/a
Maximum individual equivalent dose (mSv)	29.11	22.62	36.99	31.20	29.91	500 mSv/year

Table E-21: GEH-C Toronto – equivalent (skin) dose statistics for nuclear energy workers

Dose data	2010	2011	2012	2013	2014	Regulatory limit
Average equivalent dose (mSv)	13.80	10.81	12.45	10.29	11.08	n/a
Maximum individual equivalent dose (mSv)	78.60	55.48	58.40	52.84	51.67	500 mSv/year

The following table provides the average and maximum annual equivalent skin dose statistics for workers at Nordion.

Table E-22: Nordion (Canada) Inc. – equivalent (skin) dose statistics for nuclear energy workers

Dose statistic	2010	2011	2012	2013	2014	Regulatory limit
Average equivalent dose (mSv)	0.6	0.5	0.4	0.4	0.5	n/a
Maximum individual equivalent dose (mSv)	5.5	6.1	5.2	6.4	6.11	500 mSv/year

F. ENVIRONMENTAL DATA

Blind River Refinery

Table F-1: Blind River Refinery – soil monitoring results

Parameter	2010	2011	2012	2013	2014	CCME Guidelines (µg/g)*
Minimum uranium concentration (µg/g)	0.2	0.2	0.1	0.1	0.1	23
Average uranium concentration (µg/g) (within 1000 m, 0-5 cm depth)	2.1	4.8	3.3	4.3	2.7	
Maximum uranium concentration (µg/g)	4.0	18.0	12.1	16.4	7.2	

*Canadian Council of Ministers on the Environment (CCME) Soil Quality Guidelines for the Protection of Environment and Human Health (for residential/parkland land use).

Table F-2: Blind River Refinery – annual average groundwater monitoring results

Parameter	2010	2011	2012	2013	2014
Average uranium concentration (µg/L)	0.4	0.4	0.3	0.5	0.6
Maximum uranium concentration (µg/L)	2.9	4.1	2.0	3.7	8.9

Table F-3: Blind River Refinery – Lake Huron annual average results at diffuser

Parameter	2010	2011	2012	2013	2014	PWQO*
Average uranium concentration (µg/L)	0.3	0.4	0.2	0.4	< 0.2	5
Average nitrate concentration (mg/L as N)	0.2	0.1	0.1	0.3	0.2	2.93
Average radium-226 concentration (Bq/L)	< 0.005	0.006	< 0.005	< 0.005	< 0.005	1
Average pH	6.9	7.9	7.4	7.2	7.6	6.5 – 8.5

*Interim Ontario Provincial Water Quality Objectives (PWQO)

Port Hope Conversion Facility

Figure F-4: Port Hope Conversion Facility – average uranium concentrations from the south cooling water intake

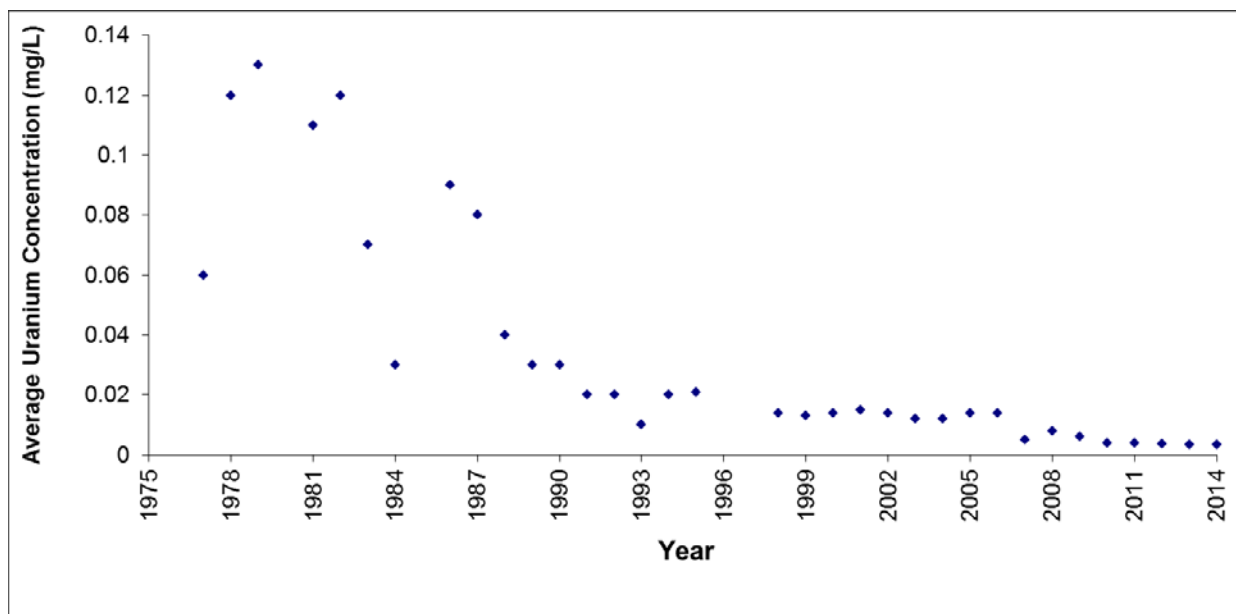


Table F-5: Port Hope Conversion Facility – uranium concentrations at Waterworks side yard remediated with clean soil (µg/g)

Depth (cm)	2010	2011	2012	2013	2014	CCME Guideline*
0-2	1.1	1.0	1.4	1.0	1.4	23
2-6	1.0	0.7	1.1	0.9	1.2	
6-10	1.0	0.3	1.3	1.0	1.1	
10-15	1.0	0.8	1.5	1.0	1.1	

*Canadian Council of Ministers on the Environment (CCME) Soil Quality Guidelines for the Protection of Environment and Human Health (for residential/parkland land use).

Table F-6: Port Hope Conversion Facility – fluoride concentration in local vegetation

Result/year	2010	2011	2012	2013	2014	MOECC Guidelines*
Fluoride in vegetation (ppm)	2.3	3.6	2.1	5.6	2.6	35

*Ontario Ministry of the Environment and Climate Change's Upper Limit of Normal (ULN) guidelines

Table F-7: Port Hope Conversion Facility – harbour water quality

Parameter	Value	2010	2011	2012	2013	2014	PWQO*
Uranium (µg/L)	Average	4.4	4.1	3.7	3.3	3.3	5
	Maximum	21	9.2	10	8.3	7.6	
Fluoride (mg/L)	Average	0.20	0.078	0.099	0.10	0.11	N/A
	Maximum	0.25	0.60	0.14	0.18	0.39	
Nitrate (mg/L)	Average	0.87	0.88	0.83	0.84	0.86	2.93
	Maximum	1.6	1.5	1.5	1.6	1.5	
Ammonia + ammonium (mg/L)	Average	0.10	0.11	0.10	0.11	0.23	20,000
	Maximum	0.50	0.33	0.40	0.35	0.52	

*Interim Ontario Provincial Water Quality Objectives (PWQO)

Cameco Fuel Manufacturing

Table F-8: Cameco Fuel Manufacturing – soil monitoring results

Parameter	2010	2013	CCME Guidelines**
Average uranium concentration (µg/g)	4.5	3.7	23
Maximum uranium concentration (µg/g)	21.1	17.4	23

* Note that CFM reverted to a three-year soil monitoring program and did not monitor soil in 2011, 2012 and 2014.

**Canadian Council of Ministers on the Environment (CCME) Soil Quality Guidelines for the Protection of Environment and Human Health (for residential and parkland land use).

GEH-C Toronto

Table F-9: GEH-C Toronto – uranium in air emission and liquid effluent monitoring results, 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limit
Uranium discharged to air (kg/year)	0.017	0.009	0.013	0.006	0.006	0.76
Uranium discharged to sewer (kg/year)	0.4	1.1	0.9	0.8	0.7	9,000

Table F-10: GEH-C Toronto – uranium in boundary air monitoring results, 2010–2014

Parameter	2010	2011	2012	2013	2014
Average uranium concentration ($\mu\text{g}/\text{m}^3$)	0.0011	0.0011	0.0011	0.0007	0.0006
Maximum uranium concentration ($\mu\text{g}/\text{m}^3$)	0.0035	0.0047	0.0079	0.0026	0.0029

Note: Ontario Reg. 415/05 2016 average annual U in air concentration is $0.03 \mu\text{g}/\text{m}^3$

Table F-11: GEH-C Toronto – uranium in soil monitoring results, 2010–2012

Parameter	2010	2011	2012
Average uranium concentration ($\mu\text{g}/\text{g}$)	2.2	2.3	1.9
Maximum uranium concentration ($\mu\text{g}/\text{g}$)	13.7	14.8	10.8

Table F-12: GEH-C Toronto – uranium in soil monitoring results, 2013–2014

Parameter	On GEH-C property		Industrial/ commercial lands		Residential locations	
	2013	2014	2013	2014	2013	2014
Number of samples	1	1	24	34	24	14
Average uranium concentration (µg/g)	2.3	2.3	3.9	5.0	1.1	0.6
Maximum uranium concentration (µg/g)	2.3	2.3	24.9	22.1	3.1	2.1
CCME Guidelines (µg/g)*	300		33		23	

*Canadian Council of Ministers on the Environment (CCME) Soil Quality Guidelines for the Protection of Environment and Human Health.

GEH-C Peterborough

Table F-13: GEH-C Peterborough – uranium in air emission and liquid effluent monitoring results, 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limit
Total U discharged to air (kg/yr)	0.000004	0.000011	0.000005	0.000013	0.000003	0.55
Total U discharged to sewer (kg/yr)	0.0003	0.0001	0.0001	0.0002	0.0001	760

Table F-14: SRB – atmospheric emissions monitoring results, 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limit (TBq/year)
Tritium as tritium oxide (HTO), TBq/year	9.17	12.50	8.36	17.82	10.71	67
Total tritium as HTO + tritium gas (HT), TBq/year	36.43	55.68	29.90	78.88	66.16	448

Table F-15: SRB – liquid effluent monitoring results, 2010–2014

Parameter	2010	2011	2012	2013	2014	Licence limit (TBq/year)
Tritium-water soluble, TBq/year	0.007	0.008	0.012	0.009	0.013	0.200

Nordion

Table F-16: Nordion (Canada) Inc. – air emissions monitoring results, 2010–2014

Parameter (GBq/yr) ¹	2010	2011	2012	2013	2014	Derived Release Limit (GBq/yr)
Cobalt-60	0.006	0.006	0.006	0.005	0.005	78
Iodine-125	0.37	0.38	0.46	0.23	0.14	990
Iodine-131	0.99	0.29	0.40	0.39	0.46	1,110
Xenon-133	9,066	34,967	36,153	30,735	15,018	29,000,000

[1] Gigabecquerel per year

Table F-17: Nordion (Canada) Inc. – liquid effluent monitoring results, 2010–2014

Parameter (GBq/yr) ¹	2010	2011	2012	2013	2014	Derived Release Limit (GBq/yr)
Beta emitters <1MeV	0.569	0.395	0.261	0.288	0.209	7,780
Beta emitters >1MeV	0.129	0.088	0.060	0.065	0.050	105,000
Iodine-125	0.011	0.007	0.005	0.005	0.051	14,700
Iodine-131	0.021	0.013	0.009	0.009	0.006	10,800
Molybdenum-99	0.180	0.116	0.075	0.077	0.055	467,000
Cobalt-60	0.044	0.027	0.017	0.022	0.018	64,100
Niobium-95	0.001	0.001	0.0002	0.0006	0.0007	64,100
Zirconium-95	0.001	0.001	0.0003	0.0006	0.0005	64,100
Cesium-137	0.001	0.0004	0.0004	0.0005	0.0004	64,100

[1] Gigabecquerel per year

G. LOST-TIME INJURIES IN 2014

Table G-1: Lost-time injuries

Facility	Lost-time injury	Action taken
Port Hope Conversion Facility	An employee was injured when bending over to pick up a piece of pipe from the floor; when he stepped back, he tripped on a raised drain in the floor causing a loss of balance, and fell to the floor. The employee's right arm was outstretched to break his fall which resulted in an injury to his right shoulder. This resulted in 26 days of lost time (incurred in 2015).	As a result of this event, Cameco performed an investigation of this LTI which involved a causal analysis as part of their non-conformance and corrective action process. As a result of the investigation, interim and long-term corrective actions have been established to prevent reoccurrence such as: <ul style="list-style-type: none"> • identify newly exposed hazards and schedule their removal before any further work is required in the affected area • increase the visibility of any exposed hazards (like the one related to this event) before these protrusions/hazards can be eliminated • review and update Cameco's hazard analysis process to include requirement(s) for identifying exposed hazards and determining the actions needed to address these hazards.

Table G-2: Lost-time injuries

GE Hitachi Nuclear Energy Canada Inc.	On Sept. 15, 2014 an employee was injured when a dolly supporting a full skid of uranium pellets toppled over onto his foot as he was moving it out of the elevator.	As a result of this event, GEH-C performed a tap root analysis of the event and identified five (5) causal factors. Several corrective actions were implemented including training, use of transition plates, investigating dolly redesign, as well as an engineering assessment of the material handling practices and associated human factors.
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Table G-3: Lost-time injuries

Facility	Lost-time injuries	Action taken
Nordion Inc.	An employee was dismounting from a truck when he missed a step, causing him to swing and jar his side on the truck. This resulted in a back injury and 15 days of lost time.	Practical training was provided to the employee regarding proper dismounting from the back of a truck and use of hand grips. The applicable personnel were also reminded of safe dismounting techniques.
Nordion Inc.	An employee pulled on a pallet truck which had not been lowered all the way to the ground. The truck caught on the pallet and caused jarring of the employee's neck. This resulted in 13 days of lost time.	The employee and staff were reminded of proper pallet truck operating techniques: to ensure pallet trucks are completely lowered prior to pulling them from under pallets, to avoid jerking movements, to initiate movement with small amounts of force, and to ensure the pallet truck is free before applying greater force.
Nordion Inc.	An employee was manually closing a heavy lead door to a cell and sustained a low back injury. This resulted in one day of lost time.	The functionality of the automatic door opening/closing mechanism was reviewed. Following the review, staff were reminded to use the automatic door closer. In addition, signage was posted near the door reminding employees to use the automatic door closing mechanism.

Table G-4: Lost-time injuries

Facility	Lost-time injuries	Action taken
Best Theratronics Limited	An employee suffered a hand injury from a machine shop activity, which required stitches. This resulted in six days of lost time.	Best provided additional practical training to employees to ensure that persons working with power tools were doing so safely.

H. LINKS TO LICENSEE WEBSITES

Nordion (Canada) Inc. - <http://nordion.com>

Cameco – Blind River Refinery - cameco.com/fuel_services/blind_river_refinery/

Cameco–Port Hope Conversion Facility-
cameco.com/fuel_services/port_hope_conversion/

Cameco Fuel Manufacturing - cameco.com/fuel_services/fuel_manufacturing/

GE Hitachi Nuclear Energy Canada - <http://geh-canada.ca/>

SRB Technologies (Canada) Inc. - <http://www.srbt.com>

I. ACRONYMS

ALARA	As low as reasonably achievable
Bq/L	Becquerel per litre
BRR	Blind River Refinery
BMS	Bundle manufacturing system
CCME	Canadian Council of Ministers of the Environment
CFM	Cubic feet per minute
CFM	Cameco's Fuel Manufacturing Inc.
CIRS	Cameco Incident Reporting System
CMD	Commission member document
CNSC	Canadian Nuclear Safety Commission
COC	Contaminants of concern
DRL	Derived release limit
EC	Environment Canada
EMS	Environmental Management System
EP	Environmental protection
ERT	Emergency response team
ESDC	Employment and Social Development Canada (formerly Human Resources and Skills Development Canada HRSDC)
FHSC	Facility Health and Safety Committee
FSD	Fuel Services Division
GBq	Gigabecquerel
GEH-C	General Electric-Hitachi Canada
GTLS	Gaseous tritium light sources
IAEA	International Atomic Energy Agency
ISO	International Organization for Standardization
JH&SC	Joint Health and Safety Committee
KOH	Potassium hydroxide
KPI	Key performance indicator
LCH	Licence Conditions Handbook
LLRD	Long-lived radioactive dust
LTI	Lost-time injury
mg/L	Milligram per litre

mSv	Millisievert
MOECC	Ontario's Ministry of the Environment and Climate Change
SCA	Safety and control area
SRB	SRB Technologies (Canada) Incorporated
TBq	Terabequerel
TLD	Thermoluminescent dosimeters
TSP	Total suspended particulate
VIM	Vision in motion
WNSL	Waste nuclear substance licences
WHSC	Workplace Health and Safety Committee

J. SIGNIFICANT CHANGES TO LICENCE AND LICENCE CONDITIONS HANDBOOK(S)

There were no significant changes to licences or LCHs in nuclear substance processing facilities in 2014.