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Annual Report

Rapport annuel

**Annual Performance  
Report AECL's Nuclear  
Sites and Projects: 2013**

**Rapport annuel sur le  
rendement des sites et  
des projets nucléaires  
d'EACL : 2013.**

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Submitted by:

CNSC Staff

Soumise par :

Le personnel de la CCSN

**Summary**

- This CMD presents *CNSC Staff's Assessment of AECL's Nuclear Sites and Projects: 2013*.

There are no actions requested of the Commission. This CMD is for information only.

The following item is attached:

- *Annual Performance Report AECL's Nuclear Sites and Projects: 2013*.

**Résumé**

- Ce CMD présente l'*Évaluation du personnel de la CCSN des sites et des projets nucléaires d'EAACL : 2013*.

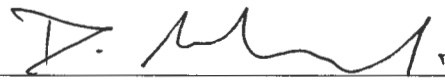
Aucune mesure n'est requise de la Commission. Ce CMD est fourni à titre d'information seulement.

La pièce suivante est jointe :

- *Rapport annuel sur le rendement des sites et des projets nucléaires d'EAACL : 2013*.

**Signed/Signé le**

October 10, 2014

A handwritten signature in black ink, appearing to read 'D. Newland', is written over a horizontal line.

D. Newland

**Director General (Acting)**

Directorate of Nuclear Cycle and Facilities Regulation

**Directeur général (Intérimaire) de la**

Direction de la réglementation du cycle et des installations nucléaires

**Attachment:** *Annual Performance Report AECL's Nuclear Sites and Projects: 2013*

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## EXECUTIVE SUMMARY

Each year, the Canadian Nuclear Safety Commission (CNSC) produces a report on the performance of Atomic Energy of Canada Limited (AECL) Chalk River Laboratories. This year, the scope has been expanded to include an assessment of AECL's Nuclear Sites and Projects. The report, entitled *Annual Performance Report AECL's Nuclear Sites and Projects: 2013* summarizes CNSC staff's assessment of the safety performance of:

- Chalk River Laboratories (CRL)
- Whiteshell Laboratories (WL)
- Port Hope Area Initiative (PHAI); includes the Port Hope project and the Port Granby project

Through inspections, reviews and assessments, CNSC staff conclude that AECL has operated all facilities and activities safely during 2013. The evaluations of all findings for the safety and control areas show that, overall, AECL made adequate provision for the security, the protection of health and safety of persons and the environment from the use of nuclear energy, and took the measures required to implement Canada's international obligations.

The following observations support the conclusion of safe operation:

- No member of the public received a radiation dose that exceeded the regulatory limit
- No worker at any AECL site received a radiation dose that exceeded the regulatory limits
- The frequency and severity of non-radiological injuries to workers was minimal
- No radiological releases to the environment from the sites/projects exceeded the regulatory limits
- AECL complied with their licence conditions concerning Canada's international obligations

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## 1 INTRODUCTION

As part of the assessment, CNSC staff evaluated how well AECL is meeting regulatory requirements and expectations for the performance of programs in 14 safety and control areas (SCAs). The report makes comparisons and shows trends, where possible, and it highlights emerging regulatory issues pertaining to AECL's nuclear sites and projects.

## 2 OVERVIEW

The review of each nuclear site or project's safety performance in the SCA framework confirms that AECL has made adequate provisions for the protection of the health and safety of Canadians and the environment, as well as to ensure that Canada continued to meet its international obligations on the peaceful use of nuclear energy.

Ratings for CRL for the year 2013 ranged from "below expectations" to "satisfactory". A notable rating change was issued for the SCA Management System previously reported as "below expectations" in CMD 13-M14: *Report for the Performance of Atomic Energy of Canada Limited Chalk River Laboratories* and now rated as "satisfactory". As indicated, this SCA was in an improving trend. Since, AECL has completed several improvements which have resulted in the satisfactory rating. For SCA Fitness for Service, CNSC staff continue to rate this as "below expectations" due to the aging and legacy issues of systems, structures and components at CRL, particularly the National Research Universal (NRU) reactor.

For WL, ratings for 2013 were deemed "satisfactory" or "fully satisfactory" for the reporting period which remains unchanged from reports previously made to the Commission in CMD 12-M47: *Interim Status Report on the Progress of Decommissioning Activities at Whiteshell Laboratories*.

Unchanged ratings were also noted for AECL's projects (Port Hope and Port Granby), as previously reported in CMD 11-H10: *Application by Atomic Energy of Canada Limited for a Waste Nuclear Substance Licence for the Port Granby Long-Term Low-Level Radioactive Waste Management Project* and CMD 12-H10: *Application by Atomic Energy of Canada Limited for Amendment of Waste Nuclear Substance Licence for the Port Hope Long-Term Low-Level Radioactive Waste Management Project*. All SCAs for these two projects continue to be rated as "satisfactory" for the year 2013.

### **3 CONSULTATION**

A draft version of the report was posted on the CNSC Web site, in both official languages, for consultation from October 15, 2014 to November 17, 2014. The public was invited to comment, in writing, on this report. Written submissions will be filed with the Secretariat of the Commission. It is noted that all submissions will be available to the public upon request to the Secretariat.

CNSC staff will review each comment, and would be pleased to provide feedback to the Commission.

### **4 OVERALL CONCLUSIONS**

Following this meeting, *Annual Performance Report AECL's Nuclear Sites and Projects: 2013* will be published on the CNSC Web site and made available to licensees and stakeholders.



# Annual Performance Report AECL's Nuclear Sites and Projects: 2013



October 2014

# DRAFT



*Annual Performance Report AECL's Nuclear Sites and Projects: 2013*

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**Document availability**

This document can be viewed on the CNSC Web site at [nuclearsafety.gc.ca](http://nuclearsafety.gc.ca) or to request a copy of the document in English or French, please contact:

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## EXECUTIVE SUMMARY

Each year, the Canadian Nuclear Safety Commission (CNSC) produces a report on the performance of Atomic Energy of Canada Limited (AECL) Chalk River Laboratories. This year the scope of the report has been expanded to include an assessment of AECL's Nuclear Sites and Projects. The report, entitled *Annual Performance Report AECL's Nuclear Sites and Projects: 2013* summarizes CNSC staff's assessment of the safety performance of AECL sites and projects where physical operations occurred in 2013:

- Chalk River Laboratories (CRL)
- Whiteshell Laboratories (WL)
- Port Hope Area Initiative (PHAI), which includes the Port Hope Project and the Port Granby Project

The report highlights the regulatory requirements and expectations in selected areas, and discusses significant events, licence changes, major developments and overall performance. It provides performance data on all 14 of the safety and control areas (SCAs) where applicable.

The report is organized by nuclear site and project and covers CRL, WL, the Port Hope Project and the Port Granby Project. The information presented covers the complete 2013 calendar year and, when applicable, compares information to previous years. The report also provides recent updates on key issues up to June 30, 2014.

### ***Overall performance highlights***

CNSC staff efforts during the reporting period for AECL's nuclear sites and projects focused on desktop reviews, performance analyses, and site compliance inspection activities. Inspections conducted in 2013 covered various aspects of many SCAs, commensurate with the risk associated with the facilities. In 2013, a total of 28 inspections were conducted by CNSC staff, 22 at CRL, three at WL, three for the PHAI (1 at Port Hope and 2 at Port Granby). Through these inspections and additional reviews and assessments, CNSC staff conclude that AECL operated all facilities and activities safely during 2013. Overall, AECL made adequate provisions for security, the protection of health and safety of persons and the environment and took the measures required to implement Canada's international obligations.

The following observations support the conclusion of safe operation:

- No member of the public received a radiation dose that exceeded the regulatory limit
- No worker at any AECL site received a radiation dose that exceeded the regulatory limits
- The frequency and severity of non-radiological injuries to workers were minimal
- No radiological releases to the environment from the sites/projects exceeded the licence limits
- AECL complied with its licence conditions concerning Canada's international obligations

Tables 1, 5, 10 and 12 summarize the 2013 ratings for AECL's nuclear sites and projects. These tables present the SCAs for each site/project, along with the ratings that gauge the overall safety performance. The rating categories are "fully satisfactory" (FS), "satisfactory" (SA), "below expectations" (BE) and "unacceptable" (UA). A rating of "satisfactory" indicates the licensee's safety and control measures are effective while a "fully satisfactory" indicates they are highly effective. An SCA rating of "below expectations" indicates the safety and control measures are marginally ineffective, while "unacceptable" indicates the safety and control measures are significantly ineffective.

Ratings for CRL for the year 2013 ranged from "below expectations" to "satisfactory". A notable rating change was issued for the SCA "management system" previously reported as "below expectations" in Commission Member Document (CMD) 13-M14: *Report for the Performance of Atomic Energy of Canada Limited Chalk River Laboratories* and now rated as "satisfactory". As indicated in the CMD, this SCA was in an improving trend. Since that report, AECL has completed several improvements that have resulted in the satisfactory rating. Regarding the SCA "fitness for service", CNSC staff continue to rate this SCA as "below expectations" due to the aging and legacy issues of structures, systems and components at CRL, particularly the National Research Universal (NRU) reactor.

For WL, the 2013 ratings were deemed "satisfactory" or "fully satisfactory" for the reporting period which remains unchanged from reports previously made to the Commission in CMD 12-M47: *Interim Status Report on the Progress of Decommissioning Activities at Whiteshell Laboratories*.

Unchanged ratings were also noted for AECL's projects (Port Hope and Port Granby), as previously reported in CMD 11-H10: *Application by Atomic Energy of Canada Limited for a Waste Nuclear Substance Licence for the Port Granby Long-Term Low-Level Radioactive Waste Management Project* and in CMD 12-H10: *Application by Atomic Energy of Canada Limited for Amendment of Waste Nuclear Substance Licence for the Port Hope Long-Term Low-Level Radioactive Waste Management Project*. All SCAs for these two projects continue to be rated as "satisfactory" for the year 2013.

During the review period for the CRL site, CNSC staff have focused and continue to focus oversight efforts on the implementation of the Integrated Implementation Plan (IIP). CNSC staff have been monitoring the progress of the IIP actions throughout the review period. An assessment was performed by CNSC staff in February 2014 to evaluate the implementation of IIP. Overall, CNSC staff conclude that most of the actions reported by AECL as closed have been completed as scheduled (with supporting documented evidence); however, there are many instances where closure of some actions may be delayed. AECL continues to emphasize that the delayed actions have no adverse effect on safety, stating that the overall progress supports ongoing confidence in the safety of the NRU reactor. CNSC staff are following up on these delayed actions with AECL. For more details regarding this assessment, see the related SCA within this report.



Addressing the lessons learned from the nuclear accident at the Fukushima Daiichi nuclear power plant in Japan continues to be a focus area for CNSC staff in 2013 for both the CRL and WL sites. AECL reviewed its existing safety cases and emergency management program against the ability to withstand extreme external events. By reviewing AECL's reports, CNSC staff concur that the underlying defence-in-depth provisions are in place to deal with natural disasters. AECL has identified a number of improvements for CRL and included them in the IIP.

CNSC staff's evaluations conducted throughout the review period identified that AECL has operated the nuclear sites and projects safely. This conclusion is based on CNSC staff's assessment activities which included: site inspections, desktop reviews, event review, follow-up and general communication and exchange of information with the licensee. CNSC staff continue to plan compliance activities over the next year to confirm the effective implementation of AECL's planned activities.

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# Annual Performance Report of AECL's Nuclear Sites and Projects: 2013

## 1 OVERVIEW

### 1.1 Background

This report on the annual performance of AECL's nuclear sites and projects: 2013 summarizes CNSC staff's assessment for the safety performance of AECL sites where physical operations occurred in 2013:

- Chalk River Laboratories (CRL)
- Whiteshell Laboratories (WL)
- Port Hope Area Initiative (PHAI), which includes the Port Hope Project and the Port Granby Project

The report highlights AECL's performance against the regulatory requirements and expectations, discussing significant events, licence changes, and major developments. It provides performance data on all 14 of the SCAs, where applicable.

The report is organized by nuclear site and project, covering CRL, WL, Port Hope and Port Granby. The information presented covers the complete 2013 calendar year and, when applicable, compares information to previous years. The report also provides recent updates on key issues up to June 30, 2014.

This report has 10 appendices:

- Appendix A: Safety and Control Area Framework
- Appendix B: Rating Methodology and Definitions
- Appendix C: Trend in Safety and Control Area Ratings
- Appendix D: Financial Guarantees
- Appendix E: Worker Dose Data
- Appendix F: Environmental Data
- Appendix G: Status of Fukushima Actions
- Appendix H: Changes to Licence(s) and Licence Conditions Handbook(s)
- Appendix I: Links to Licensee Websites
- Appendix J: Acronyms

## 1.2 AECL's restructuring

On February 28, 2013, the Minister of Natural Resources announced that Canada would undertake a competitive procurement for a contractor to manage the operations of AECL's nuclear laboratories using a government-owned, contractor-operated model. Similar models are used in the management of nuclear operations in other jurisdictions, such as in the United States and the United Kingdom. Going forward, the nuclear laboratories will focus on three key areas: (i) managing radioactive waste and decommissioning responsibilities; (ii) performing science and technology activities to meet core federal responsibilities; and (iii) supporting Canada's nuclear industry through access to science and technology facilities and expertise on a commercial basis.

The federal government is undergoing a procurement process to obtain the services of a contractor to manage the Canadian Nuclear Laboratories Limited (CNL). The CNL was created in June 2014 as a wholly owned subsidiary of AECL. The plan is that this company will become operational in the fall of 2014; it is anticipated to then become the employer of the majority of AECL's employees. The CNL will perform most of the functions and operations that AECL currently performs, including the management of operations of AECL's nuclear laboratories, dependent upon the attainment of the necessary regulatory approvals. The CNL will hold all necessary licences, permits and other regulatory approvals required to operate AECL's properties and assets. Because the CNL will be a wholly owned subsidiary of AECL, it will retain its overall governance and executive structure and will not fundamentally change.

AECL has applied to transfer (in July 2014) from the AECL parent body to the CNL: (i) CNSC licences (Commission issued, and Designated Officer issued); and (ii) exemptions from *Class II Nuclear Facilities and Prescribed Equipment Regulations* and *Cost Recovery Fees*. CNSC staff are currently drafting a CMD for the transfer of Commission-issued licences and the regulations exemptions that will be presented at an abridged hearing in October. AECL has requested that the effective date of the transfer be coincident with the stand-up (i.e., bringing into operation) of the CNL, which is expected to occur on November 3, 2014. The amendments made to the Commission-issued licences and the issuance of exemptions to the regulations is strictly administrative in nature; the requirements of the licences and the licensing periods will remain the same. The transfer of licences issued by Designated Officers will be processed separately. CNSC staff are monitoring the situation to understand the implications of AECL's restructuring for licensing and compliance activities for its sites.

In late 2015, it is anticipated that the federal government will complete its procurement of a contractor to manage all AECL laboratories and sites. At that time, the ownership of the CNL will be transferred to the contractor, and the contractor will own the CNL for the term of the contract and any subsequent extension. It is anticipated that the CNL will have a new executive team provided by the contractor. It is also expected that the contractor will institute changes in the CNL to bring about business efficiencies. In this regard, CNSC staff have been confirming that the necessary change management requirements are in place and that they will remain in place throughout the transition.

### 1.3 CNSC's regulatory efforts

The CNSC regulates Canada's nuclear research and testing establishments and waste nuclear substances in order to protect the health and safety of persons, to protect the environment, and to ensure that Canada continues to implement its international obligations on the peaceful use of nuclear energy. The CNSC achieves this mission by ensuring compliance through verification, enforcement and reporting.

CNSC staff establish compliance plans for each licensed facility based on the relative risks of the facility's activities in order to identify appropriate levels of regulatory monitoring and control. Modifications to the compliance plans are made on an ongoing basis in response to events, facility modifications and changes in licensee performance.

CNSC staff efforts during the reporting period for AECL's nuclear sites and projects focused on desktop reviews, performance analyses, and site compliance inspection activities. Inspections conducted in 2013 covered various aspects of many SCAs, commensurate with the risk associated with the facilities. For CRL, WL, and the PHAI, CNSC staff's assessments and inspections confirmed that:

- no member of the public received a radiation dose that exceeded the regulatory limit
- no worker received a radiation dose that exceeded the regulatory limits
- the frequency and severity of injuries/accidents involving workers were minimal
- no radiological releases exceeded the regulatory limits
- AECL complied with its licence conditions

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

In 2013, CNSC staff efforts continued to focus on the lessons learned from the nuclear accident at the Fukushima Daiichi nuclear power plant in Japan. For each of the facilities covered by this report, AECL reviewed existing safety cases and emergency management programs against its sites' abilities to withstand extreme external events. CNSC staff reviewed and verified the licensee reports and findings. CNSC staff conclude that the underlying defence-in-depth controls are in place to deal with natural disasters, confirming that the facilities continue to be operated safely. AECL continues to make improvements identified in the Fukushima action plan.

CNSC staff previously updated the Commission regarding CNSC's Fukushima action plans. These updates were presented in October 2012 and August 2013, as referenced below:

- CMD 12-M56 Status Update on the CNSC Action Plan: Lessons Learned from the Fukushima Accident, October 2012; and

- CMD 13-M34 Status Update on the CNSC Integrated Action Plan: Lessons Learned from the Fukushima Accident, August 2013.

The current status of the Fukushima actions for CRL and WL can be viewed in appendix G. There are no Fukushima actions for the PHAI.

## 1.4 Public information and disclosure

Licensees have an important responsibility to inform the public about their respective nuclear facilities and activities. To ensure Class I licensees (such as CRL and WL) provide open and transparent information to the public, in 2012, the CNSC published new regulatory requirements in RD/GD-99.3, *Public Information and Disclosure*.

These regulatory requirements include:

- The identification of clear and measurable objectives
- The identification of target audiences
- The tracking of public comments and concerns related to licensee activities
- The development of strategies for open and transparent communication of information
- The establishment and implementation of rules for the public disclosure of information
- The review and evaluation of the public information and disclosure programs to determine their effectiveness and the identification of improvements
- The documentation of records to demonstrate that public information and disclosure requirements are met

Since 2011, AECL has made significant progress in developing its Corporate Public Information Program (PIP) and disclosure protocol and incorporating its activities among its various sites which meets the requirements of RD/GD-99.3. A challenge remains, however, in balancing the level of public interest, involvement and information disclosure commensurate with the public perception of risk for each site/project in one corporate program. Although the varied risk levels of each site are recognized, this challenge needs to be articulated within the PIP to provide the context and scope for individual evaluations. AECL is addressing this as part of the regular updates to its PIP as required by RD/GD-99.3.

Further information on the performance of specific site/project PIPs can be found in corresponding sections of this report.

## 1.5 Nuclear Legacy Liabilities Program

The Nuclear Legacy Liabilities Program (NLLP) was established by the Government of Canada in 2006 to manage Canada's nuclear legacy liabilities at AECL sites (other than the PHAI). The main objective of the NLLP is to safely and cost-effectively reduce the nuclear legacy liabilities on AECL's sites and the associated risks based on sound waste management and environmental principles. The NLLP includes projects to design, construct and operate waste processing and storage facilities; to identify viable long-term management, waste acceptance criteria, and interim end state criteria; to develop decommissioning strategies; and to remediate contaminated lands and areas arising from past practices and legacy wastes.

Canada's nuclear legacy liabilities comprise aging nuclear facilities and associated infrastructure, a wide variety of buried and stored waste, and contaminated lands, all the result of nuclear research and development, medical isotope production and the production of heavy water for use in nuclear power reactors. The earliest liabilities were generated in 1944 by the National Research Council, as part of the national Second World War effort, and since 1952 by AECL, the federal Crown Corporation established to exploit the peaceful applications of the atom. The nuclear legacy liabilities are associated with a number of sites (figure 1), as follows:

- Chalk River Laboratories in Chalk River, Ontario
- Whiteshell Laboratories in Pinawa, Manitoba and the nearby Underground Research Laboratory
- The partially decommissioned Douglas Point prototype power reactor in Kincardine, Ontario
- The partially decommissioned Nuclear Power Demonstration (NPD) prototype power reactor in Rolphton, Ontario
- The partially decommissioned Gentilly-1 prototype power reactor located near Bécancour, Quebec
- The site of the former heavy water plant in Laprade, Quebec (near the Gentilly-1 reactor)

Currently, Douglas Point, NPD, and Gentilly-1 are each in a safe storage state with no operational activities taking place during 2013.

In addition to the NLLP, the PHAI is funded separately. In a news release from January 13, 2012, Canada's Minister of Natural Resources announced that the Government of Canada is investing \$1.28 billion over 10 years to clean up low-level radioactive waste in the Port Hope area.

**Figure 1: AECL sites associated with the Nuclear Legacy Liabilities Program**

The CRL and WL sites contain the majority of the nuclear legacy liabilities. At these sites, the inventory of legacy wastes includes used nuclear fuel, and intermediate-level and low-level solid and liquid radioactive waste, as well as contaminated lands, buildings, structures, and tanks. It also includes waste from site clean-up work performed across Canada (e.g., contaminated soils) and radioactive waste received from Canadian hospitals, research facilities, and universities. Prior to the NLLP, most of the legacy waste was in an unconditioned form, and limited characterization information was available for the waste generated in the past. Efforts are currently being made by AECL to both re-package and characterize these wastes as part of the NLLP.

In January 2014, AECL and CNSC staff agreed to a series of meetings to discuss strategic initiatives associated with the NLLP activities. The objective of the meetings was to ensure a better informed approach and alignment with international best practice in the development of waste solutions, executing selected projects and developing an acceptable disposal strategy that includes in-situ disposal, all to be considered in the context of the NLLP.

The NLLP projects and associated actions/milestones are also subject to the CNSC compliance activities. AECL submits semi-annual progress updates on key NLLP projects and matters of interest. Compliance findings for the projects executed under the NLLP are listed within this report under the SCA “waste management” for CRL and WL.



## PART I: NUCLEAR SITES

### 2 OVERVIEW

The Chalk River Laboratories (CRL) are located in the province of Ontario, 160 kilometres northwest of Canada's national capital, Ottawa, and represent the largest single complex within Canada's science and technology infrastructure. The site contains several nuclear facilities, including the National Research Universal (NRU) reactor, Molybdenum Production Facility, waste management areas, and many other facilities and laboratories.

The Whiteshell Laboratories (WL), located 100 kilometres northeast of Winnipeg, Manitoba, operated from 1961 to 1997. This is where AECL pioneered the development of dry storage containment facilities for used nuclear fuel, a technology that is now in use throughout the world. The site is no longer operating and is currently being decommissioned.

In addition to these two sites, AECL also maintains a number of nuclear reactor facilities that include Douglas Point, Nuclear Power Demonstration, and Gentilly-1. At the time of writing of this report, these sites were transitioning to modern licences and were therefore not included in the report. An abridged hearing was held on June 30, 2014, where an update on these sites was given via CMD 14-H107: *Application by Atomic Energy of Canada Limited to Replace the AECL Prototype Waste Management Facility Licences*.

Part I of this report focuses on two of AECL nuclear sites in Canada. These sites are:

- AECL's Chalk River Laboratories
- AECL's Whiteshell Laboratories

The locations of AECL's nuclear sites in Canada are shown in figure 2.

Figure 2: Location of AECL's nuclear sites



## 2.1 Chalk River Laboratories

### 2.1.1 Overview

**Figure 2-1: Chalk River Laboratories as seen from above**



*(Source: AECL)*

Located on the south shore of the Ottawa River, 160 kilometres northwest of Ottawa, CRL is one of the most complex nuclear facilities in Canada. The CRL site is occupied by 159 buildings. Outside the built-up area, there are several waste management areas for handling and storage of both nuclear and non-nuclear waste. AECL employs approximately 3000 people at the CRL site. The site is expected to continue operating for many years, although some facilities will undergo decommissioning activities. For planning purposes, the remaining operational life of the site is assumed to be approximately 85 years.

The CRL site provides for the production of medical isotopes, the delivery of various nuclear services and the conduct of a wide variety of research and development programs. The site includes 12 Class I nuclear facilities in an operational state and six either in extended shutdown or in storage with surveillance, including research reactors, processing facilities, fuel manufacturing facilities, and hot cells. The site also includes 13 different waste management areas, five in operation and eight in long-term monitoring, three Class II nuclear facilities such as accelerators and irradiators, and more than 50 radioisotope laboratories, support facilities and offices.

After a two-day public hearing held on June 8, 2011 and October 4, 2011, the CNSC issued a five-year operating licence to AECL for the operation of the CRL site, valid from November 1, 2011 to October 31, 2016 [2]. To support licence renewal, AECL conducted an Integrated Safety Review of the NRU reactor which resulted in a list of actions referred to as the Integrated Implementation Plan (IIP). The IIP drives improvements related to the NRU reactor for the current licensing period (expiring 2016), and provides an overview of additional action plans for the period of 2016 to 2021. CNSC staff have been monitoring the progress of IIP actions throughout the review period. Details of the compliance activities related to oversight of IIP implementation are provided in the relevant SCA.

CNSC staff continue to verify implementation of AECL's programs at CRL and assess them against the performance objectives and compliance verification criteria defined in the regulations, the licence [1] and the Licence Conditions Handbook (LCH) [2, 3]. Verification includes desktop reviews and site inspections. Program documents referenced in the LCH are revised by AECL as needed; these are subject to desktop review by CNSC staff, as appropriate. Many inspections have been carried out during the review period; details of these are provided in the related SCAs within the report.

An update on the performance of CRL operations by SCA follows. For 2013, the ratings concerning each SCA are based on CNSC staff assessment for the review period. The review period for CRL is the complete 2013 calendar year and, when applicable, compares information to previous years. The report also provides recent updates on key issues through June 30, 2014.

## 2.1.2 Public information and disclosure

As previously stated, licensees are required to have a robust public information program and public disclosure protocol as a fundamental element in accordance with RD/GD-99.3, *Public Information and Disclosure*. As a component, where the public has indicated an interest to be informed, the program shall include a protocol for ongoing, timely communication of information related to the licensed facility during the course of the licence period.

AECL has met the requirement of RD/GD-99.3 when it comes to keeping the public informed of and disclosing activities at CRL, including for example, any environmental releases, emergency preparedness drills/exercises, and the posting of reports. AECL is aware of its role in the community and is also aware of sensitivities, which AECL regularly brings to its Environmental Stewardship Council.

When dealing specifically with Aboriginal communities interested in CRL, AECL conducts engagement activities targeted to them, including ensuring there is representation from Aboriginal groups on the Environmental Stewardship Council. During the review period, CNSC staff have been satisfied with AECL's engagement activities and deem them appropriate to keep interested Aboriginal groups informed.

### 2.1.3 Safety and control areas

Table 1 presents the ratings for CRL for the year 2013. All SCA ratings ranged from “below expectations” to “satisfactory” for this reporting period. A notable rating change was issued for the SCA “management system” previously reported as “below expectations” in CMD 13-M14 [4] and now rated as “satisfactory”. As indicated in [4], this SCA has been exhibiting an improving trend. Since the last CNSC staff report, AECL has completed several improvements that have resulted in the satisfactory rating. Regarding the SCA “fitness for service”, CNSC staff continue to rate this SCA as “below expectations” due to the aging and legacy issues of structures, systems and components (SSCs) at CRL, particularly the NRU reactor. More details on this SCA and the performance of all SCAs are contained within the particular sections below.

**Table 1: Performance ratings for Chalk River Laboratories**

<b>Safety and control area</b>	<b>Rating</b>
Management system	<b>SA</b>
Human performance management	<b>SA</b>
Operating performance	<b>SA</b>
Safety analysis	<b>SA</b>
Physical design	<b>SA</b>
Fitness for service	<b>BE</b>
Radiation protection	<b>SA</b>
Conventional health and safety	<b>SA</b>
Environmental protection	<b>SA</b>
Emergency management and fire protection	<b>SA</b>
Waste management	<b>SA</b>
Security	<b>SA</b>
Safeguards and non-proliferation	<b>SA</b>
Packaging and transport	<b>SA</b>

Notes:

- For specific areas within the SCAs where there were no significant observations from CNSC staff compliance verification activities, no information is given in the subsection of the report.
- The information presented below is site specific; general trends are not identified.

**Management system**

RATINGS FOR MANAGEMENT SYSTEM		
Overall Performance Ratings		
2011	2012	2013
BE	BE	SA
For the review period, CNSC staff rate the “management system” SCA at CRL as “satisfactory” primarily based on progress related to AECL’s transition to the CSA (Canadian Standards Association, now called the CSA Group), standard N286-05, <i>Management System Requirements for Nuclear Power Plants</i> , improvements made in safety culture and further implementation of the Operating Experience (OPEX) program.		

The “management system” SCA covers the framework establishing 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.

For CRL, this SCA encompasses the following specific areas:

- Management system
- Organization (see section 1.2 on AECL restructuring)
- Performance assessment, improvement and management review (no significant observations to report)
- Operating experience
- Change management
- Safety culture
- Records management (no significant observations to report)
- Management of contractors (no significant observations to report)
- Business continuity (no significant observations to report)

***Management system*****Transition towards compliance with CSA N286-05**

At licence renewal in 2011, CNSC staff indicated that AECL was transitioning to a management system for CRL, that met the requirements of CSA N286-05, *Management System Requirements for Nuclear Power Plants*. AECL’s transition plan to CSA N286-05, including the timelines, is listed in the LCH.

In the last review [4], CNSC staff noted that AECL was taking steps to implement the transition in accordance with its Project Execution Plan [6], identifying the actions and timelines to meet the requirements of the standard.

In July 2013, AECL reported that the transition activities included in Phase I of the Project Execution Plan were completed and concluded that "AECL's Management System substantially complies with the requirements of CSA N286-05", addressing over 80 percent of the previously identified gaps. CNSC staff observed that AECL had recognized the need to execute additional transition activities for gaps associated with the following elements of the standard:

- Operating procedures
- Changes are controlled
- Safety analysis
- Verification of work
- Preparation and distribution of documents are controlled
- Identification and labelling of systems and components
- Surveillance testing

AECL submitted the revised version of the Project Execution Plan, including in it, revised due dates for actions and additional transition activities (identified at the completion of Phase I) required for AECL's management system to become fully compliant with the standard. AECL progress against Phase II, ending June 30, 2015, is currently on track. CNSC staff recognize that this transition is a very lengthy process and that a cautious approach is required. The complete transition to CSA N286-05 is scheduled for June 2016.

As stated in CMD 13-M14 [4], acknowledging that AECL is taking appropriate steps to complete the transition to a management system fully compliant with the requirements of the standard, CNSC staff are conducting compliance verification activities of AECL's management system. Thus, CNSC staff are currently reviewing a sample of AECL's programmatic documents that have been revised as part of Phase I transition to CSA N286-05. Also, CNSC staff have conducted an inspection to assess AECL's implementation of its revised processes. These verification activities have focussed on key AECL processes, such as procurement, construction, installation, commissioning and turnover processes. Improvements are needed in the conduct of commissioning and completion assurance. AECL has submitted its proposed actions to address these elements which CNSC staff are reviewing.

#### Management System Manual

As previously reported [4], CNSC staff reviewed revision 2 of AECL's *Management System Manual* and identified opportunities for improvement related to consistent definitions of roles and responsibilities, and clarification of interfaces.

AECL recently revised its *Management System Manual* which documents the framework through which all work is managed and executed. CNSC staff are in the process of reviewing this manual, including several subsidiary documents to which it refers.

### *Operating experience*

The OPEX program at AECL comprises the processes that ensure the organization uses the experience both from within the organization and from industry peers to improve the safety of operations, improve operational performance, and reduce the significance and the occurrence of unplanned events. OPEX provides the process for the identification and investigation of unplanned events, the apparent cause analysis and root cause analysis, determination of corrective actions, notification of stakeholders, trending and information sharing internally and between industry peers.

The OPEX program has matured significantly since licence renewal in 2011, when many recently introduced processes were still in early development. Such processes include AECL's Improvement Action process which is the vehicle used for reporting adverse conditions, with a specific focus on events with potential consequences on health, safety, security and the environment.

The OPEX program was one of the areas identified as needing improvement under AECL's Voyageur Phase-II improvement plan, including the strengthening of the cause analysis processes, corrective action, trending and ensuring the broad use of lessons learned by AECL personnel to improve safety, reliability, time at risk and overall performance. All actions from the Voyageur Phase-II were completed, including those on OPEX processes. More details on the Voyageur Phase-II can be found in the safety culture section below.

Other processes under the OPEX program, such as trending, internal and external sharing of safety issues, communication of safety information and benchmarking appear to be effective and satisfactory. CNSC staff will continue to confirm this during an assessment of components of the OPEX program in 2015. The OPEX program has increased its presence at AECL, and its overall contribution to safety, by way of integration into processes, procedures, plans and operations has been beneficial.

### *Change management*

In September 2012, CNSC staff conducted an inspection of the organizational change control process, implemented at CRL in March 2011 within the 'Operations' Division. CNSC staff found that AECL followed this process for the reorganization; however, CNSC staff identified that AECL did not perform a post-reorganization assessment to evaluate the impact of the change as required by its processes. Consequently, CNSC staff requested AECL to conduct a post-reorganization self-assessment. AECL communicated the results of its self-assessment which was reviewed and accepted by CNSC staff. Further inspections of AECL's organizational change control process will be conducted to verify all elements of the process are being performed.



CNSC staff also identified the need for AECL to conduct self-assessments during the inspections of the NRU extended outage in 2012 and the system health program in 2013 (see the specific area “outage management performance” in the SCA “operating performance”). In both instances, AECL has committed to conducting self-assessments of these newly established processes to identify opportunities for improvement.

In conclusion, CNSC staff have observed that AECL would benefit from periodic reviews and self-assessments of important initiatives to confirm that they (1) meet requirements, (2) bring about the goals of the organization, and (3) identify opportunities for improvement. CNSC staff will continue to monitor AECL's performance of assessments during the remainder of the licence period.

### *Safety culture*

Safety culture at AECL has been the object of important strides for improvement, especially since the 2009 vessel leak event [5], which highlighted some shortcomings in the areas of safety culture and human performance. In response to this event, AECL undertook a significant effort to improve a wide range of programs and elements of safety culture and human performance. AECL built upon the Voyageur theme introduced in 2006 and revitalized this improvement plan as the Voyageur Phase-II. The Voyageur Phase-II included 98 actions linked to each of the contributing factors of the vessel leak event, many of which were in the area of safety culture. CNSC staff have closely followed the implementation of this plan, ensuring that AECL carries out the actions as committed in the Voyageur Phase-II. During the review period, CNSC staff verified that all actions under the Voyageur Phase-II were completed.

Changes in safety culture within AECL have been noticeable in a wide range of activities. CNSC staff observed the use of event free tools (questioning attitude, pre-job-briefings, procedure adherence, three-way communication, Stop-Think-Act-Review) in daily operations. Observation and coaching is also carried out broadly, contributing to improvements in safe practices.

### **Human performance management**

<b>RATINGS FOR HUMAN PERFORMANCE MANAGEMENT</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff continued to rate the “human performance management” SCA at CRL as “satisfactory”. Significant improvements were made during the review period including the completion of the Voyageur Phase-II, the creation of a formal Human Performance program, a program based on the Systematic Approach to Training and the development of the Practical Learning Facility.		

The “human performance management” SCA covers the 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.

For CRL, this SCA encompasses the following specific areas:

- Human performance program
- Personnel training
- Personnel certification
- Work organization and job design (no significant observations to report)
- Fitness for duty (no significant observations to report)



AECL employees participating in an on-the-job training session

### ***Human performance program***

AECL has made significant efforts to develop and improve human performance in all operations at CRL during the review period, particularly via the Voyageur Phase-II program. AECL has also implemented a Practical Learning Facility. The facility includes the following practice stations: Lock-Out Tag Out, use of harnesses, three-way communication simulator, including a rig with pumps circulating water with different controls and actuators, foreign material exclusion, fire response, and radiation protection.

In February 2013, during a controlled shut down of the NRU reactor, a potential loss-of-flow event occurred when inadvertent closure of the main heavy water pump outlet isolation valves was manually initiated. This event was reported to the Commission via an Event Initial Report (EIR) in May 2013 [6]. AECL completed a root cause analysis that identified causal factors and corrective actions, with a focus on training and the use of event free tools, to prevent recurrence of this event. AECL also performed a technical assessment of the potential consequences had the error not been discovered and the valves not been re-opened. CNSC staff continue to follow-up with AECL on this event and AECL's subsequent assessment of the potential impacts of a loss-of-flow event on the safety of the NRU reactor. As a corrective measure stemming from this event, all NRU direct operational personnel are required to complete Operator Fundamentals training in the Practical Learning Facility. CNSC staff note this facility and the mandatory training are significant developments in promotion of better human performance.

***Personnel training***

In 2013, CNSC staff conducted an inspection of AECL's Radiation Protection training program. The objective of the inspection was to verify compliance with AECL's Systematic Approach to Training (SAT), as required by section 3.2 of the LCH for the Chalk River Laboratories.

This inspection concluded that, although AECL has established training processes and procedures in accordance with SAT, AECL's Radiation Protection training program is not fully compliant with the processes and procedures under AECL's SAT-based training system. AECL subsequently developed an action plan to address the inspection findings which was found acceptable by CNSC staff. Completion of actions is targeted for April 2016. CNSC staff are monitoring the progress to completion of these actions.

***Personnel certification***

AECL is required to maintain a sufficient number of certified senior reactor shift engineers and NRU health physicists to support NRU operations. During the review period, AECL successfully certified four senior reactor shift engineers and one health physicist. CNSC staff are confident that all certified staff at CRL are competent to perform the duties of their respective positions.

The current complement of reactor engineers is deemed sufficient; however, CNSC staff have expressed concerns with the current complement of certified health physicists. Frequently, during the review period, NRU operations was reliant on one certified health physicist due to the unavailability of the other certified health physicist. The reliance upon one certified health physicist resulted in AECL requesting time limited changes from the LCH to allow a former certified health physicist to cover for periods of rest and vacations. This interim measure was accepted by CNSC staff with the commitment from AECL to develop a plan that will ensure sustainability of this position for future NRU operations. CNSC staff are tracking this plan closely.

**Operating performance**

RATINGS FOR OPERATING PERFORMANCE		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
The rating for the "operating performance" SCA over the review period is "satisfactory". Overall, AECL operated CRL safely and in compliance with the <i>Nuclear Safety and Control Act</i> (NSCA), regulations, conditions of the licence and the Licence Conditions Handbook, and in accordance with the licensing basis.		

The “operating performance” SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

For CRL, this SCA encompasses the following specific areas:

- Conduct of licensed activity
- Procedures
- Reporting and trending
- Outage management performance (NRU reactor)

### *Conduct of licensed activity*

Facilities at CRL are governed by AECL's *Facility Authorization and Conduct of Operations* documents, which indicate the operational limits and conditions for the various facilities. Facilities in storage with surveillance or undergoing active decommissioning are governed by storage-with-surveillance plans or decommissioning plans.

These governing documents prescribe how each facility are operated and maintained to ensure nuclear safety and keep the risk to the public acceptably low. As such, they are referenced in the CRL operating licence and listed in the LCH.

CNSC staff assessments conclude that AECL has conducted its activities at CRL in compliance with regulatory requirements and the licensing basis for CRL.

### *Procedures*

AECL maintains a comprehensive suite of procedures across all programs and facilities at the CRL site. During the review period, facility-specific procedures relating to operations, maintenance, and emergency response were reviewed and updated as required. There were no significant changes to operating documentation that could have affected the safe operation of facilities at CRL.

As part of the IIP, AECL is prepared to update operating manuals for the NRU reactor and issue the revised manuals for use. AECL has developed the framework by which the manuals will be revised, updated and validated to meet best practice. AECL continues to work toward the target end date of March 31, 2016, for this project.



Molybdenum-99 production technician

***Reporting and trending***

The requirements for reporting unplanned situations or events at CRL to the CNSC are prescribed in appendix H of the CRL's LCH. AECL has complied with the requirements for submission of these reports during the review period.

AECL categorizes reportable events by Significance Level as follows:

- Significance Level 1: Highly significant problem
- Significance Level 2: Significant problem
- Significance Level 3: Problem
- Significance Level 4: Minor problem/improvement

Events reported to the CNSC by Significance Level category are presented in table 2:

**Table 2: Reportable events for CRL (2011-2013)**

	2011	2012	2013
<b>Level 1</b>	-	-	1
<b>Level 2</b>	17	24	14
<b>Level 3</b>	162	95	110
<b>Level 4</b>	44	34	41
<b>Total</b>	<b>223</b>	<b>153</b>	<b>166</b>

The Level 1 event was reported to the Commission via an EIR [6] and is discussed in the human performance management SCA. CNSC staff's review of the other reports did not identify significant regulatory concerns, thus those were not subject to EIRs or otherwise reportings to the Commission.

AECL also submits annual reports on compliance monitoring and operational performance of facilities at CRL, as required by condition 4.16 of the CRL operating licence. No significant regulatory issues were identified during CNSC staff's review of these reports.

***Outage management performance (NRU reactor)***

Continued operation of the NRU reactor has historically relied upon periodic outages to conduct maintenance that cannot be performed with the reactor at power. AECL operates the NRU reactor for two to three weeks and then shuts it down for planned five-day maintenance outages.

Condition 16.1 of the CRL operating licence additionally requires AECL to implement extended outages for the NRU reactor in order to perform maintenance, inspection, repair and replacement activities that cannot be completed during the regular monthly maintenance outages, including hardware improvements required by the IIP.

CNSC staff closely monitored the 2011, 2012, and 2013 extended outages. AECL's performance in the planning and preparation of these outages has improved over time. Further monitoring will be conducted in order to assess AECL's management and implementation of activities.

### Safety analysis

RATINGS FOR SAFETY ANALYSIS		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the "safety analysis" SCA at CRL as "satisfactory" based on the information assessed. CNSC staff conclude that the implementation of the safety analyses at CRL meets applicable regulatory requirements.		

The "safety analysis" SCA covers maintenance of the safety analysis that supports the overall safety case for CRL facilities. 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 preventive measures and strategies in reducing the effects of such hazards.

For CRL, this SCA encompasses the following specific areas:

- Deterministic safety analysis
- Hazard analysis
- Probabilistic safety analysis
- Criticality safety
- Severe accident analysis
- Environmental risk assessment

#### *Deterministic safety analysis*

The safety analyses for CRL facilities are mostly deterministic complemented in cases by probabilistic safety analysis (PSA) and hazard analysis.

A formal Safety Analysis Report (SAR) is required under the *Class I Nuclear Facilities Regulations* for Class I nuclear facilities. In addition, AECL has performed safety analyses for its Class II nuclear facilities, radioisotope laboratories and other locations at CRL where nuclear materials are used. There are currently 33 safety analyses documented for Class I and Class II nuclear facilities. AECL has updated five SARs (for Recycle Fuel Fabrication Laboratories, Tritium Facility, Health Physics Neutron Generator, Fuel and Materials Cells Facilities, and the Van de Graaff Accelerator) and produced a SAR for the new Fuel Packaging and Storage facility. The safety analyses demonstrate that, for operation of the nuclear facilities, operational limits are not exceeded, radiological doses to workers and members of the public are within the prescribed limits, and releases of radioactive materials into the environment are within the limits allowed by the licence.

AECL has committed to completing the revision of the NRU reactor SAR by March 30, 2016, through the IIP. The revised SAR will incorporate and integrate results of previously submitted deterministic safety analyses, PSA, hazard analyses, criticality safety, and severe accident analyses. During an assessment, CNSC staff confirmed that AECL has taken some measures to expedite the initiation and execution of work by a contractor to recover delays in the project under IIP.

### ***Hazard analysis***

Various hazard analysis techniques are used to determine internal and external events to be considered for the design basis of new nuclear facilities at CRL. The major techniques used are Preliminary Hazard Analysis, Hazard and Operability Study, Failure Modes and Effects Analysis and "What If" Analysis. In addition, systematic review of hazards from similar facilities is performed. The extensive use of these hazard identification methods by AECL gives confidence that all major hazards are identified and have produced a clear design basis.

### **Fire protection**

AECL has a robust fire protection program in place for the CRL site which complies with the current licence and associated LCH, the *National Building Code*, the *National Fire Code*, and NFPA-801: *Fire Protection for Facilities Handling Radioactive Material*. During the review period, CNSC and AECL fire protection staff held regular meetings to discuss the progress of projects and any other programmatic matters or subjects of interest.

### ***Probabilistic safety analysis***

The probabilistic safety analysis is used where methods and data are available to complement the deterministic safety analysis in support of safety case for CRL facilities, and to evaluate and optimize facility design.

AECL has conducted Level 1 and Level 2 PSA for the NRU reactor according to REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants*. CNSC staff have reviewed AECL's Level 1 and Level 2 PSA and deemed them acceptable.

### ***Criticality safety***

This specific area addresses operations with fissionable materials outside nuclear reactors and prevention of nuclear criticality events.

CNSC requirements for the prevention of criticality accidents in operations with fissionable materials are documented in RD-327, *Nuclear Criticality Safety*. The associated GD-327, *Guidance for Nuclear Criticality Safety*, provides information on how to meet those requirements.

The CRL site operating licence requires AECL to implement and maintain a nuclear criticality safety program compliant with RD-327, *Nuclear Criticality Safety*. AECL has developed a suite of nuclear criticality safety program documents acceptable to CNSC staff. AECL has made significant progress in the implementation of the program through revisions and updates to the nuclear criticality safety documents.

There are currently 46 criticality safety documents for CRL. Due to the nature of the work changing since 2011, AECL has revised and updated 11 of these documents. AECL continues to conduct updates as needed.

### ***Severe accident analysis***

Regulatory document: REGDOC-2.3.2, *Severe Accident Management Program for Nuclear Reactors*, issued in September 2013, describes CNSC's expectation that AECL develops and implements measures to:

- prevent the escalation of a reactor accident into an event involving severe damage to the reactor core
- mitigate the consequences of an accident involving severe damage to the reactor core
- achieve a safe, stable state of the reactor and plant over the long term

Related to this specific area, AECL continues to implement the Fukushima action items established to address the recommendations of the CNSC Fukushima Task Force through the NRU's IIP. The progress of these actions can be viewed in appendix G of this report.

AECL has performed a severe accident analysis for the NRU reactor and developed a framework for development and implementation of an NRU severe accident management program (SAMP). The completion of SAMP implementation is targeted for September 30, 2015. CNSC staff confirmed through an assessment that AECL's project management tools and practices are helping AECL toward the successful completion of the SAMP project.



### *Environmental risk assessment*

AECL has performed an environmental risk assessment for the CRL site based on the CSA standard N288.6, *Environmental Risk Assessment at Class I Nuclear Facilities and Uranium Mines and Mills*. The assessment has predicted acceptably low risk and adequate provision for the protection of the environment and public.

On December 16, 2013, a [Memorandum of Understanding \(MOU\)](#) was signed between the CNSC and the Department of Fisheries and Oceans (DFO). Under the MOU, the CNSC is now responsible for reviewing licence applications for potential impacts to fish and fish habitats and informing the DFO of all applications where a *Fisheries Act* authorization is anticipated. The CNSC will also monitor compliance with any condition relating to fish and fish habitat in CNSC licences. The issuance of *Fisheries Act* authorizations remains the responsibility of the DFO Minister.

### Physical design

RATINGS FOR PHYSICAL DESIGN		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “physical design” SCA at CRL as “satisfactory” as the information assessed meets regulatory requirements.		

The “physical design” SCA relates to activities that impact upon the ability of structures, systems, and components (SSCs) and to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

For CRL, this SCA encompasses the following specific areas:

- Design governance
- Site characterization
- Facility design
- Structure design (no significant observations to report)
- System design (no significant observations to report)
- Component design (no significant observations to report)

### *Design governance*

Requirements specified in AECL's conduct of design engineering document and associated procedures and instructions ensure that:

- design activities are defined, effectively planned, and controlled
- work activities are coordinated and progress monitored
- performance of work is verified to meet design, customer, and regulatory requirements in accordance with approved procedures and applicable codes and safety standards

Several documents were updated in 2013 to improve the overall design engineering process addressing topics such as:

- Conduct of design engineering
- Design engineering and configuration management
- Engineering change control, including reduced risk engineering change control
- Field change control
- Technical operability evaluation
- Environmental qualification
- Human factors
- Contractor supplied design
- Release of design documents for manufacturing and construction
- Conduct of procurement engineering

Changes were also made to safety engineering procedures that impact upon the control of design processes. The changes to safety engineering procedures are discussed in the safety analysis SCA.

### *Site characterization*

AECL document *CRL Site Characteristics* provides details on the CRL site characteristics most commonly used in the preparation of other documentation, such as safety analysis reports. The information in this document is also intended to be used in the design of new, and modification of existing, nuclear facilities at CRL or CRL site infrastructure.

AECL revised and updated the document to include the lessons learned from Fukushima event. Some of the notable changes are:

- design basis tornado for the CRL site, which increased from a 1 to a 2 on the Enhanced Fujita Scale

- provisions of additional details added to the flood analysis to (a) summarize the analysis basis, its facts and assumptions, (b) address possible effects of a frozen river, and (c) review the models used to calculate flood levels and also the simulation software used to implement the models
- review of class IV power to address the expected improvements in class IV reliability as a result of class IV upgrade project
- information regarding the population around CRL which has been updated according to 2011 census data

### *Facility design*

CNSC staff reviewed the design of two new facilities: the Fuel Packaging and Storage (FPS) Facility and the Shielded Modular Above-Ground Storage building (SMAGS 3), located in the waste management areas.

#### Fuel Packaging and Storage facility

AECL has over 750 tile holes (below-grade vertical cylindrical concrete pipes sitting on a poured concrete base and backfilled with sand) located in the Waste Management Area B containing spent fuel rods used in research reactors and as prototypes. Approximately 100 tile holes have shown signs of degradation (e.g., fuel corrosion, production of hydrogen gas). AECL designed and built the FPS facility in order to retrieve the spent fuel from specific tile holes and store them in a better controlled and monitored facility and up to current standards.

The storage block of the FPS facility is designed to last at a minimum 50 years and will provide safe interim storage for the packaged fuel until a disposal or a long-term storage facility is available. The Nuclear Waste Management Organization (NWMO) assumes responsibility for long-term management of Canada's used nuclear fuel. The NWMO estimates an operating repository will be available within the next 30 to 40 years.



The Fuel Packaging and Storage facility storage block

The safety analysis report for the FPS facility demonstrates the adequacy of the facility design, and the Commission granted the approval to operate the FPS facility [7]. For more information on the FPS facility, see the waste management SCA.

Shielded Modular Above-Ground Storage building

SMAGS are engineered facilities designed for the storage of packaged low-level solid radioactive waste. CNSC staff have reviewed the design requirements document for the SMAGS 3 and concluded the SMAGS 3 was designed to an appropriate set of codes and standards. Subsequently, CNSC staff granted AECL the approval to construct the SMAGS 3.

**Fitness for service**

RATINGS FOR FITNESS FOR SERVICE		
Overall Performance Ratings		
2011	2012	2013
BE	BE	BE
For the review period, CNSC staff continue to rate the “fitness for service” SCA at CRL as “below expectations” due to the aging and legacy issues of systems, structures and components, particularly the NRU reactor.		

The “fitness for service” SCA covers activities that impact the physical condition of SSCs 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.

For CRL, this SCA encompasses the following specific areas:

- Equipment fitness for service / equipment performance
- Maintenance
- Structural integrity
- Aging management
- Chemistry control

### *Equipment fitness for service / equipment performance*

During the review period, AECL addressed a number of issues previously reported to the Commission [4], including the NRU reactor ceiling repairs, the active drain system lines replacement, the NRU reactor fixed radiation monitors, and the fire water supply system. Hardware improvements for the NRU reactor have also been implemented through the IIP. These improvements were confirmed by CNSC staff during the IIP assessment, and found that, for most of the items assessed, the equipment inspections or replacements had progressed or had been completed as planned. For instance, CNSC staff confirmed the completion of inspections of Building 440's (Emergency Water Supply) 35 cm and 50 cm pipes and valves, the replacement of the small gasholders bellows, the replacement and inspection of the heat exchangers 23 and 50, and rectifier #2.

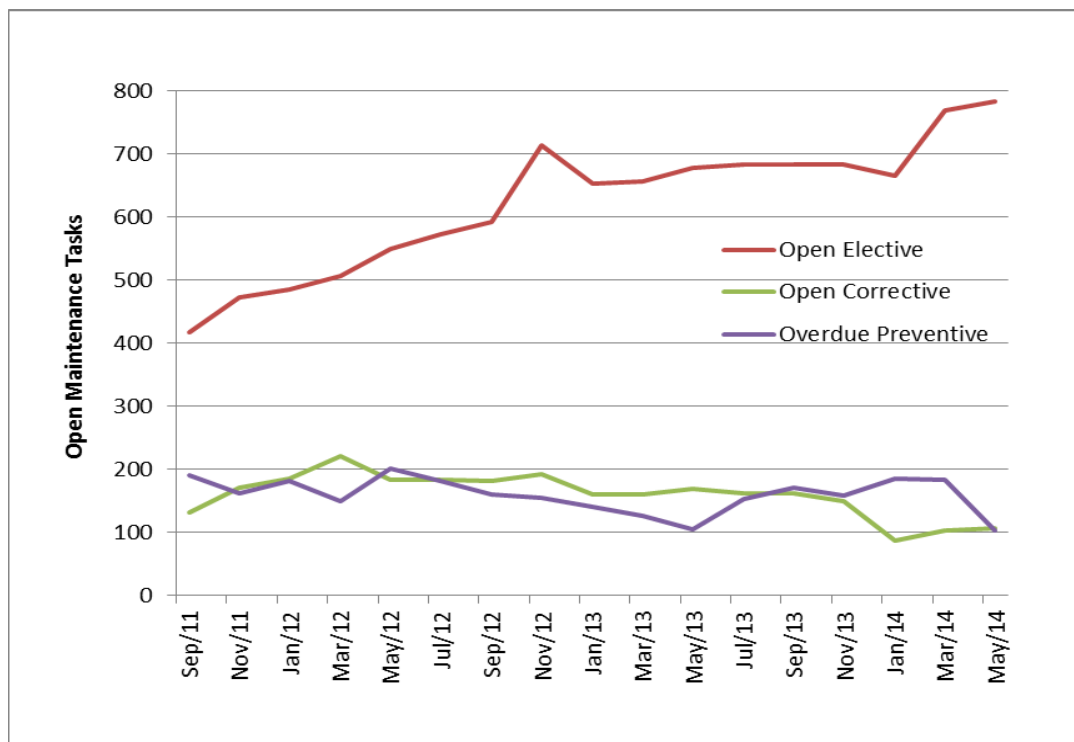
AECL continues to experience challenges due to equipment aging; however, in all instances, AECL has taken action to mitigate or correct the deficiencies. For example, there have been a number of issues with the NRU fuel rod flask and reactor control system that have been addressed by the replacement of the faulty components. AECL is implementing a more systematic approach to prevent recurrence of these events. CNSC staff will continue to monitor the reliability improvement of these NRU reactor systems during future assessments.

Finally, AECL has also reported a number of failures or degradations at the CRL steam system, which provides building heat to a majority of the CRL facilities and to some process systems. CNSC staff are satisfied by AECL's commitment to address the failures and degradation of the steam system, which has exceeded its design life, by repairing steam system components as they fail. In addition, AECL has launched a project to replace the Controlled Area-2 steam, condensate and compressed air systems. CNSC staff hold regular meetings with AECL to discuss the ongoing site infrastructure inspection, maintenance and systems replacement progress and implementation.

### *Maintenance*

Licence condition 7.1 requires AECL to develop, implement and maintain a maintenance program for SSCs important to safety. From the review of AECL's governing documents for the conduct of maintenance at CRL, CNSC staff conclude that the program meets the requirements of the licence and the criteria described in the LCH. Future planned inspections will focus on the implementation of the maintenance program at CRL.

Given the regulatory significance of the NRU reactor at CRL, CNSC staff focused on maintenance backlogs for the NRU reactor which are indicators of maintenance effectiveness and the facility's equipment condition.

**Figure 3: NRU reactor maintenance backlogs for CRL September 2011 to May 2014**

As shown in figure 3, an improvement has been observed since 2011 with respect to the NRU reactor corrective maintenance backlog, while the preventive maintenance backlog has remained constant and the elective maintenance backlog has steadily increased. Elective maintenance is the classification of any work on isotope production SSCs for which identified potential or actual degradation is minor and does not threaten component design function or performance criteria. Due to elective maintenance being considered lower priority work than preventive maintenance, the backlog has grown over the year. There will always be a certain level of maintenance backlog, due in part to the normal work management process, emergent conditions, and equipment aging. A reduction of the maintenance backlog in the NRU facility will remain a focus area for CNSC staff for the remainder of the licence period.

AECL has improved the preventive maintenance program by establishing categories of preventive maintenance tasks, along with a preventive maintenance deferral process that requires escalated approvals to defer preventive maintenance work based on safety significance. AECL is also developing a process to better incorporate technical basis into the NRU reactor's preventive maintenance activities as part of the overall equipment reliability program for the NRU reactor. AECL is improving the information available for preventive maintenance to better support execution. Additional NRU reactor outages are planned for 2014 to reduce the maintenance backlog.

A key item for the improvement of equipment safety and reliability is AECL's system health program which is being rolled out with the assessment of 46 systems in the NRU reactor and three Molybdenum Production Facility (MPF) systems. Even though the system health program's implementation is new to CRL, AECL is planning to expand the monitoring of the system health program to include the Power House. CNSC staff's review of the program governing documents and selected output documents from the system health monitoring concluded that AECL's governance is in line with the industry guidance and practice. However, some of the system performance monitoring plans and system health reports were incomplete and did not, in all instances, identify key issues affecting system reliability, such as critical spare parts and obsolescence.

In December 2013, CNSC staff conducted an inspection of the system health program implementation. From the inspection, CNSC staff concluded that the program is not fully implemented. Progress on a number of initiatives is required to sustain the program and its implementation. CNSC staff also noted that system health goals and priorities are not provided to assist personnel in making decisions, taking actions and implementing changes that contribute to the safe and reliable operation of the facilities. Finally, CNSC staff observed that the system health program would benefit from self-assessments to confirm that it meets requirements and to identify opportunities for improvement. CNSC staff consider that these additional improvements are required for the program to fulfill its stated objectives to increase safety and reliability of the nuclear facilities at CRL. AECL has developed an action plan to address the inspection findings which was found acceptable by CNSC staff. Completion of actions is targeted for the end of 2014. CNSC staff are monitoring the progress to completion of these actions.

### ***Structural integrity***

To satisfy licence condition 7.1, AECL is required to establish inspection programs to monitor the structural integrity of fluid boundary systems and components and civil structures that are important to safety, including those in the Main Heavy Water System, the U-1 and U-2 Loops and the Loop Test Sections. AECL has developed programs using guidance from CSA standards N285.4, *Periodic inspection of CANDU nuclear power plant components*, and CSA N291, *Requirements for safety-related structures for CANDU nuclear power plants*.

CNSC staff have reviewed the governing program documents and identified elements of the programs that do not meet the CSA standards. AECL has committed to addressing these elements in upcoming program revisions. CNSC staff have also identified other areas for improvements such as meeting program schedules, implementing program updates and the timely submission of annual inspection reports. CNSC staff will continue to monitor the implementation of the programs primarily through desktop reviews of the annual inspection reports and dispositions of inspection findings prepared by AECL.

In addition to the periodic inspection program, AECL is required to implement an in-service inspection program for the NRU vessel. The NRU vessel in-service inspection program is being implemented in accordance with the current program document. CNSC staff carry out desktop reviews of the annual vessel condition monitoring assessment which summarizes the inspection activities and CNSC site inspectors carry out on-site monitoring. The information provided to date by AECL indicates that annulus side corrosion of the vessel wall has not progressed at a rate that would challenge the current structural integrity of the vessel; however, CNSC staff remain concerned that the possibility of a localized leak that could challenge operability of the vessel cannot be completely ruled out. CNSC staff requested that AECL provides updates on the leak mitigation strategies.

### *Aging management*

Licence condition 7.4 requires AECL to develop, implement and maintain an aging management program at the CRL site. The progress of this initiative is tracked under the IIP for the NRU reactor. CNSC staff conducted a desktop review of AECL's submissions related to aging management, including: the aging management program documentation, obsolescence management program and the NRU aging management plan and NRU spare parts. Overall, CNSC staff conclude that AECL's aging/obsolescence management program and plan comply with the requirements in the LCH.

During the system health program inspection, CNSC staff confirmed that aging-related degradation mechanisms that required monitoring and inspections have been incorporated into the system health monitoring plans.

### *Chemistry control*

AECL is required by licence condition 4.14 to implement and maintain a chemistry control program for the NRU reactor main heavy water system and the waste contained in the Fissile Solution Storage Tank (FISST). This involves monitoring and analysis of chemistry parameters to demonstrate compliance with limiting conditions for operation of these facilities. AECL reported two limit exceedances at the NRU facility and one limit exceedance at the MPF. The events consisted of a defected fuel at the NRU facility, which led to exceedances of AECL's concentration limits for uranium and iodine in the main heavy water system. AECL is taking steps to return water chemistry to the normal range which includes addressing issues with the purification system (evaporator and ion exchange column).

With respect to the MPF, AECL reported an exceedance of an operating limit regarding the aluminum concentration in FISST. CNSC staff followed up on the approach implemented by AECL and confirmed the mitigation measures returned the chemistry to normal.



## Radiation protection

RATINGS FOR RADIATION PROTECTION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
<p>For the review period, CNSC staff continue to rate the “radiation protection” SCA at CRL as “satisfactory”. AECL has implemented and maintained a radiation protection program to control the radiological hazards present in its facilities and to ascertain doses for each person who performs duties in connection with their licensed activities, as required by the <i>Radiation Protection Regulations</i>. In addition, doses to the public continue to be well below the regulatory annual public dose limit.</p>		

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 as low as reasonably achievable (ALARA).

For CRL, 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

### *Application of ALARA*

As required by the *Radiation Protection Regulations*, AECL implemented a radiation protection program that integrates ALARA into planning, scheduling and work control.

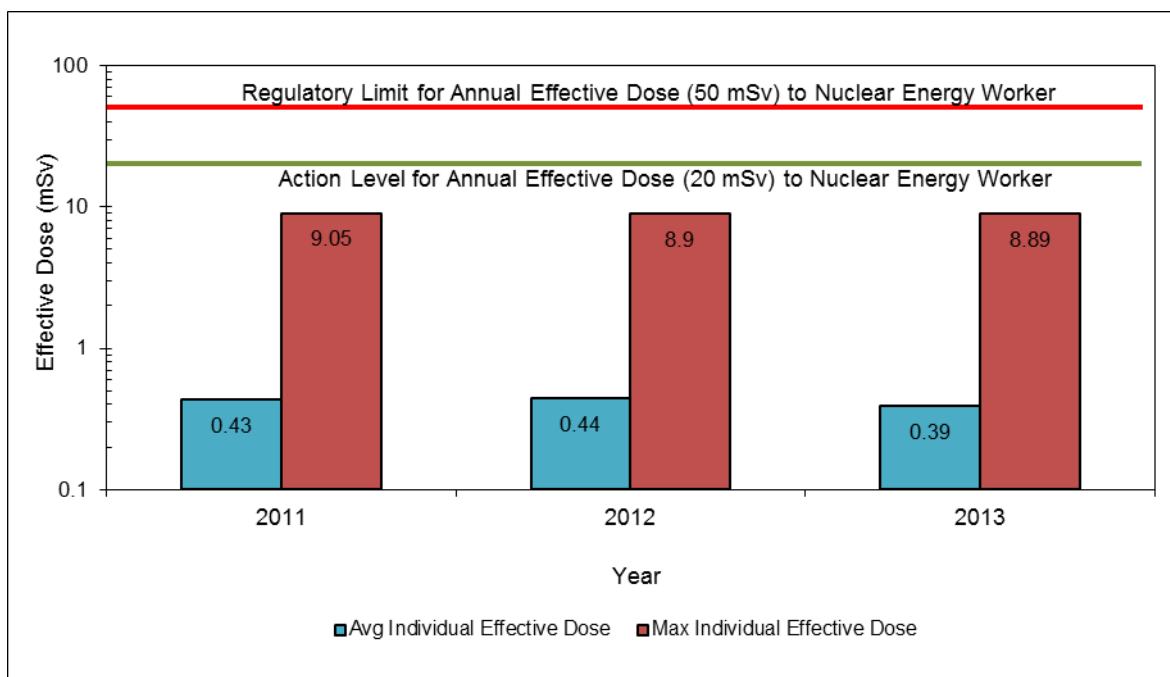
During the review period, AECL ensured that radiation exposures and doses to workers remain ALARA, taking into consideration social and economic factors.

### *Worker dose control*

AECL has a well-established system in place to control radiation doses received by workers, which CNSC staff monitored for adequacy and effectiveness via inspections and document reviews. At no time from 2011 to 2013, did AECL report that an employee received a radiation dose exceeding the regulatory limits for nuclear energy workers, as specified in the *Radiation Protection Regulations*. Figure 4 provides the average and maximum individual annual effective worker doses at CRL from 2011 to 2013. Additional worker dose statistics can be found in appendix E.

CNSC staff's review of AECL's dose data for the CRL site concluded that AECL adequately controlled worker doses.

**Figure 4: AECL-CRL worker effective dose (2011-2013)**



### ***Radiation protection program performance***

AECL's performance in regards to radiation protection has been assessed through CNSC staff compliance activities. These activities included inspections of CRL facilities by CNSC site inspectors with a focus on radiation protection to assess compliance with regulatory and AECL's programmatic requirements, as well as to assess the effectiveness of the program's implementation.

Although these compliance activities identified areas for improvement, CNSC staff's assessment is that overall, AECL's corrective actions stemming from the findings have been appropriate, and that compliance with the radiation protection program has been acceptable.

One component of AECL's radiation protection program is its dosimetry service. In 2013, AECL discovered that approximately 1650 worker dose records were not transferred to the National Dose Registry as required by AECL's Dosimetry Service Licence [8]. This event was reported to the CNSC and also to the Commission via an EIR [9]. Upon further investigation, AECL reported an additional event where tritium doses were not assigned and subsequently not included in the dose totals for approximately 100 contractors and visitors. This event was also reported to the CNSC and to the Commission via CMD 14-M5: *Compliance Activities Following Discovery of Dose Records not submitted to the National Dose Registry*.

CNSC staff view the consequences of these two events as minimal, since the magnitude of each of the doses involved was small. To date, AECL has implemented several improvements to strengthen dosimetry record control, review, and acceptance within dosimetry services. However, the radiation protection program is dependent on the reliable provision of accurate dose results to optimize the control of work, to limit radiation exposure to acceptable levels, and to evaluate the effectiveness of the program. Therefore, future verification activities are planned by CNSC staff to ensure the accuracy and completeness of AECL's dose records. This will include a review of the dosimetry program with program elements and interfaces with AECL's operating licence.

### ***Radiological hazard control***

As part of its Radiation Protection program, AECL has established a number of action levels that, if reached, trigger its staff to establish the cause for reaching the action level and, if applicable, restore the effectiveness of the Radiation Protection program. AECL reports all action level exceedances to the CNSC.

During the review period, no radiation exposures received by workers at the CRL site resulted in a dose that exceeded the regulatory limits. Furthermore, the maximum whole body dose has remained less than 20 mSv, with no worker exceeding any of AECL's dose action level in the years 2012 or 2013.

There was, however, one instance of an action level exceedance in 2011. In this case, a worker was assigned a skin dose of 273 mSv due to a local-area (1 cm<sup>2</sup>) skin contamination event; this value exceeded AECL's action level of 50 mSv. In that case, CNSC staff determined that AECL took appropriate measures to decontaminate the individual, to investigate the cause and to enact corrective measures.



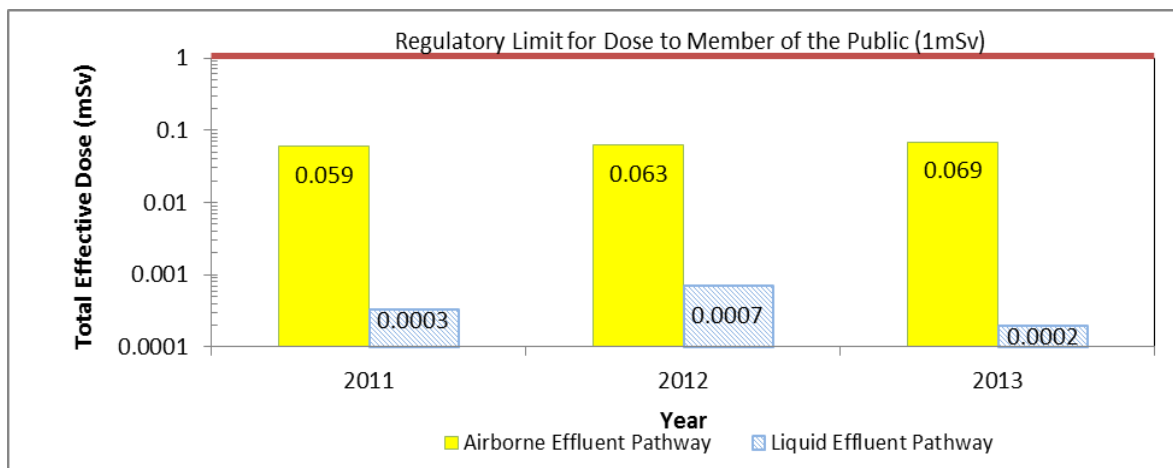
Worker measuring dose rates

### ***Estimated dose to the public***

The dose to the public from CRL operations is calculated by using environmental monitoring results. Components including Ottawa River water, ambient air, sand along the Ottawa River shoreline, and food are measured both on the CRL site and off site in neighboring communities. Airborne and liquid exposure pathways such as inhalation and ingestion are also taken into account when determining public dose.

Doses to the public continue to be well below the regulatory annual public dose limit of 1 mSv, as shown in figure 5.

**Figure 5: Effective dose to a member of the public (2011-2013)**



**Conventional health and safety**

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “conventional health and safety” SCA at CRL as “satisfactory”. Overall, compliance verification activities conducted throughout all licensed facilities at CRL confirm that AECL continues to view conventional health and safety as a paramount consideration in all activities. AECL has demonstrated a satisfactory ability to keep its workers safe from occupational injuries.		

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

For CRL, this SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness

### *Performance*

A key performance measure for this SCA is the number of Recordable Lost-Time Injuries (RLTIs) that occur per year. An RLTI 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. In reviewing RLTIs, CNSC staff must also consider the severity of these injuries (e.g., the total days lost) and the frequency as they relate to the size of the workforce. The severity rate is a measure of the total number of days lost due to injury for every 200,000 person-hours worked at a site and the frequency is the number of fatalities and injuries (lost time and medically treated) due to accidents for every 200,000 person-hours worked at a site.

As per table 3, the frequency and the severity rates of RLTIs in 2013 are reduced below the levels in the previous two years (2011 and 2012). The reduction in severity rate is a direct result of increased management focus on the return to work program. This program supports safe and early return to work within the abilities of the injured worker, leading to fewer lost work days.

In 2013, AECL provided more training to its employees, increasing the awareness of occupational hazards, and has put further measures in place to reduce the exposure to conventional hazards (such as improved machine guarding, protective equipment and clothing and introduction of a safe lifting, hoisting and rigging procedure).

**Table 3: Recordable lost-time injuries (RLTI), frequency and severity at CRL 2011-2013**

<b>Year</b>	<b>RLTIs</b>	<b>RLTI Frequency</b>	<b>RLTI Severity</b>
<b>2011</b>	13	0.53	6.55
<b>2012</b>	21	0.68	5.65
<b>2013</b>	18	0.56	2.68

### *Practices*

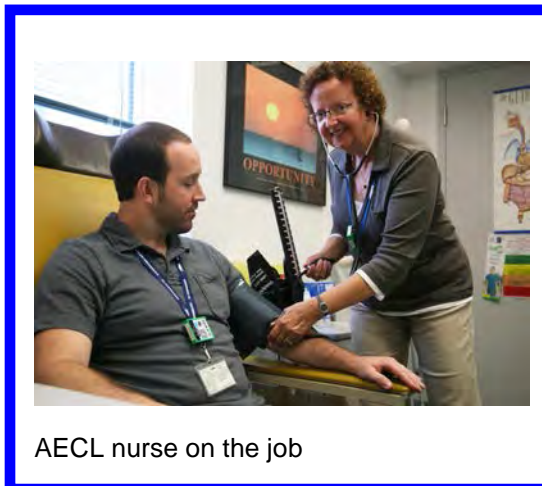
In addition to the NSCA and its regulations, AECL's activities and operations at the CRL site must comply with Part II of the *Canada Labour Code* and the *Canada Occupational Health and Safety Regulations*, the *Hazardous Products Act*, *Controlled Products Regulations*, *Workplace Hazardous Materials Information System*, and other applicable federal and provincial health and safety-related acts and regulations.

CNSC staff have confirmed through its various inspections that AECL has met the performance objectives and requirements for housekeeping and management of conventional hazards, in accordance with the regulatory requirements and AECL's own occupational health and safety program.

**Awareness**

AECL continues to develop and maintain a comprehensive Occupational Health and Safety program for the CRL site.

During the reporting period, AECL has improved aspects of the program based on best industry practices and results from incident investigations as well as results of internal focused audits. CNSC staff have noted improvements in the work authorization and approvals process and in the oversight and management of contractors.



AECL nurse on the job

In 2013, a Practical Learning Facility was constructed that allows enhanced hands-on training for conventional hazards encountered at CRL - such as confined space entry, Lock-Out Tag-Out, and working at heights (see specific area human performance program for more details). Additionally, AECL has executed due diligence training and rolled out a company-wide initiative called the "Rules to Live By". Both of these initiatives aim to heighten worker and management awareness of conventional hazards. CNSC staff will continue to monitor the effectiveness of these improvements through future inspections.

**Environmental protection**

RATINGS FOR ENVIRONMENTAL PROTECTION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff rate the "environmental protection" SCA at CRL as "satisfactory". AECL continues to implement and maintain an environmental protection program to control and monitor liquid and air releases of nuclear and hazardous substances to the environment.		

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

For CRL, this SCA encompasses the following specific areas:

- Environmental management system
- Effluent and emissions control (releases)
- Assessment and monitoring
- Protection of the public

#### ***Environmental management system***

AECL must have adequate provision for protection of the environment via policies, programs and procedures at CRL, as required by the CNSC S-296, *Environmental Protection Policies, Programs and Procedures at Class I Nuclear Facilities and Uranium Mines and Mills*. AECL's environmental protection program consists of an environmental policy, along with comprehensive programs and procedures to protect the environment. These include an environmental monitoring program at CRL comprising of three integrated components: effluent monitoring, environmental monitoring, and groundwater monitoring. Through sampling and analysis for nuclear and hazardous substances, this program assists in verifying that releases from CRL do not pose hazards to the environment or human health.

The AECL environmental management system is ISO-14001 registered, and is subject to periodic audits and reviews to identify potential improvements.

#### ***Effluent and emissions control***

CSA N288.5, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, was published in 2011 and listed within the LCH. AECL assessed the existing CRL effluent monitoring program against this standard to identify areas of non-conformance. Appropriate modifications to the program were made such that it is now fully compliant.

The supporting data for the environmental protection SCA section are located in appendix F and discussed below.

#### **Nuclear substance releases**

Annual liquid and airborne effluent release limits were introduced into the CRL operating licence in 2011 (appendix A of [1]). These limits are based on a dose limit to the critical group of 0.3 mSv due to the sum of all releases from CRL in any period of 12 consecutive months. During 2012 and 2013, there were no airborne or liquid exceedances of these release limits, either by individual parameter or in any 12-month period.

As part of its environmental protection program, AECL has established a number of action levels that if exceeded may indicate a loss of operational control. If an action level is reached, AECL is required to establish the cause and if applicable, restore the effectiveness of the program. AECL is required by the LCH to report all action level exceedances to the CNSC.

In 2012, there were no action level exceedances at the CRL site.

In 2013, there were no action level exceedances for liquid releases at the CRL site.

There were, however, 30 action level exceedances for airborne releases in 2013. Of particular note were 15 iodine-131 exceedances that occurred in October 2013 at different locations across the CRL site. The increased emissions did not result in an exceedance of regulatory limits for worker dose or environmental releases. AECL conducted a consolidated investigation into these exceedances to identify potential common causes. AECL's investigation concluded that the higher Iodine-131 emissions were related to operations of the MPF and the isotope production process. AECL has identified corrective and remedial actions, including reinstating more frequent operating equipment maintenance and cleaning. CNSC staff will monitor AECL's implementation of these corrective actions.

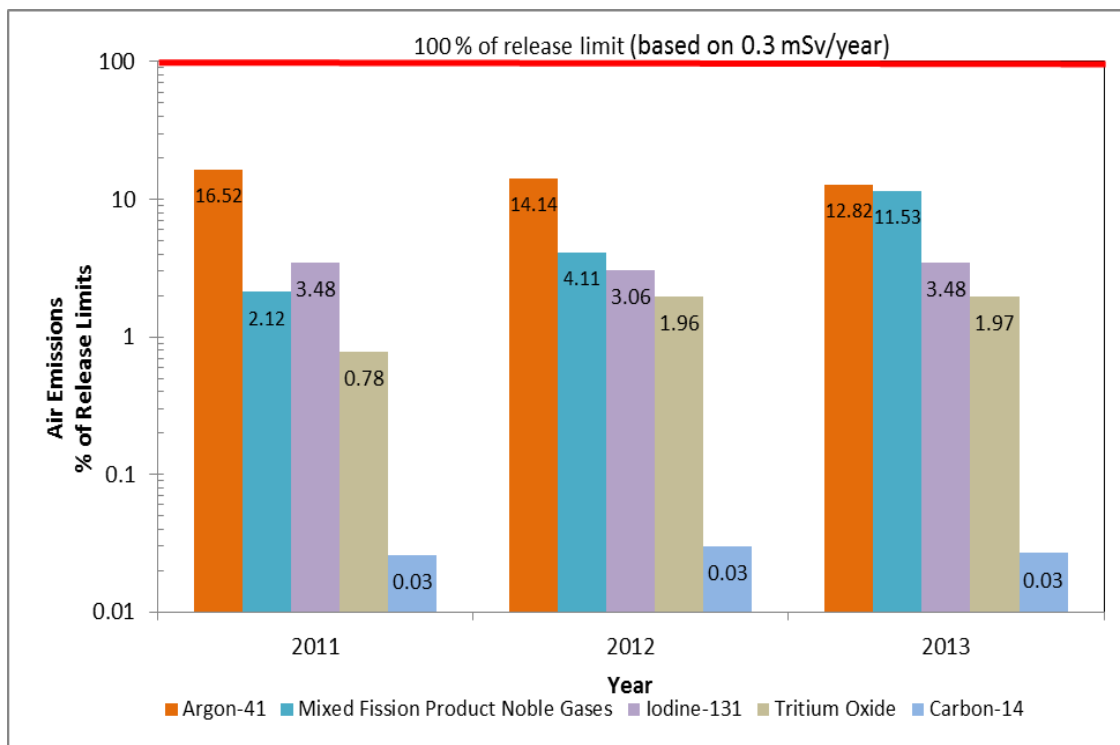
#### Airborne nuclear substance releases

AECL's radiological air effluent verification program at CRL comprises 51 monitoring points, including the NRU reactor stack and the MPF stack. Monitoring is either by direct measurement or by sampling and analysis for radionuclides. The main airborne contaminants are argon-41 from the NRU reactor stack, noble gases from the MPF, iodine-131 from the cemented molybdenum waste process, carbon-14 and tritium oxide (see appendix F).

The airborne radiological emissions from the CRL continue to be effectively controlled and below the annual release limits, as shown in figure 6.



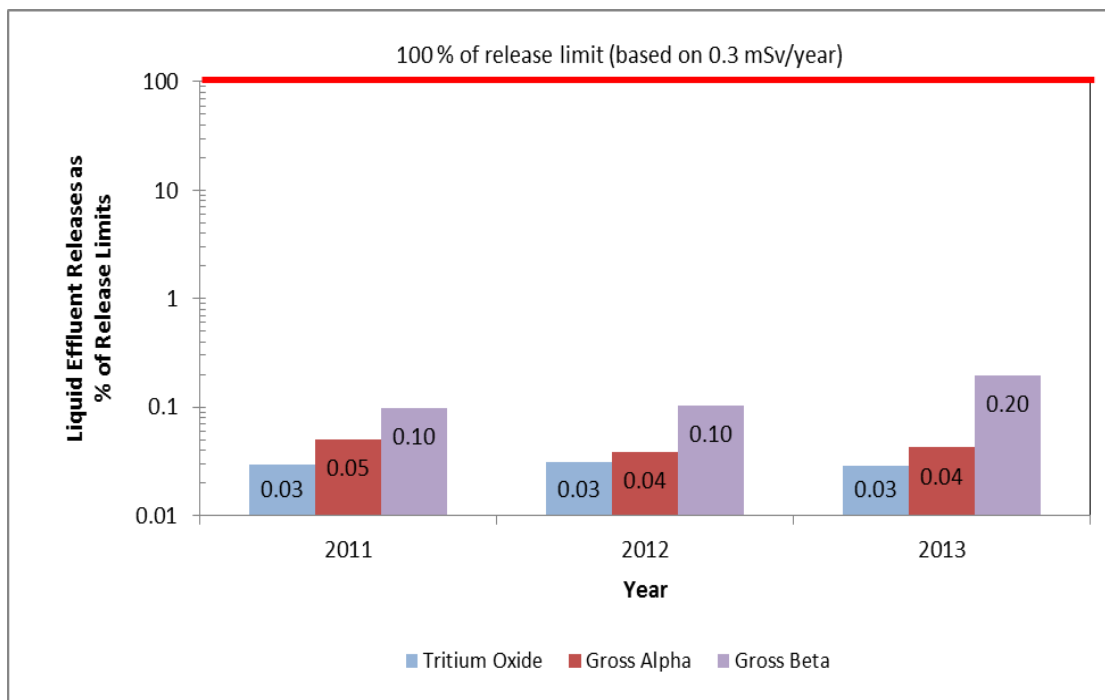
**Figure 6: AECL's CRL airborne nuclear substance releases (2011-2013)**



Liquid nuclear substance releases

AECL's nuclear liquid effluent verification program at CRL comprises 14 monitoring points for effluent streams flowing into the Ottawa River, discharges to Maskinonge Lake, and groundwater to the Ottawa River. Monitoring is either by direct measurement or by sampling and analysis for radionuclides including tritium oxide, gross alpha and gross beta.

The liquid nuclear emissions from the CRL continue to be effectively controlled and below the annual release limits, as shown in figure 7.

**Figure 7: AECL's CRL liquid nuclear substance releases (2011-2013)**

#### Airborne hazardous substance releases

The main stationary sources of hazardous effluents to air from the CRL site are the Powerhouse stacks. The Powerhouse burns Number 6 fuel oil to supply district heating and process steam to the main buildings. AECL estimates emissions using oil consumption data and emission factors provided by Environment Canada. The estimated emission results are compared to the compliance verification criteria set forth in the CRL's LCH. These criteria include limits for Air Contaminants such as: carbon monoxide, nitrogen oxides, sulphur dioxide, total particulate matter, particulate matter < 10 µm, particulate matter < 2.5 µm, and volatile organic compounds.

For 2012 and 2013, the estimated releases for each parameter were compliant with the compliance verification criteria set in the CRL LCH.

#### Liquid hazardous substance releases

AECL monitors 12 effluent streams that discharge to the Ottawa River from the CRL site for hazardous parameters, and compares the concentrations of significant effluent against compliance verification criteria set forth in the LCH and AECL's internal guideline values. A wide variety of parameters are measured including mercury, phenolics, zinc, iron, phosphorus, nickel, and Total Suspended Solids.

In 2012, there were no exceedances of the liquid compliance verification criteria set out in the CRL's LCH. In 2013, there was one exceedance of the criteria, for mercury in the Waste Treatment Centre's Liquid Water Evaporator.

The number of AECL guideline exceedances for 2012 and 2013 were 25 and 32, respectively. The exceedances occurred at the Waste Treatment Center (Liquid Waste Evaporator and Building 205 tanks) for phenolics, iron and Total Suspended Solids; at the Sanitary Outfall for Biological Oxygen Demand and nickel at the Storm Outfall (4F7) for iron. CNSC staff accept AECL's conclusion that there were no identified negative impacts on the environment due to guideline exceedances.

### ***Assessment and monitoring***

CSA N288.4, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, was revised and reissued in 2010 and listed within the LCH. AECL assessed the existing CRL environmental monitoring program against this standard to identify areas of non-conformance. Appropriate modifications to the program were made such that it is now fully compliant.

### **Environmental monitoring**

AECL maintains a comprehensive environmental monitoring program for CRL to verify that radiation doses to members of the public, as a result of nuclear releases from the CRL site, remain ALARA, social and economic factors being taken into account. The program also serves to verify that hazardous releases do not pose hazards to human health and that neither nuclear releases, hazardous releases, nor physical stressors pose hazards to the environment.

The nuclear component of the program is conducted through routine collection and analysis of environmental samples from locations at the CRL site and in the surrounding area. Monitored media include ambient air, foodstuffs (such as milk, fish, garden fruits and vegetables), large game and farm animals, groundwater, Ottawa River water and other surface waters onsite and offsite. Monitoring of beach sand and river sediments is also performed.

The hazardous component focuses on onsite surface waters and groundwater. Environmental sampling for hazardous analysis is performed on nine surface monitoring points on the CRL site. It also includes monitoring for physical stressors, biodiversity (including species at risk) and fish impingement.

Environmental monitoring results in 2012 and 2013 continue to demonstrate AECL's successful implementation of an environmental monitoring program at CRL. The environmental monitoring program assists in verifying that releases from CRL do not pose hazards to the environment or human health.

In 2012, CNSC staff conducted an inspection of the environmental monitoring program at CRL. No compliance actions were identified.

### Ottawa River monitoring

Along with monitoring surface water from locations on the CRL site, AECL also samples surface water at nine locations along the Ottawa River between Rolphton and Pembroke, and at 14 locations along streams outside the CRL boundary. Water samples are analyzed for radionuclides such as tritium, gross alpha, gross beta, total strontium and cesium-137. The sampling results for 2012 and 2013 demonstrate that radionuclide concentrations in the Ottawa River water remain very low. Tritium concentrations at all monitoring locations are well below the Maximum Acceptable Concentration of 7000 Bq/L indicated in Health Canada's *Guidelines for Canadian Drinking Water Quality*. Specifically, annual average concentrations of tritium in water ranged from 3 to 64 Bq/L in 2012 and from 2 to 43 Bq/L in 2013, with the maximum values occurring downstream at the CRL site boundary (Pointe au Baptême). Tritium concentrations decrease with distance from the CRL site, with average tritium concentrations at Petawawa and Pembroke of 4 Bq/L in 2012 and 2.5 Bq/L in 2013.

### Groundwater monitoring

AECL's groundwater monitoring program involves approximately 180 monitoring wells located at 32 different monitoring sites. Groundwater from these wells is sampled on an annual or semi-annual frequency and analyzed for radionuclides including tritium, strontium-90, cobalt-60, gross beta, and gross alpha.

The legacy plumes in the waste management areas and Controlled Area 1 (built up area, non-radiological side) are contained within the CRL site. The Controlled Area 2 (built up area, radiological side) region contains two plumes that extend from the National Research Experimental (NRX) and the NRU reactor source areas to the Ottawa River. The NRX plume is dominated by strontium-90 and the NRU reactor plume is dominated by tritium. Groundwater monitoring results demonstrate that the plumes are essentially stable. Tritium concentrations downgradient of NRU are expected to decrease over time following the swap of the NRU rod bays water which occurred in November 2012.



Workers sampling ground water at CRL

### Environmental assessment follow-up

In accordance with the *Canadian Environmental Assessment Act*, several environmental assessments have been completed for projects at the CRL site. Some of these assessments identified follow-up commitments to verify the accuracy of the assessments conclusions and the effectiveness of mitigation measures.

AECL is required by condition 10.5 of the CRL operating licence to report on the environmental assessment follow-up programs. To date, AECL has submitted the annual reports as required, and has completed many of the follow-up commitments. CNSC staff continues to review and assess AECL's follow-up reports.

### ***Protection of the public***

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the CRL licence and LCH.

Review of hazardous (non-radiological) discharges to the environment for CRL in 2012 and 2013 indicate that no significant risks to the public or environment occurred during this period.

In 2013, CNSC staff conducted an inspection of the CRL hazardous waste management program. Most requirements of this program were effectively implemented and several positive operating practices were observed; however, some findings such as incomplete Waste Management Plans and not following the Waste Management program's process for disposing of hazardous waste were also identified. AECL provided an action plan to address the inspection findings, which has been accepted by CNSC staff. CNSC staff have continued and will continue to monitor the effective implementation of the corrective action plan.

### **Emergency management and fire protection**

<b>RATINGS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff continue to rate the "emergency management and fire protection" SCA at CRL as "satisfactory". Overall, compliance verification activities conducted at CRL confirm that AECL continues to maintain a comprehensive and well-documented emergency management program and fire response that met applicable regulatory requirements.		

The "emergency management and fire protection" SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.

For CRL, this SCA encompasses the following specific areas:

- Conventional emergency preparedness and response
- Nuclear emergency preparedness and response
- Fire emergency preparedness and response

### *Conventional emergency preparedness and response*

AECL continues to maintain and enhance its conventional emergency preparedness and response capabilities at CRL. CNSC staff have verified the response programs against the regulatory criteria set out in the operating licence and the LCH. The programs continue to be maintained through training, and the execution of drills and exercises.

### *Nuclear emergency preparedness and response*

AECL continues to maintain and improve its nuclear emergency preparedness and response capabilities at the CRL site. Proficiency within this area was achieved through regular and on-going training, drills and exercises, as specified in the site emergency management program documentation.

As per the CNSC inspection schedule, CNSC staff performed an inspection of a site stay-in exercise during the annual report review period. This inspection confirmed that AECL maintains sufficient provisions for emergency preparedness and response capability needed to mitigate the effects of an accidental release of nuclear and/or hazardous substances. However, areas for improvement were identified (which AECL has since addressed); these included immediate access to emergency facilities, communication protocols and alternate sheltering requirements for the affected building.

### *Fire emergency preparedness and response*

CNSC staff performed two inspections of AECL's Industrial Fire Brigade response at CRL and concluded that improvements were required in the interoperability of responders. AECL has executed a comprehensive corrective action plan to ensure fire fighters can perform firefighting duties without undue delay.



This was achieved by documenting interoperability requirements and training all responders on the expectations. CNSC staff will continue to monitor the effectiveness of these improvements via future inspections. Of note, significant investment has been made in acquiring additional firefighting equipment (aerial platform vehicle) to enhance the firefighting capabilities. This equipment was purchased in response to the events related to Fukushima. For more information on the status of Fukushima actions, see appendix G.

## Waste management

RATINGS FOR WASTE MANAGEMENT		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
<p>For the review period, CNSC staff conclude that the rating for “waste management” SCA at CRL is “satisfactory”. All radioactive waste is managed in accordance with applicable regulations and internal procedures. The CRL waste management program documents and implements requirements for minimization, segregation, characterization, handling, monitoring, storing, and processing of radioactive waste.</p>		

The “waste management” SCA covers internal waste-related programs that form part of the facility’s operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning.

For CRL, this SCA encompasses the following specific areas:

- Waste characterization and minimization
- Waste management practices
- Decommissioning plans

### *Waste characterization and minimization*

The Waste Management Areas (WMA) provides interim storage capability for the solid radioactive waste produced at the CRL from operational and decommissioning activities and from offsite organizations. Radioactive liquid waste is collected, sampled and transferred to the Waste Treatment Centre where it is processed prior to release to the process outfall.

AECL’s waste management program establishes the requirements for waste management activities at AECL sites for both radioactive and hazardous wastes. The CRL waste management program identifies, documents and implements requirements for waste minimization at the source, and for segregation, characterization, packaging, processing, storage, and properly disposal of the waste.

### *Waste management practices*

Waste management practices align and comply with the AECL’s program requirements and procedures, CRL licence conditions, applicable federal and provincial acts, regulations and guidelines, and national/international codes, standards and guidelines.

During the review period, AECL has either completed a number of waste management projects or made significant progress including the following:

- As indicated previously in the physical design SCA, construction completion of the FPS facility and construction approval for the SMAGS 3 were granted to AECL
- Final repair of the active drain line between the decontamination centre (B468) and B242 with a like for like piping system
- Remediation of the active liquid waste in WMA "A". Radioactive liquid was successfully removed from the tanks and shipped offsite for processing
- WMA "C" engineered cover project completed. A multi-layer impermeable cover was installed over WMA "C" to prevent infiltration of rainwater and intrusion into the buried waste
- South Swamp Initiative: The permeable reactive barrier has been installed down-gradient of WMA "A" to intercept and treat the contaminated groundwater. Installation of the cover over WMA "A" is planned following completion of intrusive characterization activities in WMA "A"

The following subsection describes the progress of some projects under the Nuclear Legacy Liabilities Program, as previously described in section 1.5.

#### Stored Liquid Waste Cementation project

The intent of the Stored Liquid Waste Cementation (SLWC) project is to recover and solidify the remaining contents (liquid and/or sludge) of 20 legacy liquid waste tanks, and prepare the tanks for decommissioning.

AECL continues its care, maintenance and monitoring of the legacy tanks, and also improves the monitoring program to strengthen reliability. AECL removed almost 75 percent (32 m<sup>3</sup>) of the radioactive liquid waste from Tank 40D (single walled direct buried with the most significant liquid inventory) in 2013 with further removal planned for 2014.

AECL engaged in negotiations with three proponents who had been selected based on their submissions in response to the SLWC project request for proposal. AECL has awarded three conceptual design contracts to contractors. AECL anticipates having the conceptual design selected by January 2015, which will provide basis for the project description preparation.

From a project perspective, AECL has developed product performance criteria to meet the interim storage and long-term waste management requirements and, through testing, reduced the risk of identifying potential concerns with increasing the waste product mass to the production scale.

AECL anticipates that the inventory of the remaining legacy tanks can be addressed by 2021/2022.



### Very Low-Level Waste facility

The Very Low-Level Waste (VLLW) facility will provide for the long-term management of waste such as slightly contaminated soil, vegetation, concrete, asphalt and decommissioning rubble and building materials that is considered as exceeding the waste acceptance criteria and unconditional release limits for offsite landfills. Two preferred sites at CRL were selected to host the facility, the conceptual design is complete and the contract for the detailed design was awarded in December 2013.

### Highly-Enriched Uranium Repatriation project

In April 2010, the governments of Canada and the United States (U.S.) committed to work cooperatively to repatriate spent highly-enriched uranium (HEU) fuel currently stored at Chalk River Laboratories to the United States. Repatriation activities are part of the Global Threat Reduction Initiative, a broad international effort to consolidate HEU inventories in fewer locations around the world. In March 2012, Prime Minister Harper announced that Canada and the U.S. were expanding their efforts to return additional inventories of HEU materials, including those in liquid form. HEU in Canada is essentially of U.S. origin, and has been used over decades in fuel for research reactors and for the production of medical isotopes. AECL is currently working to fulfill Canada's commitment to return these inventories to the U.S.

All shipments of HEU follow stringent transportation and security requirements. HEU is transported in packages (casks) that are specifically designed for this purpose. The CNSC, the U.S. NRC and the U.S. Department of Transportation certify these transportation packages. Certification of these packages is in accordance with international safety requirements established by the International Atomic Energy Agency (IAEA).

Shipments are also subject to stringent security plans. Specific details on shipments are considered prescribed information (as per the *General Nuclear Safety and Control Regulations*) and details on transportation activities are limited to persons who have a legitimate need to know. Transportation routes and security measures put in place are pre-approved and agreed to by authorities in both Canada and the U.S.

In 2013, AECL completed the repatriation of two disassembled Highly Enriched Uranium SLOWPOKE research reactor fuel cores to the U.S. In addition, the transport package for the repatriation of spent fuel rods from research reactors in Chalk River, were certified both in Canada and the U.S. The certification process for the transport package for HEU in liquid form remains on going.

In support of repatriation activities, AECL has undertaken a communication program that consists of the production and maintenance of online information ([www.AECL.ca](http://www.AECL.ca)) and the provision of repatriation updates to local stakeholders.

### *Decommissioning plans*

In March 2014, pursuant to the CRL licence condition 12.2, AECL submitted an updated version of the Comprehensive Preliminary Decommissioning Plan (CPDP). The CRL CPDP has been updated to reflect and incorporate changes since the last revision, including other changes resulting from the 2013 review of the AECL nuclear legacy liabilities cost estimate. CNSC staff reviewed AECL's submission and found it acceptable.

During the review period, several CRL buildings and facilities were planned for decommissioning. The decommissioning of the Pool Test Reactor has been completed and the space has been released for other uses. The Heavy Water Upgrading Plant decommissioning is progressing well with the goal of returning the building to other uses planned to take place in 2015/2016 at which time the end state report will be submitted to CNSC staff.

Regulatory approval has been granted by the Commission to decommission the Plutonium Tower, the Waste Water Evaporator and other ancillary buildings associated with the NRX reactor. The associated decommissioning activities are planned to begin within the 2015/2016 time period.

### **Security**

RATINGS FOR SECURITY		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
AECL has sustained its "security" SCA during the review period at a satisfactory rating. AECL continues to implement a security program at CRL that meets the requirements of the <i>Nuclear Security Regulations</i> and associated regulatory documents.		

The "security" SCA covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.

For CRL, this SCA encompasses the following specific areas:

- Facilities and equipment
- Security practices
- Response arrangements
- Drills and exercises

### *Facilities and equipment*

AECL is required to maintain security devices and equipment in accordance with manufacturer specifications. AECL reported some equipment deficiencies during the review period where devices were affected for brief periods resulting in AECL implementing compensatory measures until repairs were undertaken. All events were related to repeat issues of minor significance due in most part to system upgrades. AECL demonstrated the effective maintenance of facilities and equipment, and met regulatory requirements.



AECL Nuclear Response Force

CNSC staff conducted five security inspections and one security exercise during the review period. Findings related to facilities and equipment were technical in nature, where devices were showing signs of aging and in need of minor repairs and/or calibration. All findings have been closed to the satisfaction of CNSC staff. Action plans and corrective measures are currently being tracked.

### *Security practices*

AECL is required to control access to the CRL site through physical and administrative security measures. The events related to security practices that were reported to CNSC staff were administrative in nature and of minor significance. AECL continues to demonstrate procedural compliance and is equipped with access control measures that meet regulatory requirements.

In late 2011, CNSC staff reported potential indicators of a reduced security culture at CRL. AECL conducted a third party review and are committed to enhancing the security culture as part of their overall security review. CNSC staff are satisfied with AECL's proposed path forward and will continue to monitor AECL's progress.

CNSC staff reported findings during five security inspections and the security exercise conducted during the review period. Various procedural issues with respect to Site Access Security Clearances were in need of review and updating. AECL has modernized procedures to enhance the security program and findings have been closed to the satisfaction of CNSC staff. AECL continues to maintain good practices through robust corporate governance.

### *Response arrangements*

AECL maintains a qualified Nuclear Response Force (NRF) to meet the requirements of the *Nuclear Security Regulations* and of S-298, *Nuclear Response Force* (now REGDOC-2.12.1). AECL has reported issues related to response arrangements in the review period that were administrative in nature. Documents were corrected or updated and events are now closed.

The findings reported during CNSC staff's inspections that were related to response arrangements were linked to the NRF training documentation. CRL files were reviewed and corrections were made to the satisfaction of CNSC staff.

In previous years, AECL sent NRF recruits to the Bruce Power basic officer training course. In the summer of 2012, CRL conducted its first in-house NRF training course. This opportunity allowed AECL to produce site-specific training that will result in skilled members who are familiar with the facility.

### *Drills and exercises*

AECL is required to hold drills every 30 days and an exercise every two years. CNSC staff have completed the third cycle of their performance testing program at high-security nuclear facilities in Canada, which included CRL. The third Force on Force exercise at CRL was evaluated in October 2012. The licensee received an evaluation that highlighted a marked improvement from previous exercises. Findings have been closed to the satisfaction of CNSC staff. AECL continues to support the performance testing program.

### **Safeguards and non-proliferation**

<b>RATINGS FOR SAFEGUARDS AND NON-PROLIFERATION</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
Based on the information assessed from 2011 to 2013, CNSC staff conclude that the implementation of the safeguards program for the "safeguards and non-proliferation" SCA at CRL met all applicable regulatory requirements with a satisfactory performance.		

The "safeguards and non-proliferation" SCA covers the programs required for the successful implementation of the obligations arising from the Canada/ and the International Atomic Energy Agency (IAEA) safeguards agreements, as well as all other measures arising from the treaty on the *Non-Proliferation of Nuclear Weapons*.

For CRL, this SCA encompasses the following specific areas:

- Nuclear material accountancy and control
- Access and assistance to the IAEA
- Operational and design information
- Safeguards equipment, containment and surveillance

***Nuclear material accountancy and control***

During the review period, CRL provided the CNSC and IAEA with all nuclear material accounting reports and information in an accurate and timely manner, as required by RD-336, *Accounting and Reporting of Nuclear Material*.

***Access and assistance to the IAEA***

AECL has granted access and assistance to the IAEA both for inspection activities and for the maintenance of the IAEA's equipment installed at CRL. From 2011 to 2013, the IAEA conducted in total 96 inspections at various facilities at CRL. Details of the IAEA inspections can be found in table 4.

**Table 4: IAEA verification activities at CRL**

Year	SNRI	PIV	DIV	UI	Total
2011	12	5	3	12	32
2012	10	12	7	8	37
2013	13	7	2	5	27
Total Inspections					96

SNRI - Short Notice Random Inspection

PIV - Physical Inventory Verification

UI - Unannounced Inspection

DIV - Design Information Verification

The IAEA has indicated that the results from their inspection activities at CRL were satisfactory and no actions were requested from either facility. On this basis, the IAEA concluded that all nuclear material at CRL facilities remained in peaceful activities.

***Operational and design information***

AECL submits annual operational program and quarterly updates, as required. These documents provide a forward-looking plan of CRL's activities and are updated by AECL, as needed. AECL also submits information under the *Additional Protocol to the Canada - IAEA Safeguards Agreement*, including a description of each building, the scale of its operations, and future plans for nuclear fuel research and development activities. In addition, Design Information Questionnaire documents were updated as required for various facilities and submitted to CNSC staff.

***Safeguards equipment, containment and surveillance***

AECL continues to provide assistance to the IAEA for the installation and maintenance of the IAEA's equipment at CRL.

In 2013, the IAEA installed remotely monitored safeguard equipment, specifically at the new FPS Facility (see waste management SCA for more details on the FPS facility). The IAEA also upgraded the cameras at the NRU reactor with the Next Generation Surveillance System.

### Packaging and transport

RATINGS FOR PACKAGING AND TRANSPORT		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff rate the “packaging and transport” SCA at CRL as “satisfactory”. AECL continues to effectively implement the transport program at the CRL site. The transport of nuclear substances to and from the CRL site continues to be performed in a safe manner.		

The “packaging and transport” SCA covers the safe packaging and transport of nuclear substances shipped to and from the CRL site. CRL has a packaging and transport program that ensures compliance with the *Packaging and Transport of Nuclear Substances Regulations* and the *Transportation of Dangerous Goods Regulations*.

For CRL, this SCA encompasses the following specific areas:

- Package design and maintenance (no significant observations to report)
- Packaging and transport

#### *Packaging and transport*

During the review period, CNSC staff performed an inspection of AECL’s radioactive material transportation program to verify compliance with the regulatory requirements. There were no findings noted during the inspection. CNSC staff conclude that the program continues to be effectively implemented and that the transport of nuclear substances to and from CRL is performed in a safe manner.

## 2.2 Whiteshell Laboratories

### 2.2.1 Overview

**Figure 8: Whiteshell Laboratories, near Pinawa, Manitoba**



*(Source: AECL)*

AECL operates the Whiteshell Laboratories (WL), comprising nuclear facilities under a research and test establishment decommissioning licence, located near the town of Pinawa, Manitoba. The licence was issued for a 10-year period commencing on January 1, 2009 and running to December 31, 2018 [10].

The WL site encompasses an area of 4,375 hectares. The site comprises of a number of nuclear and non-nuclear facilities and activities, including the Whiteshell Reactor (WR-1), the Shielded Facilities, the liquid and solid radioactive waste management facilities, and various research laboratories.

The facility operated for approximately 40 years as a nuclear research and test establishment, first under an operating licence issued by the Atomic Energy Control Board, and since then coming into force of the NSCA under an operating licence issued by the CNSC. Based on its decision to discontinue operations at WL, AECL applied for a licence to decommission the facility in 2002.

AECL's decommissioning activities included the demolition of redundant non-nuclear buildings, continued decommissioning of Building 300 (Research and Development Complex), and the construction of enabling facilities and remediation of existing buildings, such as the construction of the SMAGS building and the remediation of the Shielded Facilities area to support decommissioning activities.

Of the major facilities that were operated on the site, the Van de Graff Accelerator and the Neutron Generator were fully decommissioned during the previous licensing period. The WR-1 reactor at WL is permanently shut-down and de-fuelled. In keeping with the evolution of international best practices, AECL's decommissioning strategy has been moving toward reduced deferment periods. Therefore, the decommissioning of WR-1 initially planned for 2024 is planned to start in 2015.

CNSC staff continue to verify implementation of AECL's programs at WL and assess them against the performance objectives and compliance verification criteria defined in the regulations and the licence. Inspections have been carried out by CNSC staff during the review period. Details of these are shared in the various SCA within the report.

An update on the performance of WL operations by SCA follows. In 2013, the ratings for each SCA are based on CNSC staff's assessment for the review period. The information in this report covers the complete 2013 calendar year and, when applicable, compares information to previous years. The report also provides recent updates on key issues through June 30, 2014.

## 2.2.2 Public information and disclosure

As mentioned in section 1.4, AECL's corporate Public Information Program (PIP) meets the requirements of RD/GD-99.3. However, there is no distinct public disclosure approach for WL that reflects the different nature of the site when compared to CRL. The protocol should be distinct from the requirements outlined in a licence or LCH, and must focus on communications with all the key audiences for WL, as identified in section 3.2 of AECL's PIP. A new version of the PIP (with disclosure protocol) has been submitted and is currently being reviewed by CNSC staff.

CNSC staff were satisfied, based on the information reviewed, that AECL has kept the Sagkeeng First Nation (who reside in close proximity to WL) informed regarding AECL's activities at WL. CNSC staff encourage AECL to continue to provide the Sagkeeng First Nation with information updates and further establish direct lines of communication with the appropriate representative(s).



### 2.2.3 Safety and control areas

Table 5 presents the ratings for WL for the year 2013. All SCA ratings are “satisfactory” or “fully satisfactory” for the reporting period which remains unchanged from reports previously made to the Commission [11].

**Table 5: Performance ratings for Whiteshell Laboratories**

<b>Safety and control area</b>	<b>Rating</b>
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	FS
Safeguards and non-proliferation	SA
Packaging and transport	SA

Notes:

- For specific areas within the SCAs where there were no significant observations from CNSC staff compliance verification activities, no information is given in the subsection of the report
- The information presented below is site specific; general trends are not identified

#### Management system

<b>RATINGS FOR MANAGEMENT SYSTEM</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff continue to rate the “management system” SCA for WL as “satisfactory” as the decommissioning quality assurance program is well established and effectively implemented.		

The “management system” SCA 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. For WL, this SCA encompasses the following specific areas:

- Management system
- Organization (see section 1.2 on AECL restructuring)
- Performance assessment, improvement and management review
- Operating experience (no significant observations to report)
- Change management (no significant observations to report)
- Safety culture (no significant observations to report)
- Configuration management (no significant observations to report)
- Records management (no significant observations to report)
- Management of contractors
- Business continuity (no significant observations to report).

#### ***Management system***

The activities at WL are broadly governed under the AECL corporate management system, and more specifically defined in the *WL Decommissioning Quality Assurance Plan* which is required by licence condition 2.1. CNSC staff have reviewed and accepted this document as it meets CSA N286.6-98, *Decommissioning Quality Assurance for Nuclear Power Plants*. AECL has proceeded to carry out the decommissioning activities at WL in accordance with this program.

During the reporting period, AECL developed a *Detailed Decommissioning Plan (DDP)*, describing the decommissioning work of WR-1 and Building 100. This document describes a relatively complex component of the WL decommissioning activities.

#### ***Performance assessment, improvement and management review***

According to CSA N286.6-98, AECL must evaluate its effectiveness in achieving organizational goals, using both self and independent assessments. In addition, a formal review of the effectiveness of its Decommissioning Quality Assurance program shall be conducted annually.

CNSC staff reviewed the results of AECL's assessments and identified some minor areas for improvement. These areas included the adequacy of AECL's assessment methodology as it was not evident that AECL's methodology ensured all components of the program would be assessed.

AECL committed to conducting future assessments using AECL's "Management System Assessment Framework" instead of the previously used methodology. This activity is in progress and CNSC staff will continue to review and assess the results of these and future assessments.

### *Management of contractors*

AECL stated that its Decommissioning Quality Assurance program applies to all staff and contractors who participate in, or support, projects or activities. However, CNSC staff determined that the information included in the DDP does not provide a clear description of how AECL would manage external contractors involved in this project.

To clarify some aspects, AECL was requested to ensure all requirements of CSA N286.6-98 are fully addressed by all workers, including contractors, involved in AECL decommissioning activities. This activity is currently in progress. CNSC staff will continue to monitor the progress of this improvement.

### Human performance management

RATINGS FOR HUMAN PERFORMANCE MANAGEMENT		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the "human performance management" SCA for WL as "satisfactory". AECL has implemented a human performance program that ensures personnel receive the appropriate training to safely carry out their duties.		

The "human performance management" SCA 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 who have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties. For WL, this SCA encompasses the following specific areas:

- Human performance program (no significant observations to report)
- Personnel training
- Personnel certification
- Work organization and job design (no significant observations to report)
- Fitness for duty (no significant observations to report)

***Personnel training***

During an inspection in October 2013, CNSC staff reviewed the training records relating to the AECL corporate training plan for employees in decommissioning and waste management. The review of these records verified that AECL has established a training program to ensure staff are trained prior to conducting work at WL.

***Personnel certification***

CNSC staff verified during an inspection that personnel assigned to the industrial radiography were Certified Exposure Device Operators/Qualified Operators. Their certification cards were reviewed and found valid.

**Operating performance**

RATINGS FOR OPERATING PERFORMANCE		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “operating performance” SCA for WL as “satisfactory”. Procedures are in place and followed by AECL staff. Events are reported as per the requirements and actions are put in place to avoid recurrence.		

The “operating performance” SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

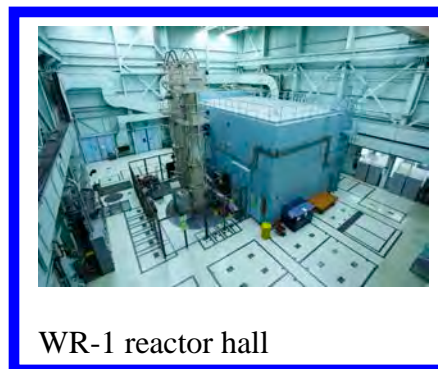
For WL, this SCA encompasses the following specific areas:

- Conduct of licensed activity
- Procedures
- Reporting and trending

***Conduct of licensed activity***

Facilities at WL are governed by AECL's *Facility Authorization* and *Conduct of Operations* documents, which describe the roles and responsibilities of positions with authority within AECL's organization.

In May 2011, AECL revised four of these documents. CNSC staff's review noted that some functional responsibilities were not clearly and completely documented in the revised documents for all positions within the AECL's organization. AECL committed to submitting the revised facility authorizations in 2014/2015. As this activity is still in progress, CNSC staff will continue to monitor progress of these improvements.



### ***Procedures***

CNSC staff conducted semi-annual inspections under the baseline compliance program. CNSC staff's inspections confirmed that programs, procedures, and work plans for the decommissioning and operations at WL remain in place. Some minor issues have been reported, such as posting of radiation warning signs and maintenance records of instrumentation. All were corrected to the satisfaction of CNSC staff.

CNSC staff reviewed the WL Annual Safety Report during the review period. AECL has satisfactorily addressed all CNSC staff's comments and recommendations relating to these reports.

### ***Reporting and trending***

The requirements for reporting unplanned situations or events at WL to the CNSC are prescribed in licence condition 9. AECL has complied with the requirements for submission of these reports during the review period.

As stated previously, AECL categorizes reportable events by Significance Level as follows:

- Significance Level 1: Highly significant problem
- Significance Level 2: Significant problem
- Significance Level 3: Problem
- Significance Level 4: Minor problem/improvement

Events reported to the CNSC by Significance Level category are presented in table 6:

**Table 6: Reportable events for WL (2011-2013)**

	2011	2012	2013
<b>Level 1</b>	0	0	0
<b>Level 2</b>	0	0	0
<b>Level 3</b>	7	4	1
<b>Level 4</b>	3	1	3
<b>Total</b>	<b>10</b>	<b>5</b>	<b>4</b>

CNSC staff have reviewed the reportable events and their associated corrective action plans. All actions have been closed to CNSC staff's satisfaction. These events did not have an impact on the health and safety of the public, workers or the environment.

### Safety analysis

RATINGS FOR SAFETY ANALYSIS		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the "safety analysis" SCA for WL as "satisfactory". AECL's safety analysis is in line with the Fukushima actions and no other activities with fissionable material occur at WL other than what is stored.		

The "safety analysis" SCA 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.

For WL, this SCA encompasses the following specific areas:

- Deterministic safety analysis
- Hazard analysis
- Criticality safety

#### *Deterministic safety analysis*

In April 2012, AECL commenced operation of the SMAGS building for the storage of low- and intermediate-level waste. As required by the licence for the operation of a newly constructed nuclear facility, AECL submitted the SAR: *Safety and Hazard Assessment for the SMAGS facility at WL*. CNSC staff's review concluded that AECL met the requirements of the licence, and that the operation of the SMAGS facility provided adequate protection for the health and safety of persons, workers and the environment.

Following the events at the Fukushima site in Japan, CNSC staff requested all Class I nuclear facilities review the lessons learned and re-examine the facilities safety case. During the review, AECL identified no significant gaps for WL, thus adequately addressing the request from CNSC staff. However, AECL identified areas for improvement to update the WL safety case documentation. During the review period, AECL began the revisions to the SAR documentation, with the submission of these revised documents due to CNSC staff in December 2014. For more information on the status of Fukushima actions, see appendix G.

## *Hazard analysis*

### Fire protection

AECL has a fire protection program in place to minimize both the probability of occurrence and the consequences of fire at WL and comply with the requirements of the *National Building Code* (2005), the *National Fire Code* (2005), and National Fire Protection Association, *NFPA-801: Fire Protection for Facilities Handling Radioactive Material* (2008). There were no significant reportable events during the review period that had an effect on the licensees' fire protection program or its implementation.

AECL has reported the completion of all the recommendations of the Biennially Independent Third Party Review and all the corrective actions relating to the focused fire protection inspection, with the exception of replacing an aging fire alarm system due to the complexity of the system and the decommissioning activities. The replacement of the fire alarm system is currently underway. This activity is planned to be completed by the end of the fiscal year 2014/2015.

### *Criticality safety*

There remain no activities associated with fissionable material at WL, other than storage of used fuel in the Concrete Canister Storage Facility and the waste management area's standpipes, which AECL and CNSC staff consider to be low risk and low priority.

The nuclear criticality safety program at AECL is a corporate-wide program, and is used at both WL and CRL. AECL has implemented limits to be used as the Upper Subcritical Limits (USL) until all Criticality Safety Documents are revised to include explicit USLs. CNSC staff have reviewed the temporary USLs and concluded the limits are consistent with CNSC regulatory requirements.

## **Physical design**

<b>RATINGS FOR PHYSICAL DESIGN</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff continue to rate the "physical design" SCA as "satisfactory" as changes at the WL are controlled as per the Engineering Change Control procedure.		

The "physical design" SCA relates to activities that impact the ability of SSCs to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

Given that the WL site is undergoing decommissioning, there is very little work on physical design.

For WL, this SCA encompasses the following specific areas:

- Design governance
- Site characterization (no significant observations to report)
- Facility design (no significant observations to report)

#### *Design governance*

For more details on AECL's design governance, see the corresponding CRL section.

#### **Fitness for service**

RATINGS FOR FITNESS FOR SERVICE		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the "fitness for service" SCA as satisfactory. A periodic inspection plan is effectively in place at WL.		

The "fitness for service" SCA covers activities that impact the physical condition of SSCs 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.

For WL, this SCA encompasses the following specific areas:

- Equipment fitness for service / equipment performance (no significant observations to report)
- Maintenance
- Structural integrity

#### *Maintenance*

In 2009, the Periodic Inspection Plan, met the requirements of CSA N291-08, *Requirement for Safety Related Structures for CANDU Nuclear Power Plants*, for the WMA storage structures, and was developed following a 2008 fitness-for-service evaluation. This plan was implemented at WL to ensure the waste storage structures continued to be fit for service.



CNSC staff reviewed the inspection and maintenance related information provided in AECL's Annual Safety Reports, which confirmed that inspection and maintenance activities of the waste storage structures have been conducted and no significant issues have been identified. Additionally, CNSC staff have reviewed the SAR and the Commissioning Report of the new SMAGS building, and concluded the proposed SMAGS maintenance program is appropriate.

In the winter of 2013, some water leakage (in the form of icicles) was detected between the seam of the roof and the north-east wall structure of the SMAGS. The leakage was caused from drainage water freezing in the scupper causing new melting water to pool and make its way through the seam. The leakage was not infringing on any of the waste bins currently stored in the SMAGS. In February 2014, a heat tape was installed to eliminate any ice buildup.

### *Structural integrity*

The standpipes are vertical tile holes, partially or fully covered, buried in the ground, containing historical radioactive waste. In 2009, AECL provided a technical document to demonstrate that the standpipe structures are fit for service, in which AECL stated there was considerable planning on developing testing and monitoring methods for these structures. Field work to complete the inspection and monitoring activities for the standpipe was performed in 2012. Excavation work around the standpipes, in order to examine the condition of the concrete, was done during the summer of 2013. The results will be provided to CNSC staff for review.

AECL continues to perform the annual inspection of the WMA concrete bunkers in accordance with the Periodic Inspection Plan. The inspection findings are evaluated by AECL and the information is submitted to CNSC staff for review and acceptance. No significant degradation has been identified in the inspections but some minor repairs will be carried out. AECL has provided target dates for these repairs. CNSC staff plan to conduct an inspection on the implementation of the periodic inspection program in the next 12 to 15 months.

### **Radiation protection**

<b>RATINGS FOR RADIATION PROTECTION</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff continue to rate the "radiation protection" SCA as "satisfactory". AECL has implemented and maintained a radiation protection program to control radiological hazards, ascertain doses to workers, and estimate doses to the public.		

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 as low as reasonably achievable (ALARA).

For WL, this SCA encompasses the following specific areas:

- Application of ALARA
- Worker dose control
- Radiation protection program performance
- Radiological hazard control
- Estimated doses to the public

#### ***Application of ALARA***

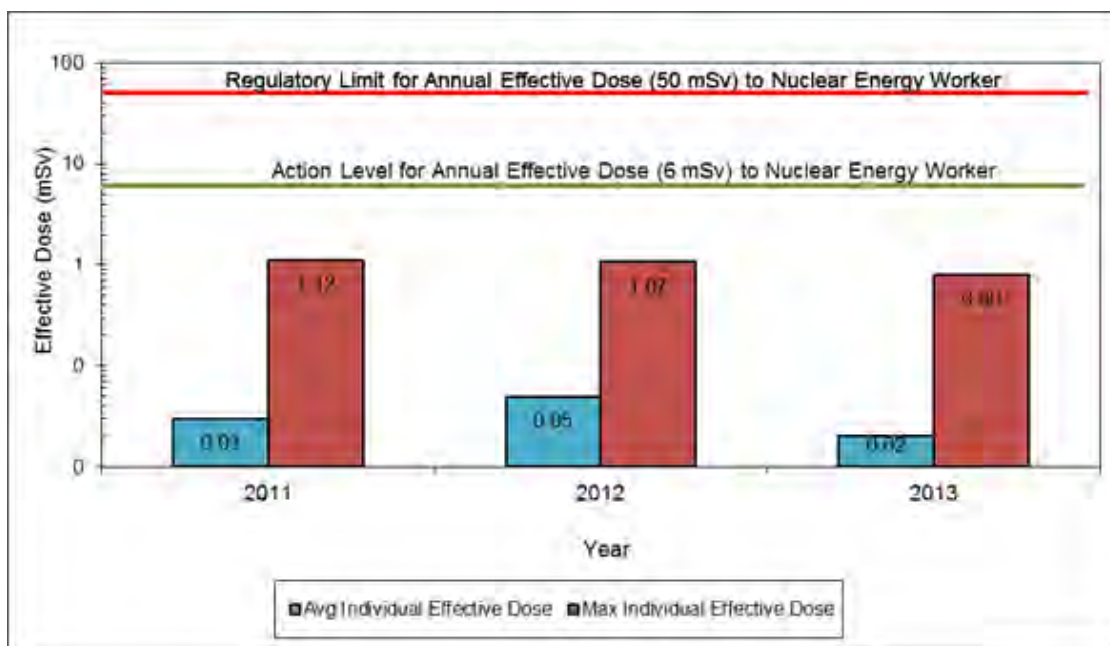
AECL continues to strive to maintain doses to workers ALARA. An example of which was the development and implementation of the document: *Job Scope and Safety Analysis*, which provides an all hazards integrated approach to planning and executing decommissioning work and non-routine nuclear facility activities. Through this process, AECL maintains exposures and potential for unplanned exposure ALARA through the application of “remove the hazard”, “guard the hazard” and “guard the worker” hazard controls and safety measures. The focus has been on defining clear limiting conditions for work and applying aggressive safe back-out points for early detection of unexpected or abnormal hazards.

As a result of this process, AECL has executed radiological work in the 2009 to 2013 period with minimal dose consequence, no internal intakes and no significant contamination or exposure events. Examples of this include the Building 300 plutonium laboratory glove box removal, the hot cell facility windows refurbishment, and the warm cells active drain line and ventilation duct removal.

#### ***Worker dose control***

CNSC staff review of dose data from 2011 to 2013 indicates that radiation doses to workers are being adequately controlled to levels well below the regulatory limits (figure 9). During the review period, the maximum individual effective annual dose for a Nuclear Energy Worker (NEW) was 1.12 mSv, or 2.24 percent of the annual regulatory limit of 50 mSv. Annual dose averages include all reported doses, including zero values.

**Figure 9: Effective dose statistics for nuclear energy workers at AECL's WL (2011-2013)**



### ***Radiation protection program performance***

AECL continues to maintain and implement a radiation protection program, including its own dosimetry service licensed by the CNSC to ascertain whole-body dose, extremity beta/gamma dose, and internal dose. When applicable, neutron whole-body dose is monitored using CR-39 dosimeters supplied by Health Canada's CNSC licensed National Dosimetry Services. For immediate monitoring of individual gamma doses, direct reading electronic dosimeters are used.

### ***Radiological hazard control***

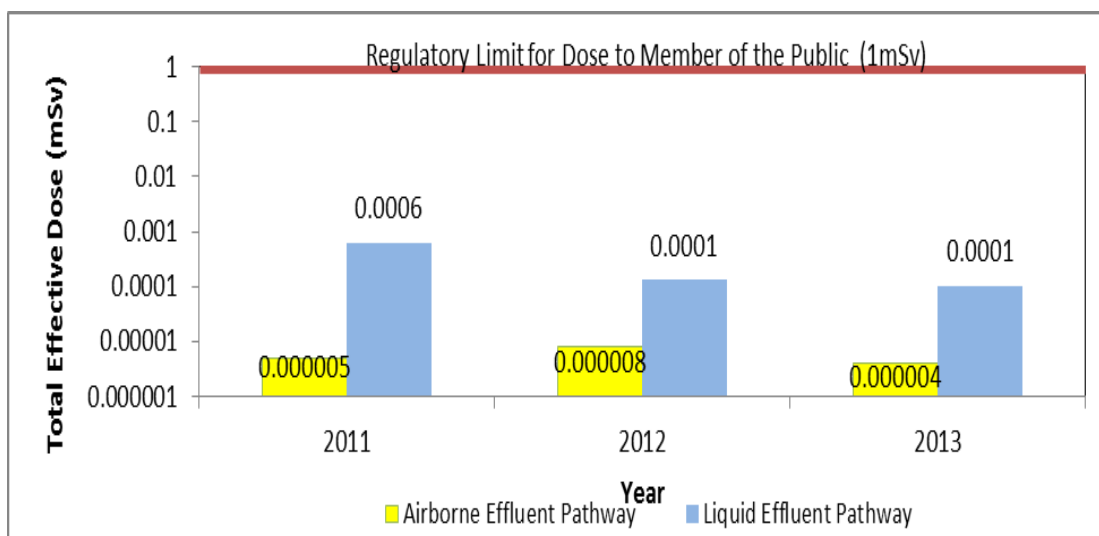
Action levels have been established as part of the WL radiation protection program. If one is reached, it triggers AECL staff to establish the cause for reaching the action level and, if applicable, restore the effectiveness of the radiation protection program. There have been no action level exceedances at WL over the review period.

AECL continues to effectively maintain and implement a surface contamination monitoring program to effectively control contamination at WL.

*Estimated dose to the public*

The dose to the public from WL activities is calculated by using environmental monitoring results. The dose due to airborne exposure pathways was estimated by multiplying the WL total air release, as a fraction of the derived release limit (DRL), by 1 mSv and is negligible. The dose due to the liquid exposure pathways was calculated using the river water, fish, game meat and vegetable components. Doses to the public continue to be well below the regulatory annual public dose limit of 1 mSv, as seen in figure 10.

**Figure 10: Total effective dose (mSv) to a member of the public (2011-2013)**



**Conventional health and safety**

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “conventional health and safety” SCA at WL as “satisfactory” as AECL continues to view conventional health and safety as a paramount consideration in all decommissioning activities.		

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

For WL, this SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness (no significant observations to report)

### *Performance*

A key performance measure for this SCA is the number of RLTIs that occur per year. An RLTIs 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. In reviewing RLTIs, CNSC staff must consider the severity of these injuries (e.g., the total days lost) and the frequency as they relate to the size of the workforce. The severity rate is a measure of the total number of days lost due to injury for every 200,000 person-hours worked at a site and the frequency is the number of fatalities and injuries (lost time and medically treated) due to accidents for every 200,000 person-hours worked at a site.

As per table 7, the number of RLTIs and their frequency is relatively stable; however, the severity rate is increasing. This means a considerable number of injuries at WL are resulting in extended absences from the workplace. Although most of these injuries are minor (requiring first aid), improvements to the return to work program are still required to minimize the number of days lost. AECL is currently in the process of implementing these improvement actions.

**Table 7: Recordable lost-time injuries (RLTI), frequency and severity at WL 2011-2013**

<b>Year</b>	<b>RLTIs</b>	<b>RLTI Frequency</b>	<b>RLTI Severity</b>
<b>2011</b>	8	2.28	9.98
<b>2012</b>	5	1.69	12.19
<b>2013</b>	7	2.29	20.27

### *Practices*

In addition to the NSCA and regulations, AECL's activities and operations at the WL site must comply with the *Canada Labour Code Part II* and the *Canada Occupational Health and Safety Regulations*, *Hazardous Products Act*, *Controlled Products Regulations*, *Workplace Hazardous Materials Information System*, and other applicable federal and provincial health and safety related acts and regulations.

## Environmental protection

RATINGS FOR ENVIRONMENTAL PROTECTION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff rate the “environmental protection” SCA at WL as “satisfactory”. AECL continues to implement and maintain an environmental protection program to control and monitor liquid and air releases of radioactive and hazardous substances to the environment.		

The “environmental protection” SCA covers the 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.

For WL, this SCA encompasses the following specific areas:

- Environmental management system
- Effluent and emissions control (releases)
- Assessment and monitoring
- Protection of the public

### *Environmental management system*

Licensees must have adequate provision for the protection of the environment via policies, programs and procedures, as required by REGDOC-2.9.1, *Environmental Protection: Environmental Protection Policies, Programs and Procedures*. AECL's environmental protection program consists of an environmental policy along with comprehensive programs and procedures to protect the environment. This includes an effluent monitoring program and an environmental monitoring program at WL.

Through sampling and analysis of nuclear and non-nuclear substances, these programs assist in verifying that releases from WL do not pose hazards to the environment or human health.

AECL's environmental management system is ISO-14001 registered, and is subject to periodic audits and reviews to identify potential improvements.



AECL worker gathering samples for environmental monitoring at WL

### *Effluent and emissions control*

CSA N288.5, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, was published in 2011. Unlike CRL, as specified earlier in the report, AECL is currently transitioning toward this standard at WL with a target date of March 2015.

#### Nuclear substance releases

Established DRLs for airborne and liquid effluents are listed in the WL licence. The DRLs represent the maximum radionuclide releases to the environment to maintain the public annual dose below the 1 mSv annual regulatory dose limit. During 2012 and 2013, there were no airborne or liquid exceedances of these release limits. The total releases of airborne and liquid effluents for 2012 and 2013 were well below the 1 mSv limit.

As part of its environmental protection program, AECL has established a number of action levels, which if exceeded may indicate a loss of operational control. If an action level is reached or exceeded, AECL is required to establish the cause and, if applicable, restore the effectiveness of the program. AECL is required to report all action level exceedances to the CNSC.

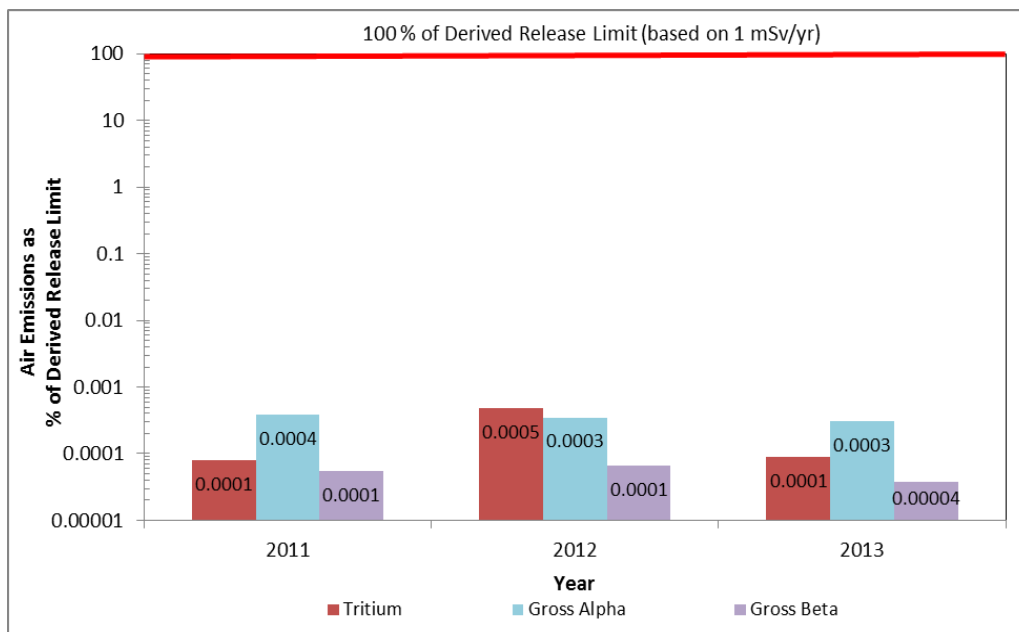
In 2012 and 2013, there were no action level exceedances of airborne or liquid releases at WL.

#### Airborne nuclear substance releases

AECL's radiological air effluent verification program at WL comprises eight monitoring points, including the Hot Cells Facility, Immobilized Fuel Test Facility, Reactor Building, Active Liquid Waste Treatment Centre and the Incinerator and Compactor/Baler in the waste management area. Monitoring is by sampling and analysis for radionuclides, including tritium, gross alpha and gross beta.

The airborne radiological emissions from WL continue to be effectively controlled and below the annual DRLs, as shown in figure 11.

**Figure 11: Airborne nuclear substance releases for WL (2011-2013)**

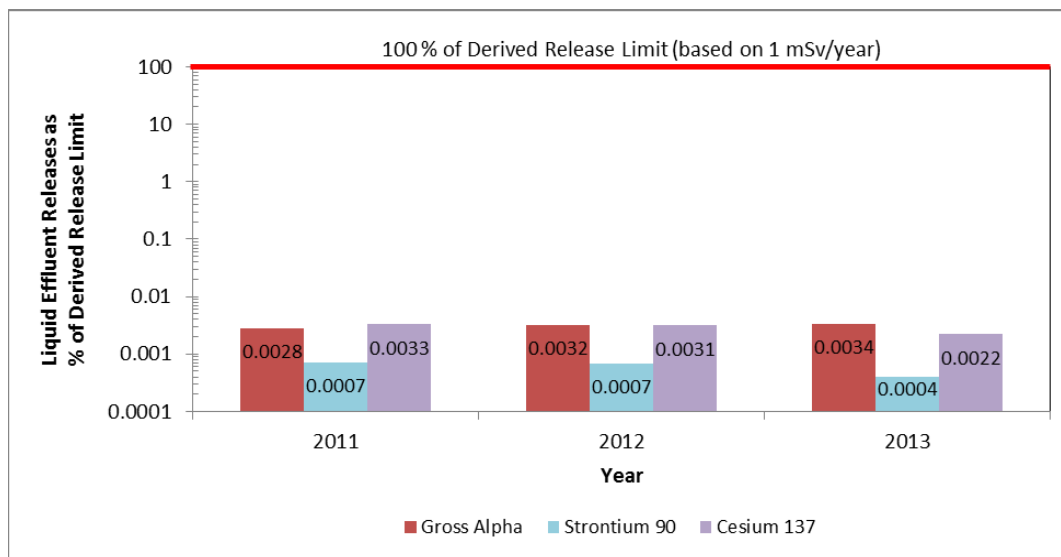


Liquid nuclear substance releases

AECL's radiological liquid effluent verification program for WL comprises eight monitoring points for process water outfall flowing into the Winnipeg River, discharges from the sewage lagoon and the waste management area's two drainage ditches. Monitoring is by sampling and analysis for radionuclides, gross alpha, strontium-90 and cesium-137.

The liquid radiological emissions from the WL continue to be effectively controlled and below the annual DRLs, as shown in figure 12.



**Figure 12: Liquid nuclear substance releases for WL (2011-2013)**

#### Airborne hazardous substance releases

The main stationary sources of non-radiological effluents to air from the WL are related to fuel combustion for building heating and steam generation purposes, and inadvertent losses of halocarbons used in research, cooling and fire suppression applications. The main source of fuel combustion releases is the combustion of Number 2 fuel oil and propane gas to generate heat. AECL does not routinely monitor these emissions instead estimates are calculated using oil consumption data and emission factors provided by Environment Canada.

The fuel consumption data is used to estimate the air emissions for Criteria Air Contaminants. Those that exceed the National Pollutant Release Inventory threshold are then reported to Environment Canada. Estimated emissions between 2012 and 2013 remained low and fall below the reporting thresholds.

#### Liquid hazardous substance releases

The WL routinely discharges, in various liquid effluents, many non-radiological substances to the environment (the Winnipeg River) via the sewage lagoon, process sewer outfall, drainage ditches and internal liquid discharges. In total, AECL routinely monitors nine different monitoring points for non-radiological parameters and compares the performance of significant effluent concentrations against AECL guidelines.

A wide variety of parameters are measured including mercury, phenolics, copper, zinc, iron, nickel, and total suspended solids. The number of guideline exceedances for 2012 and 2013 were five and two respectively. The guideline exceedances occurred at the Active Liquid Waste Treatment Center for copper, iron and mercury in 2012, and iron and phenolics in 2013. All lagoon, ditches and Outfall emissions conformed to AECL emission guidelines. In cases of reoccurring exceedences, AECL investigates the cause and potential corrective actions. CNSC staff are tracking these exceedences through the review of the annual safety reports.

### ***Assessment and monitoring***

A revision to CSA N288.4, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, was issued in 2010. In 2010, AECL assessed the WL environmental monitoring system against the revised standard to identify areas of non-compliance and make appropriate modifications to the program. In 2012, AECL initiated work on the identified subtask activities required to implement the revised standard. This transition is still in progress.

### **Environmental monitoring**

AECL maintains a comprehensive environmental monitoring program for WL to verify that radiation doses to members of the public as a result of radioactive releases from WL remain ALARA, social and economic factors being taken into account. The program also serves to verify that non-radioactive releases do not pose hazards to human health and that neither radioactive releases, non-radioactive releases, nor physical stressors pose hazards to the environment.

The radiological component of the environmental monitoring program is conducted through the routine collection and analysis of environmental samples from locations at the WL site and in the surrounding area. Monitored media include ambient air, precipitation, fish, garden vegetables, game meat, groundwater, Winnipeg River water and river sediments.

The non-radiological component focuses on groundwater samples from wells located at the waste management area lagoon and landfill.

Environmental monitoring results in 2012 and 2013 continue to demonstrate AECL's successful implementation of this program at WL.

Winnipeg River monitoring

AECL samples surface water at four locations along the Winnipeg River between Pinawa and the Great Falls generating station. Water samples are analyzed for radionuclides such as tritium, gross alpha, gross beta and strontium-90. The sampling results for 2012 and 2013 demonstrate that radionuclide concentration in the Winnipeg River water remain very low. Specifically, annual average concentrations of tritium in water ranged from 2.5 to 3.5 Bq/L, which is well below the Maximum Acceptable Concentration of 7000 Bq/L indicated in Health Canada's *Guidelines for Canadian Drinking Water Quality*.

***Protection of the public***

At WL, systems that discharge conventional (non-radiological) contaminants to the environment are not regulated by the province since WL is a federal site. As a result, AECL has developed its own AECL guidelines to manage non-radiological liquid releases. See the specific area "effluent and emission control" for additional information.

CNSC staff receives reports of discharges to the environment through the reporting requirements outlined in the WL licence.

Review of non-radioactive discharges to the environment for WL in 2012 and 2013 indicate that no significant risks to the public or environment occurred during the licensing period.

**Emergency management and fire protection**

RATINGS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the "emergency management and fire protection" SCA at WL as "satisfactory". Overall, compliance verification activities conducted confirm that AECL continues to maintain a comprehensive and well-documented emergency management program that meets all applicable regulatory requirements.		

The "emergency management and fire protection" SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.

For WL, this SCA encompasses the following specific areas:

- Conventional emergency preparedness and response
- Nuclear emergency preparedness and response (no significant observations to report)

- Fire emergency preparedness and response (no significant observations to report)

### ***Conventional emergency preparedness and response***

The AECL WL Site Emergency Plan and related site specific emergency procedures were reviewed by CNSC staff and determined to be consistent with the requirements of G-225, *Emergency Planning at Class I Nuclear Facilities and Uranium Mines and Mills*.

AECL's emergency preparedness documentation is appropriate for the anticipated degree of emergencies at the WL site.

### **Waste management**

<b>RATINGS FOR WASTE MANAGEMENT</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff conclude that the rating for "waste management" SCA at WL was "satisfactory". All radioactive waste is managed in accordance with applicable regulations and internal procedures.		

The "waste management" SCA covers internal waste-related programs that form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning.

For WL, this SCA encompasses the following specific areas:

- Waste characterization and minimization
- Waste management practices
- Decommissioning plans

### ***Waste characterization and minimization***

Dismantling and demolition waste produced at WL are radiologically screened and segregated at the source as either "Likely Clean" or "Contaminated". Likely Clean waste is monitored for radiological clearance. If found clean, the waste is either dispositioned for reuse or recycling where possible, or disposed of in the WL landfill or transferred to an appropriate storage or process facility for hazardous material. Contaminated waste will be decontaminated to meet clearance criteria where feasible or characterized and sent to the WMA for processing as per CSA N292.3, *Management of low- and intermediate-level radioactive waste*.

**Waste management practices**

The WMA provides storage facilities for radioactive wastes and small volumes of hazardous industrial waste. It consists of an organic incinerator, the new SMAGS building, bunkers and Quonset storage buildings used to store low-level radioactive waste (LLW) and intermediate-level radioactive waste (referred to in this report as medium-level waste, or MLW) generated from WL decommissioning.

Table 8 provides information on the percentage of space that is filled and the estimate number of years of storage space remaining in the waste storage building. There are also two empty standpipes in the WMA.

**Table 8: Status of waste storage buildings at WL (as of December 31, 2013)**

<b>Building No.</b>	<b>% Full</b>	<b>Years of Storage Space Remaining</b>
LLW B5	100 (sealed)	N/A
LLW B6	60	1
MLW B4	70	2-3
MLW B6 *	60	2-3
MLW B7	85	2-5
431 (LLW Storage Building)	60	3
433 (LLW Storage Building)	80	2
SMAGS Building #1	5	10
Soil Storage Compound	0.5	10

\* MLW B6 is currently not accepting waste due to water ingress issues.

The Concrete Canister Storage Facility is located adjacent to the WMA and has stored irradiated fuel since 1975. In January 2014, AECL reported that canister C-5 is slightly leaning (less than 1°). AECL will continue to survey the canister to ensure that there is no movement with that canister. CNSC staff continue to monitor the results of AECL's surveys during monthly licensing meeting.

To study the distribution of dose received by living organisms, AECL constructed a cesium pond in 1966. This pond was decommissioned in 2013 with work on segregating the cesium soil being completed in 2013. The soil is presently stock piled within the fenced area of the WMA for the short term, while AECL assesses long-term storage. Concrete blocks have been used to form a retaining wall around the north and west sides of the stock pile. On the inside of the retaining wall, a sand fill space was placed in a geomembrane. This membrane acts as a silt fence and porewater pressure drainage for removing water from the soil. Finally, a large tarp was placed over the pile to prevent erosion. To support the conclusion, these measures ensure the pile remains in a safe state and that the environment is protected. AECL has submitted additional information. CNSC staff are currently reviewing this information.

### *Decommissioning plans*

AECL decided to reduce the deferment period of the decommissioning of its installations. Therefore, AECL presented to CNSC staff the detailed decommissioning plan for WR-1 in September 2013. As previously indicated, work is planned to start in 2015. This work will consist of the removal of the remaining systems like the reactor vessels and the primary heat transport system, to name two. Building 200 (Active Liquids Waste Treatment Centre) and Building 411 (Decontamination Centre) are planned to be decommissioned next. The activities presently conducted in these buildings will be moved to Building 300. The activities described above fall under the Nuclear Legacy Liabilities Program, as previously described in section 1.5.

### **Security**

RATINGS FOR SECURITY		
Overall Performance Ratings		
2011	2012	2013
FS	FS	FS
Based on the information assessed, CNSC staff continue to rate the SCA "security" as "fully satisfactory" at WL. AECL has implemented a security program that meets the <i>Nuclear Security Regulations</i> and associated regulatory documents.		

The "security" SCA covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.

For WL, this SCA encompasses the following specific areas:

- Facilities and equipment
- Response arrangements
- Security practices
- Drills and exercises

### *Facilities and equipment*

During the review period, AECL demonstrated the effective maintenance of facilities and equipment, and met regulatory requirements at WL.

***Response arrangements***

AECL maintains a security force of qualified Nuclear Security Officers at WL to meet the requirements of the *Nuclear Security Regulations*. The security force employs a response strategy based on defence-in-depth and the graded approach. Arrangements also exist with the Royal Canadian Mounted Police (RCMP), its offsite response force.

***Security practices***

AECL continues to demonstrate procedural compliance and is equipped with access control measures at WL that meet regulatory requirements. AECL maintains good practices through robust corporate governance.

***Drills and exercises***

AECL continues to conduct security exercises every two years at WL in coordination with the offsite response force as per section 36(2) of the *Nuclear Security Regulations*. AECL conducted a successful security exercise in October 2013 where AECL demonstrated effective intervention capabilities against a credible threat in coordination with the RCMP. The physical protection system was realistically tested and assessed.

**Safeguards and non-proliferation**

RATINGS FOR SAFEGUARDS AND NON-PROLIFERATION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
Based on the information assessed from 2011 to 2013, CNSC staff conclude that the implementation of the safeguards program for the “safeguards and non-proliferation” SCA at WL met all applicable regulatory requirements with a “satisfactory” rating.		

The “safeguards and non-proliferation” SCA covers the programs required for the successful implementation of the obligations arising from the Canada/IAEA safeguards agreements, as well as all other measures arising from the treaty on the *Non-Proliferation of Nuclear Weapons*.

For WL, this SCA encompasses the following specific areas:

- Nuclear material accountancy and control
- Access and assistance to the IAEA
- Operational and design information
- Safeguards equipment, containment and surveillance

***Nuclear material accountancy and control***

During the review period, AECL provided the CNSC and IAEA with all nuclear material accounting reports and information in an accurate and timely manner, as required by RD-336, *Accounting and Reporting of Nuclear Material*.

***Access and assistance to the IAEA***

From 2011 to 2013, the IAEA conducted six inspections at WL. Details of the IAEA inspections can be found in table 9:

**Table 9: Verification activities by the IAEA at WL**

Year	SNRI	PIV	DIV	Total
2011	1	0	1	2
2012	1	0	1	2
2013	0	1	1	2
Total Inspections				6

SNRI - Short Notice Random Inspection

PIV - Physical Inventory Verification

DIV - Design Information Verification

The IAEA has indicated that the results from their inspection activities at WL were satisfactory and no actions were requested from AECL. On this basis, the IAEA concluded that all nuclear material at this site remained in peaceful activities.

***Safeguards equipment, containment and surveillance***

There is no IAEA equipment installed at WL.

***Operational and design information***

AECL submits annual operational program and quarterly updates, as required. These documents provide a forward-looking plan of WL's activities, and are updated by AECL as needed. AECL also submits information under the *Additional Protocol to the Canada - IAEA Safeguards Agreement*, including a description of each building, the scale of its operations, and future plans for nuclear fuel research and development activities. In addition, Design Information Questionnaire documents were updated as required for various facilities and submitted to CNSC staff.



## Packaging and transport

RATINGS FOR PACKAGING AND TRANSPORT		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “packaging and transport” SCA for WL as “satisfactory”. Transportation of dangerous goods training is in place and the handling, packaging and offering for transport of radioactive material is conducted by certified personnel.		

The “packaging and transport” SCA covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility.

For WL, this SCA encompasses the following specific area:

- Packaging and transport

### *Packaging and transport*

AECL must adhere to the *Packaging and Transport of Nuclear Substances Regulations* and *Transport Canada's Transportation of Dangerous Goods Regulations* for all shipments leaving the site.

AECL is required to have appropriate training for personnel involved in the handling, offering for transport and transport of dangerous goods, and is required to issue a training certificate to those workers. During an inspection, training certificates were reviewed and found to be missing required information. This has been satisfactorily addressed by AECL.

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## PART II: PROJECTS

### 3 OVERVIEW

#### *Port Hope Area Initiative*

The Port Hope Area Initiative (PHAI) comprises two community-based projects to develop and implement a safe, local, long-term management solutions for historic low-level radioactive waste (LLRW) in Port Hope and Port Granby. The PHAI is defined by a legal agreement between the Government of Canada and the Municipalities of Port Hope and Clarington for the management of the historic LLRW within each of the respective communities [12]. The agreement came into effect in March 2001.

Under the terms of the agreement, the Government of Canada, through Natural Resources Canada (NRCAN) has made a financial commitment to clean up and to provide long-term safe management of the historic LLRW in Port Hope and Port Granby (see appendix D for more information). These wastes arose from the activities of a former federal Crown Corporation (Eldorado Nuclear) and its private sector predecessors.

AECL was engaged by NRCAN as the proponent for environmental and licensing approvals associated with the PHAI projects and as overall project manager. Under the governance framework established by NRCAN, the PHAI Management Office is led by AECL, and the responsibility for all major contracting activities is assigned to Public Works and Government Services Canada (PWGSC). A tripartite federal steering committee oversees the PHAI Management Office and provides strategic direction to the General Manager (AECL). The PHAI Management Office conducts its work and coordinates its activities with those of the participating organizations: AECL, NRCAN and PWGSC.

The PHAI includes two distinct and separate projects:

- The Port Hope Long-Term Low-Level Radioactive Waste Management Project (the “Port Hope Project”)
- The Port Granby Long-Term Low-Level Radioactive Waste Management Project (the “Port Granby Project”)

The status for each project (Port Hope versus Port Granby) is presented separately in the following sections (3.2 and 3.3). Currently, the projects are at the same stage of development and therefore, the information presented per SCA is very similar and may appear to be duplication. However, it was deemed important to separate the two projects into distinct sections as the information that will be included in future reports will differ as the projects progress independently.

### 3.1 Public information and disclosure

AECL is currently implementing its *PHAI Phase II Communication Plan* and is committed to disclosing information about the projects with stakeholders in a timely, accurate and comprehensive manner.

In 2013, AECL conducted public information activities for PHAI that met CNSC regulatory requirements. These activities included:

- The posting recent project news and updates and environmental monitoring data to the website [www.phai.ca](http://www.phai.ca)
- The Public Information Exchange, which is located at the PHAI Management Office, is open five days a week and contains two 3-D, to scale models to help visualize how the engineered mound will look post-construction
- Citizen Liaison Groups for the Port Hope and Port Granby Projects have been launched to supplement the exchange of information with communities; the groups, which meet on a quarterly basis, each consists of volunteer citizen members who meet with AECL team leaders to discuss the project activities and community concerns
- AECL has conducted outreach activities at fairs and trade shows, site tours (37 in 2013), newsletters (mailed to 15, 000 residents), and PHAI Facebook (received about 4,500 views)
- AECL plans to update its Communication plan to reflect the progress on the projects in 2014



Residents attending a public information session

To engage Aboriginal groups interested in the PHAI, AECL also conducted activities such as regular meetings, workshops, site tours, and invitations to join a community liaison group. Based on the information received, CNSC staff are satisfied that AECL's Aboriginal engagement activities related to the PHAI are appropriate to keep interested Aboriginal audiences informed.

## 3.2 Port Hope Project

### 3.2.1 Overview

The purpose of the Port Hope Project (PHP) is to remediate sites containing historic low-level radioactive waste (LLRW) and other specified industrial waste located in the Municipality of Port Hope, and to consolidate and manage this waste in a new Long-Term Low-Level Radioactive Waste Management Facility (LTWWMF) developed on lands comprising and adjacent to the existing Welcome Waste Management Facility (WMF). The current contents of the Welcome WMF will be incorporated into the new LTWWMF.

**Figure 13: The municipality of Port Hope**



*(Source: AECL)*

The historic LLRW is the result of radium and uranium refining activities associated with the processing of pitchblende ores during the period from 1933 to 1955. Process residues and other materials were discarded or used in construction and landscaping activities at various locations within the community. The historic LLRW currently exists within licensed facilities including the existing Welcome WMF, and at miscellaneous unlicensed sites including the Port Hope Harbor and the former municipal landfill site.

PHP activities include the construction and operation of the LTWWMF, remediation of the existing Welcome WMF and remediation of sites containing historic LLRW located within the Municipality of Port Hope.

The PHP is being conducted in three phases – transition, implementation and closure.

- Phase I (transition) activities are confined to the continued operation, care and maintenance of the Welcome WMF, assumed from Cameco in March 2012
- Phase II (implementation) activities include the operation, care and maintenance of the Welcome WMF; redevelopment of the facility into the Port Hope LTWMF; operation, care and maintenance of the LTWMF; and offsite remedial activities
- Phase III (closure) activities include long-term maintenance and monitoring of the Port Hope LTWMF

In 2014, the second year of Phase II of the PHP, AECL is preparing for construction of the LTWMF, completing construction of the new water treatment plant, and delineating contaminated offsite areas to facilitate development of remediation plans. As the project proceeds, AECL continues to inform and engage the public through various mechanisms under their public information program including the Port Hope Citizen Liaison Group. Further details regarding the public information program can be found in section 3.1 of this report.

Phase II activities are governed under the PHP licence [13], which was issued on November 15, 2012. Under that licence, AECL is required to implement programs for PHP to ensure compliance with the accepted design, safe conduct of the approved activities and protection of people and the environment. These programs are referenced in the LCH [14].

CNSC staff continue to verify implementation of AECL's programs with respect to this project and assess them against the performance objectives and compliance verification criteria defined in the regulations, the licence and the LCH. Verification activities include desktop reviews and site inspections. Many program documents referenced in the LCH are currently undergoing revision; desktop reviews of these will be conducted by CNSC staff. The most recent site inspection was conducted on October 29, 2013.

As previously stated, the information presented per SCA is very similar between the two projects. It is important to separate the two projects into distinct sections because the information that will be included in future annual reports will differ as the projects progress independently. Therefore, an update on the status of the PHP by SCA follows. Prior to 2012, the PHP performance was not rated according to the SCAs. In 2012, the ratings assessed for each SCA were based on information submitted in support of the licence application. In 2013, the ratings for each SCA were based on CNSC staff assessment for the review period. The review period for the PHP is from November 15, 2012 (licence issuance) to December 31, 2013; recent updates on key issues through June 30, 2014 are also provided.

It must be noted that many of the specific areas under the SCAs do not apply to the PHP, and this is reflected in the discussion below. This is due largely to the nature of the project. Unlike CRL and WL, the PHP is not a nuclear facility. Further, many of the activities in Phase II, upon which AECL embarked with the issuance of the current licence, involve conventional construction, for example construction of the new Water Treatment Plant (WTP).

### 3.2.2 Safety and control areas

Table 10 presents the ratings for PHP for the year 2013. All SCA ratings are “satisfactory” for the reporting period which remains unchanged from reports previously made to the Commission [15].

**Table 10: Performance ratings for Port Hope project for 2013**

<b>Safety and control area</b>	<b>Rating</b>
Management system	<b>SA</b>
Human performance management	<b>SA</b>
Operating performance	<b>SA</b>
Safety analysis	<b>N/A</b>
Physical design	<b>SA</b>
Fitness for service	<b>SA</b>
Radiation protection	<b>SA</b>
Conventional health and safety	<b>SA</b>
Environmental protection	<b>SA</b>
Emergency management and fire protection	<b>SA</b>
Waste management	<b>N/A</b>
Security	<b>SA</b>
Safeguards and non-proliferation	<b>N/A</b>
Packaging and transport	<b>SA</b>

Notes:

- For specific areas within the SCAs where there were no significant observations from CNSC staff compliance verification activities, no information is given in the subsection of the report.
- The information presented below is site specific; general trends are not identified.

**Management system**

RATINGS FOR MANAGEMENT SYSTEM		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the “management system” SCA for the PHP as “satisfactory”. AECL continues to implement the <i>PHAI Quality Assurance Plan</i> and conducts oversight activities.		

The “management system” SCA 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.

For the PHP, this SCA encompasses the following specific areas:

- Management system
- Operating experience
- Safety culture
- Records management (no significant observations to report)
- Management of contractors

***Management system***

The activities of the PHP are broadly governed under the AECL corporate management system, and more specifically guided by the *PHAI Quality Assurance Plan*. This plan summarizes the processes and practices applicable to the PHAI licensed activities during execution of Phase II and clarifies the extent of their applicability to participants. These processes and practices comply with the quality management system defined in CSA-ISO 9001:08 *Quality Management Systems – Requirements*. The Quality Assurance plan, and adherence to it, is a requirement of licence condition 2.2.

***Operating experience***

As previously stated in the report, the OPEX program at AECL comprises the processes that ensure the organization uses the experience both from within the organization and from industry peers to improve the safety of operations, improve operational performance, and reduce the significance and the occurrence of unplanned events.

PHP reviews OPEX bulletins for relevance and applicability through the Improvement Action process.



### *Safety culture*

AECL staff receives mandatory training in Human Performance to help reduce human error and thus, the frequency and severity of events at PHP. Initiatives by AECL's Human Performance Branch are designed, amongst other things, to strengthen AECL's safety culture.

During the review period, safety culture related training conducted for PHP staff included *Field Observation and Coaching Fundamentals; Reinforcing Leadership Development; Communicating for Leadership Success and Building Trust; and Coaching for Peak Performance.*

### *Management of contractors*

AECL's responsibilities include defining the licence requirements to be included in contracts awarded by PWGSC for the execution of construction and remediation activities. AECL conducts oversight to ensure licence requirements are met. The *PHAI Oversight Procedure* governs how AECL oversight is conducted to confirm compliance with licensing commitments, technical requirements, and contractual obligations.

Within the review period, AECL conducted oversight for the WTP construction, the abandoned WMF pipeline resurvey, small scale site resurveys, known sites investigation, the Sculthorpe Marsh investigation, and dust monitoring associated with the construction of the new WTP.

## Human performance management

RATINGS FOR HUMAN PERFORMANCE MANAGEMENT		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the "human performance management" SCA for the PHP as "satisfactory". AECL continues to implement an acceptable training program to ensure AECL staff has the necessary skills and knowledge to safely carry out their duties.		

The "human performance management" SCA covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee personnel are available in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties. For the PHP, this SCA encompasses the following specific area:

- Personnel training

***Personnel training***

A training program, and adherence to it, is a requirement under licence condition 2.5. To meet this requirement, AECL has implemented the *PHAI Training Plan*. During the review period, AECL conducted 17 training courses for PHP staff including those reported under the specific area safety culture, above.

CNSC staff conducted a general assessment of facility operations during an inspection in October 2013. At that time, CNSC staff reviewed training records for facility managers and operational staff and found them complete. AECL's corporate database is utilized to identify and track training needs, and to file staff training records.

**Operating performance**

RATINGS FOR OPERATING PERFORMANCE		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continues to rate the "operating performance" SCA at PHP as "satisfactory". AECL continues to meet licensing and regulatory requirements in conducting Phase II activities, implementing procedures and reporting on activities.		

The "operating performance" SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

For the PHP, this SCA encompasses the following specific areas:

- Conduct of licensed activity
- Procedures
- Reporting and trending

***Conduct of licensed activity***

Licensed activities for Phase II, the current phase of the PHP, include:

- the operation of the existing Welcome Waste Management Facility (WMF)
- the construction of the new Water Treatment Plant (WTP)
- the construction of the new Long-Term Waste Management Facility (LTWMF)
- offsite remediation site

AECL plans to conduct the Phase II licensed activities over a 10-year timeframe.

### Operation of Welcome Waste Management Facility

The Welcome WMF was transferred from Cameco to AECL on March 31, 2010. Under the licence, AECL is authorized to operate and maintain the Welcome WMF, as per the operational procedures and protocols specified in the *Licensing Manual – Information in Support of the Port Hope Long-Term Low-Level Radioactive Waste Management Project Licence Application*.

CNSC staff conducted a general assessment of facility operations during an inspection in October 2013. At that time, CNSC staff visually inspected the WTP, the treatment ponds and the interceptor ditch and observed that the facility was maintained in good operating condition.

### Construction of the new Water Treatment Plant

AECL is required, under licence condition 2.6, to construct the new WTP in accordance with design documentation specified in the LCH. Construction of the WTP is being managed and overseen by PWGSC; AECL continues to conduct oversight activities for WTP construction as well as dust monitoring associated with the construction.

The building envelope of the new WTP was completed in the fall of 2013. Fitting of the building with water treatment equipment is ongoing. The plan for active commissioning has been submitted by AECL, as required under section 3.2.6 of the LCH, and has been accepted by CNSC staff.

### Construction of the new Long Term Waste Management Facility and remediation of Welcome Waste Management Facility

AECL has begun site preparation activities, including removal of trees and shrubs, in preparation for construction of the LTWMF.

Before initiating remediation of the Welcome WMF, AECL is required under licence condition 2.6 to construct and commission the new WTP. However, AECL has requested authorization to conduct some construction activities prior to commissioning the WTP, in order to maintain its current project schedule. These early works include construction of Cell 1 of the LTWMF containment mound (into which contents of the existing mound will be transferred); construction of onsite infrastructure and support facilities; and excavation and temporary onsite stockpiling of affected soil. CNSC staff have reviewed AECL's submissions with respect to this work and have granted the authorization to proceed.

### Offsite remediation sites

AECL is required, under licence condition 2.6, to remediate sites containing historic LLRW within the Municipality of Port Hope in accordance with design documentation specified in section 3.2.6 of the LCH.

Currently, AECL is conducting a radiological resurvey of the small-scale sites in Port Hope to characterize and delineate the contamination. The survey includes exterior gamma scanning, borehole testing and soil sampling, and interior contamination monitoring. During the review period, AECL made significant progress toward delineating contamination at the small scale sites including full radiological survey of 450 sites; and partial survey (radon monitoring) at 950 sites. There are approximately 4,800 small scale sites. Resurvey of these sites began in 2012 and is expected to continue into 2016.

Detailed design descriptions for the groups of small scale sites were submitted by AECL before licensing and accepted by CNSC staff. Following resurvey, AECL will submit site specific remediation plans for CNSC staff review and acceptance. The basic remediation strategy at all sites will involve the excavation of the contaminated material and transfer to the LTWMF. The clean-up criteria are given in appendix C to the current licence.

AECL is required, under licence condition 2.1, to conduct remedial work in accordance with the clean-up criteria specified in appendix C to the licence. AECL will verify completion of remedial activities utilizing its *Remediation Verification Standard Operating Procedure*. CNSC staff will conduct independent oversight and verification of remediation activities.

### ***Procedures***

AECL maintains a suite of procedures specifically applicable to the activities of the PHP. These procedures are designed to operate within the broader framework of AECL's corporate documented programs. During the review period, project-specific procedures relating to commissioning of the WTP and authorization of early works were submitted to the CNSC for review and acceptance.

### ***Reporting and trending***

As specified in licence condition 2.3, AECL is required to submit written reports for action level exceedances; quarterly liquid effluent monitoring; quarterly liquid effluent toxicity testing; annual compliance data; and a report of any failure that resulted in, or could have resulted in the release of a nuclear substance or hazardous substance from the facility. AECL has complied with the requirements for submission of these reports during the review period.

AECL reported three consecutive action level exceedances (0.0320mg/L, 0.0590 mg/L, and 0.051 mg/L) of arsenic in liquid effluent from the existing WTP in July 2013. The action level for arsenic is 0.0264 mg/L. AECL promptly instituted corrective actions and established a new procedure to prevent reoccurrence. No regulatory concerns were identified during CNSC staff's review of these event reports.

It should be noted that the events did not lead to an exceedance of the monthly effluent release limit for arsenic, as specified in appendix B of the licence (monthly average limit of 0.50 mg/L). For more information on these exceedances, see the environmental protection SCA section of this report.

## Safety analysis

RATINGS FOR SAFETY ANALYSIS		
Overall Performance Ratings		
2011	2012	2013
N/A	N/A	N/A
Not applicable		

The “safety analysis” SCA 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. There is no specific requirement for conducting safety analysis in support of an application for a Waste Nuclear Substance Licence, such as that which governs the PHP.

## Physical design

RATINGS FOR PHYSICAL DESIGN		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the “physical design” SCA at PHP as “satisfactory”. AECL continues to implement internal verification processes to ensure licence and legislative requirements for facility design are met.		

The “physical design” SCA relates to activities that impact the ability of structures, systems and components (SSCs) to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

For the PHP, this SCA encompasses the following specific areas:

- Design governance
- Facility design

### *Design governance*

All design and equipment changes are subject to the controls defined in the *PHAI Quality Assurance Plan*. Details on the plan can be viewed under the management system SCA.

### *Facility design*

The detailed design documentation for the LTWMF and the WTP were assessed and accepted by CNSC staff prior to issuance of the licence, and are referenced in section 3.2.6 of the LCH. Under licence condition 2.6, AECL is required to conduct project activities in accordance with the design documentation.



AECL workers reviewing design drawings

The proposed new WTP is a two-stage treatment process with chemical precipitation and clarification followed by a reverse osmosis stage using specific membrane technology manufactured by “ROCHEM”.

Because the Port Hope LTWMF is not a nuclear facility and the ROCHEM units will not be used as nuclear equipment, CNSC staff assigned non-nuclear Class 6 for the certification of the units. Consequently, CSA B51, *Boiler, pressure vessel, and pressure piping code*, is the governing standard for registration of the units with the Technical Standards and Safety Authority.

### **Fitness for service**

RATINGS FOR FITNESS FOR SERVICE		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the “fitness for service” SCA at PHP as “satisfactory”. AECL continues to implement an acceptable program to ensure structures and equipment performs as its intended function.		

The “fitness for service” SCA covers activities that impact the physical condition of SSCs 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.

For the PHP, this SCA encompasses the following specific areas:

- Equipment fitness for service / equipment performance (no significant observations to report)
- Maintenance
- Structural integrity (no significant observations to report)
- Aging management (no significant observations to report)

### ***Maintenance***

AECL continues to maintain the existing facilities in accordance with the previous licensee's (Cameco) operational procedures and protocols, as accepted by CNSC staff at the time of licensing.

### **Radiation protection**

<b>RATINGS FOR RADIATION PROTECTION</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
Not rated	SA	SA
For the review period, CNSC staff continue to rate the "radiation protection" SCA at PHP as "satisfactory". AECL continues to implement and maintain a radiation protection program to control radiological hazards, ascertain doses to workers, and estimate doses to the public.		

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 as low as reasonably achievable (ALARA).

For the PHP, 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

AECL is required by the *Radiation Protection Regulations*, and licence condition 2.7, to implement and maintain a radiation protection program for the PHP. The *PHAI Radiation Protection Plan* is referenced in section 3.2.7 of the LCH and forms the primary compliance criteria for radiation protection.

### *Application of ALARA*

The *PHAI Radiation Protection Plan* has been developed and implemented at PHP. It defines the radiation protection measures applicable to PHAI projects and is consistent with AECL's corporate radiation protection program.

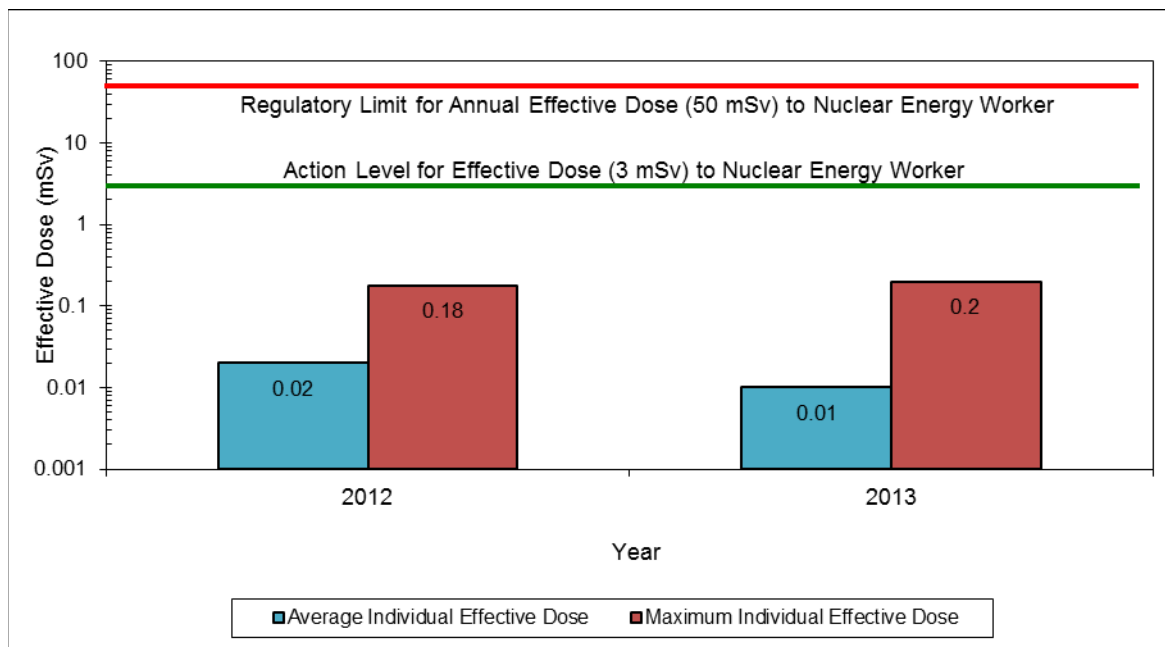
The *PHAI Radiation Protection Plan* describes the basis for protection from ionizing radiation, and for ascertaining and recording radiation exposures and doses during the PHP activities. It also defines a management framework and processes that are designed to ensure that radiation exposures arising from project activities will be maintained below regulatory dose limits and ALARA.

### *Worker dose control*

The system to control radiation exposures and doses to workers is established in the *PHAI Radiation Protection Plan*. All employees working regularly at PHP wear thermo luminescent dosimeters (TLDs) for external radiation exposure monitoring; these are provided by AECL's licensed dosimetry service. To date, AECL has not monitored worker doses independently between the two projects (see figures 14 and 16).

CNSC staff have concluded, following review of AECL's dose data for PHP, that AECL adequately controlled radiation doses to workers during the review period. The maximum doses to workers were 0.18 mSv and 0.20 mSv in 2012 and 2013, respectively; this is well below the CNSC's regulatory effective dose limit for nuclear energy workers.

**Figure 14: Effective dose statistics for nuclear energy workers at AECL's PHP**





### ***Radiation protection program performance***

AECL's performance in its radiation protection program has been assessed through various CNSC compliance activities, including inspections and desktop reviews. CNSC staff's assessment is that, overall, AECL's compliance with the *Radiation Protection Regulations* and licence requirements has been acceptable.

As part of the *PHAI Radiation Protection Plan*, AECL has established a number of action levels. Radon monitors are deployed in five separate locations onsite: four are located at the boundaries of the waste mound (north, south, east and west), and one is located at the operations trailer near the collection pond. An action level for occupational radiation exposure of 50 Bq/m<sup>3</sup> for radon was established by AECL for Phase II construction and remediation activities; this action level was being applied to the ambient radon concentration in air measured by these monitors.



AECL worker retrieving environmental TLD from perimeter fence

During the review period, AECL reported a total of eight action level exceedances over all monitoring locations. An elevated radon concentration at the locations being monitored results in negligible risks to workers since it occurs at locations where currently persons are not located for long periods of time. CNSC staff conclude that the radiation dose action levels for workers implemented by AECL are effective to control both internal and external components of radiation dose, and the *PHAI Radiation Protection Plan* assures that appropriate protective measures are in place for workers.

### ***Radiological hazard control***

Site specific contamination control requirements are implemented by AECL at PHP, consistent with the *PHAI Radiation Protection Plan*. These requirements include personal protective equipment and clothing requirements for workers and visitors, and contamination monitoring checks for personnel and equipment. During the review period, there were no incidents of personnel contamination that resulted in a risk to workers or members of the public.

### ***Estimated dose to the public***

Under the *Radiation Protection Regulations*, AECL is required to estimate dose to the public due to the PHP. Environmental TLDs posted on the perimeter fence at the Port Hope WMF are utilized for this purpose.

Monitoring results for the review period indicate an estimated dose to the public well below the regulatory limit of 1 mSv/year.

**Conventional health and safety**

RATINGS FOR CONVENTIONAL HEALTH AND SAFETY		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the “conventional health and safety” SCA at PHP as “satisfactory”. AECL continues to maintain an acceptable conventional health and safety program as no lost-time injuries have occurred at PHP during the review period.		

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

For the PHP, this SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness (no significant observations to report)

***Performance***

One of the key indicators of performance with respect to conventional health and safety is recordable lost-time injury incidents (RLTI). An RLTI 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. In reviewing RLTIs, CNSC staff must also consider the severity of these injuries (e.g. the total days lost) and the frequency as they relate to the size of the workforce. The severity rate is a measure of the total number of days lost due to injury for every 200,000 person-hours worked at a site and the frequency is the number of fatalities and injuries (lost time and medically treated) due to accidents for every 200,000 person-hours worked at a site.

As can be seen from table 11, AECL has had no lost-time injury incidents at PHP.

**Table 11: Recordable lost-time injuries (RLTI), frequency and severity at PHP 2011-2013**

Year	RLTIs	RLTI Frequency	RLTI Severity
2011	0	0	0
2012	0	0	0
2013	0	0	0

**Practices**

In addition to the *Nuclear Safety and Control Act* and its regulations, project activities at the PHP must comply with Part II of the *Canada Labour Code*, the *Canada Occupational Health and Safety Regulations* and other applicable federal and provincial health and safety-related acts and regulations.

Under licence condition 2.8, AECL is required to have a program for occupational health and safety for the PHP. The *PHAI Occupational Safety and Health (OSH) Plan*, which is referenced in section 3.2.8 of the LCH, is the primary criteria for assessing compliance, and defines the OSH program applicable to the PHP. It is consistent with AECL's corporate OSH program which covers the company-wide procedures, training, oversight and reporting. The plan also includes oversight mechanism to ensure that all workers, including contractors, follow proper health and safety procedures.

The Port Hope/Port Granby Site Safety and Health Committee oversees site specific health and safety matters, meets a minimum of nine times per year, and conducts regular site inspections.

**Environmental protection**

RATINGS FOR ENVIRONMENTAL PROTECTION		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the "environmental protection" SCA at PHP as "satisfactory". AECL continues to implement and maintain an acceptable environmental program, and effectively monitors and controls effluent releases.		

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.

For the PHP, this SCA encompasses the following specific areas:

- Effluent and emissions control (releases)
- Assessment and monitoring

### *Effluent and emissions control (releases)*

Licence conditions 2.9 and 2.10 require AECL to implement an environmental protection program, and to monitor and control releases to the environment, respectively. These requirements pertain specifically to liquid effluent releases, as there are no atmospheric release limits for this site. AECL has implemented programs to meet these requirements at the PHP including the *Environmental Management and Protection Plan for On-Site Construction and Remediation Activities* and the *Environmental Monitoring Plan*, both of which are consistent with AECL's corporate environmental management system.

CNSC staff reviewed the data submitted for the review period and found that all treated liquid effluent releases were monitored and no exceedances of the licence release limits occurred. Similarly, tests for toxicity conducted over the same timeframe demonstrated that the effluent was non-acutely lethal. Effluent monitoring results for this period can be found in appendix F.

CNSC staff conducted a general assessment of facility operations during an inspection in October 2013. At that time, analytical results for samples collected during the inspection were well below the release limits specified in the licence.

As specified in section 3.2.9 of the LCH, action level exceedances are reportable by AECL when three consecutive exceedances occur. AECL reported three consecutive exceedances of arsenic in July 2013. The WTP was shut down, and effluent was re-circulated for further treatment as per AECL's procedure. Following internal investigation, AECL determined that seasonal dry periods, which increase arsenic concentrations, combined with the necessity to continue operation of the WTP to maintain safe levels in the east collection pond, had resulted in the exceedances. The capacity in the east collection pond had been significantly reduced as a result of construction activities. AECL subsequently issued the *Brand Road Welcome Waste Management Facility Effluent Action Level Exceedance Mitigation Procedure* to address this issue. CNSC staff are satisfied with AECL's investigation and the corrective actions taken.

Regulatory oversight with respect to environmental protection is also provided by Environment Canada and the Ontario Ministry of Environment. In 2013, a joint regulatory group comprising the CNSC, Environment Canada and the Ontario Ministry of Environment was established to coordinate regulatory oversight in this area.

### *Assessment and monitoring*

#### Groundwater monitoring

Groundwater monitoring for radium-226, arsenic, and pH is conducted at the Welcome WMF in order to identify changes in groundwater conditions around the site. The results of groundwater sampling conducted in 2013 were consistent with the historical groundwater monitoring data from Cameco, the former licensee.

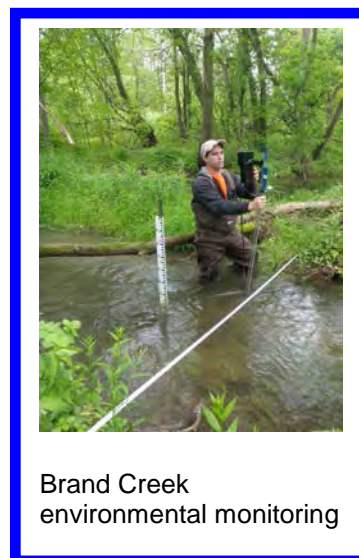
Offsite surface water monitoring

Offsite surface water monitoring for arsenic, radium-226, uranium, and pH was conducted on a monthly basis at Brand's Creek, the main stream in the watershed, which is located west of the Welcome WMF.

CNSC staff reviewed the results of this sampling for 2013 and found that concentrations of these contaminants remain within background levels.

Environmental assessment follow-up monitoring

As required under licence condition 2.11, AECL is continuing to conduct environmental assessment follow-up monitoring to obtain environmental baseline data, including offsite suspended particulate matter, groundwater, soil, sediment, surface water, and drainage water.



Brand Creek environmental monitoring

**Emergency management and fire protection**

RATINGS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the “emergency management and fire protection” SCA at PHP as “satisfactory”. AECL maintains an acceptable emergency response plan, and has arranged service agreements with local emergency response organizations.		

The “emergency management and fire protection” SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.

For the PHP, this SCA encompasses the following specific areas:

- Conventional emergency preparedness and response
- Fire emergency preparedness and response

AECL is required to have an emergency preparedness program under licence condition 2.12. The *PHAI Emergency Plan*, which is consistent with AECL’s corporate emergency preparedness program, describes planning and operational requirements for response to an emergency directly or indirectly affecting the PHP during Phase II. The *PHAI Emergency Plan* is referenced in section 3.2.10 of the LCH and forms the primary compliance verification criteria for this SCA.

***Conventional emergency preparedness and response***

In 2012, AECL signed emergency response agreements/memorandums of understanding with the Northumberland County Emergency Medical Services, Port Hope Police Services, and Northumberland Ontario Provincial Police. The PHAI does not have dedicated security or fire personnel.

***Fire emergency preparedness and response***

Fire has been identified as one of the potential hazards associated with PHP sites and buildings. However, because PHP is not a nuclear facility, the specific area of fire emergency preparedness and response is not addressed separately in this report. Mitigation measures and response to fire incidents are covered in the *PHAI Emergency Plan* and the emergency response agreements/memorandums of understanding as noted above.

**Waste management**

RATINGS FOR WASTE MANAGEMENT		
Overall Performance Ratings		
2011	2012	2013
N/A	N/A	N/A
Not applicable		

The “waste management” SCA covers internal waste-related programs that form part of the facility’s operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning. This SCA is not relevant to the PHP as waste management is the core operation for the project. The PHP is a remediation project to provide suitably constructed, environmentally safe, socially acceptable and appropriately controlled long-term management for historic LLRW.

**Security**

RATINGS FOR SECURITY		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the “security” SCA at PHP as “satisfactory”. AECL continues to implement and maintain an acceptable security program for the PHP.		

The “security” SCA covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.

For the PHP, this SCA encompasses the following specific area:

- Security practices

### *Security practices*

In response to licence condition 2.13, which requires that a security program be in place for the PHP, AECL has implemented the *PHAI Security Plan* that establishes the security arrangements required for the PHAI projects.

### **Safeguards and non-proliferation**

RATINGS FOR SAFEGUARDS AND NON-PROLIFERATION		
Overall Performance Ratings		
2011	2012	2013
N/A	N/A	N/A
Not Applicable		

The “safeguards and non-proliferation” SCA covers the programs and activities required for the successful implementation of the obligations arising from the Canada/IAEA safeguards agreements, as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*.

No safeguarded material is currently stored at the Welcome WMF; consequently, the SCA for safeguards does not apply. However, discussions are ongoing between CNSC staff and the IAEA with respect to currently-safeguarded material stored at Cameco's Port Hope Conversion Facility and that is destined for the Port Hope LTWMF. CNSC staff requested that IAEA reconsider their proposal to install IAEA neutron slabs to monitor the transfer of safeguarded material to the Port Hope LTWMF and proposed, instead, that an inspection-based scheme be employed. In order to accept the safeguarded wastes at Port Hope LTWMF, AECL will be required to implement a safeguards program based on criteria established via this dialogue.

## Packaging and transport

RATINGS FOR PACKAGING AND TRANSPORT		
Overall Performance Ratings		
2011	2012	2013
Not rated	SA	SA
For the review period, CNSC staff continue to rate the “packaging and transport” SCA at PHP as “satisfactory”. AECL continues to implement and maintain an acceptable program for radioactive material in anticipation of waste transfer slated to begin in 2015.		

The “packaging and transport” SCA covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility.

For the PHP, this SCA encompasses the following specific area:

- Packaging and transport

### *Packaging and transport*

AECL has in place the *PHAI Radioactive Material Transportation Plan* to govern transport of radioactive material. During the review period, no radioactive material was transported.

## 3.3 Port Granby Project

### 3.3.1 Overview

Located in the Municipality of Clarington, the Port Granby WMF contains LLRW including process residues, scrap equipment, industrial trash and soils that were received at the site between 1955 and 1988. The waste storage area is a relatively flat central plateau that terminates in steep bluffs, falling approximately 35 metres to the shore of Lake Ontario. On either side of the central plateau are east or west gorges; it was into these gorges that wastes were initially placed. Later trenches were dug in the central plateau and were used to house wastes.



**Figure 15: The Port Granby waste management facility**

*(Source: AECL)*

The purpose of the Port Granby Project (PGP) is to construct a new LTWMF, away from the shores of Lake Ontario, and to provide long-term storage for the contents of the existing WMF, which will then be remediated.

PGP activities include the construction and operation of the LTWMF; construction of the new WTP; remediation of the existing Port Granby WMF; and decommissioning of the existing WTP.

The PGP is being conducted in three phases – transition, implementation and closure.

- Phase I (transition) activities are confined to the continued operation, care and maintenance of the Port Granby WMF, assumed from Cameco in March 2010
- Phase II (implementation) activities include the operation, care and maintenance of the Port Granby WMF, development of the new LTWMF, and remediation of the existing WMF
- Phase III (closure) activities include long-term maintenance and monitoring of the Port Granby LTWMF

In 2014, the third year of Phase II of the PGP, AECL is preparing for construction of the LTWMF, and completing construction of the new WTP. As the project proceeds, AECL continues to inform and engage the public through various mechanisms under its public information program including the Port Granby Citizen Liaison Group. Further details regarding the public information program can be found in section 3.1 of this report.

Phase II activities are governed under the PGP licence [16], which was issued in November 2011. Under that licence, AECL is required to implement programs to ensure compliance with the accepted design, safe conduct of the approved activities and protection of people and the environment. These programs are referenced in the LCH [17].

CNSC staff continue to verify implementation of AECL's programs with respect to this project and assess them against the performance objectives and compliance verification criteria defined in the regulations, the licence and the LCH. Verification includes desktop reviews and site inspections. Many program documents referenced in the LCH are currently undergoing revision; desktop reviews of these will be conducted by CNSC staff. The most recent site inspection was conducted on October 29, 2013.

As previously stated, the information presented per SCA is very similar between the two projects. It is important to separate the two projects into distinct sections because the information that will be included in future annual reports will differ as the projects progress independently. An update on the status of the PGP by SCA follows. Ratings are provided for each SCA for 2011, 2012 and 2013. In 2011, the ratings assessed for each SCA were based on information submitted in support of the licence application. In 2012 and 2013, the ratings for each SCA were based on CNSC's staff assessment for the review period that calendar year. The review period for PGP includes 2013, and provides recent updates on key issues through June 30, 2014.

Many of the specific areas under the SCAs do not apply to the PGP, and this is reflected in the discussion below. This is due largely to the nature of the project. Unlike CRL and WL, the PGP is not a nuclear facility. Further, many of the activities in Phase II, upon which AECL embarked with the issuance of the current licence, involve conventional construction, for example construction of the new WTP.

### 3.3.2 Safety and Control Areas

Table 12 presents the ratings for PGP for the year 2013. All SCA ratings are "satisfactory" for the reporting period which remains unchanged from reports previously made to the Commission [18].

**Table 12: Performance ratings for Port Granby Project, 2013**

<b>Safety and control area</b>	<b>Rating</b>
Management system	SA
Human performance management	SA
Operating performance	SA
Safety analysis	N/A
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	N/A
Security	SA
Safeguards and non-proliferation	N/A
Packaging and transport	SA

Notes:

- For specific areas within the SCAs where there were no significant observations from CNSC's staff compliance verification activities, no information is given in the subsection of the report
- The information presented below is site specific; general trends are not identified

### Management system

<b>RATINGS FOR MANAGEMENT SYSTEM</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff continues to rate the "management system" SCA for the PGP as "satisfactory". AECL continues to implement the <i>PHAI Quality Assurance Plan</i> , and conducts oversight activities.		

The "management system" SCA 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. For the PGP, this SCA encompasses the following specific areas:

- Management system
- Operating experience
- Safety culture

- Records management (no significant observations to report)
- Management of contractors

### ***Management system***

The activities of the PGP are broadly governed under AECL's corporate management system, and more specifically guided by the *PHAI Quality Assurance Plan*. The plan summarizes the processes and practices applicable to the PHAI licensed activities during execution of Phase II and clarifies the extent of their applicability to participants. These processes and practices satisfy the requirements identified above and comply with the quality management system defined in CSA-ISO 9001:08 *Quality Management Systems – Requirements*. The quality assurance plan (and adherence to it) is a requirement of condition 2.3 of the licence.

### ***Operating experience***

As previously stated in the report, the OPEX program at AECL comprises the processes that ensure the organization uses the experience both from within the organization and from industry peers to improve the safety of operations, improve operational performance, and reduce the significance and the occurrence of unplanned events.

PGP reviews OPEX bulletins for relevance and applicability through the Improvement Action process.

### ***Safety culture***

AECL staff receives mandatory training in Human Performance to help reduce human error and thus, the frequency and severity of events at AECL. Initiatives of AECL's Human Performance Branch are designed, amongst other things, to strengthen AECL's safety culture.

During the review period, safety culture related training conducted for PGP staff included *Leadership Academy; Field Observation and Coaching Fundamentals; Nuclear Safety Culture Workshop; Communicating for Leadership Success and Building Trust; and Coaching for Peak Performance*.

### ***Management of contractors***

AECL's responsibilities within the PHAI Management Office include defining the licence requirements to be included in contracts awarded by PWGSC for the execution of construction and remediation activities. AECL conducts oversight to ensure licence requirements are met. The *PHAI Oversight Procedure* governs how AECL oversight is conducted to confirm compliance with licensing commitments, technical requirements, and contractual obligations.

Within the review period, AECL conducted oversight of the construction of the new WTP and the Elliott Road upgrades.

## Human performance management

RATINGS FOR HUMAN PERFORMANCE MANGEMENT		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “human performance management” SCA at PGP as “satisfactory”. AECL continues to implement an acceptable training program to ensure staff has the necessary skills and knowledge to safely carry out their duties.		

The “human performance management” SCA covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee personnel are available in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties. For the PGP, this SCA encompasses the following specific area:

- Personnel training

### *Personnel training*

A training program, and adherence to it, is a requirement of the PGP licence. To meet this obligation, AECL has implemented the *PHAI Training Plan*. During the review period, AECL conducted 41 training courses for PGP including those reported under “safety culture”, as listed in “safety culture”.

CNSC staff conducted a general assessment of facility operations in October 2013. At that time, CNSC staff reviewed training records for facility managers and operational staff and found them complete. AECL’s corporate database is utilized to identify and track training needs, and to file staff training records.

## Operating performance

RATINGS FOR OPERATING PERFORMANCE		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “operating performance” SCA at PGP as “satisfactory”. AECL continues to meet licence and legislative requirements in conducting Phase II activities, implementing procedures and reporting on activities.		

The “operating performance” SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

For the PGP, this SCA encompasses the following specific areas:

- Conduct of licensed activity
- Procedures
- Reporting and trending

#### ***Conduct of licensed activity***

Licensed activities for Phase II, the current phase of the PGP, include:

- the operation of the existing Port Granby Waste Management Facility (WMF)
- the construction of the new Water Treatment Plant (WTP)
- the construction of the new Long-Term Waste Management Facility (LTWMF) and remediation of the existing WMF

#### **Operation of the existing Port Granby Waste Management Facility**

The Port Granby WMF was transferred from Cameco to AECL on March 29, 2012. At that time, AECL was authorized by the licence to continue operation and maintenance of the existing Port Granby WMF, as per the operational procedures and protocols specified in the *Licensing Manual – Information in Support of the Port Granby Long-Term Low-Level Radioactive Waste Management Project Licence Application*.

#### **Construction of the new Water Treatment Plant**

AECL is required, under licence condition 2.7, to construct the new WTP in accordance with design documentation specified in section 3.2.7 of the LCH. Construction of the WTP is being managed and overseen by PWGSC; AECL continues to conduct oversight activities for construction of the new WTP.

The building envelope of the new WTP was completed in the fall of 2013. Fitting of the building with water treatment equipment is ongoing.

The plan for active commissioning has been submitted by AECL, as required under section 3.2.7 of the LCH, and accepted by CNSC staff.

#### **Construction of the Long-Term Waste Management Facility and Remediation of Port Granby Waste Management Facility**

The tendering process for the final construction contract for the new LTWMF is underway. The contract will include the construction of the Lakeshore Road underpass, removal of LLRW from the existing WMF and emplacement in the new LTWMF, and remediation of the existing WMF.

Potentially contaminated trees currently growing on the existing WMF must be removed to facilitate excavation activities. AECL has developed a plan for assessing the contamination of the trees which includes core sampling a select number of trees and scanning for contamination. AECL has identified and tagged the trees which will be sampled. The strategy for removal and disposal of the trees that will be determined based on the assessment results.

In 2009, Leader Resources Corp. proposed to construct a renewable energy project, consisting of five wind turbines, on property adjacent to the Port Granby LTWMF. AECL subsequently commissioned an independent study to evaluate the impact of the proposed project on AECL's dust management plan. AECL's response is consistent with the broad responsibility of licensees to assess external hazards to ensure the ongoing safe operation of their facility. The study concluded that the wakes from the proposed wind turbines will not impact AECL's operations with respect to data collection and dust management. Currently, Leader Resources Corp.'s application for a Renewable Energy Approval remains under review by the Ontario Ministry of Environment and Climate Change. CNSC staff will continue to monitor the progress of the wind turbine project to ensure that AECL's licensing requirements continue to be met.

### *Procedures*

AECL maintains a suite of procedures specifically applicable to the activities of the PGP. These procedures are designed to operate within the broader framework of AECL's corporate documented programs. During the review period, project-specific procedures relating to commissioning of the WTP and to investigation of toxicity test failures were submitted to the CNSC for review and acceptance.

### *Reporting and trending*

As specified in licence condition 2.4, AECL is required to submit written reports for action level exceedances; quarterly liquid effluent monitoring; quarterly liquid effluent toxicity testing; annual operational and compliance data; any failure that resulted in, or could have resulted in the release of a nuclear substance or hazardous substance from the facility; and quarterly project progress. Written reports at completion of project activities are also required.

### **Safety analysis**

<b>RATINGS FOR SAFETY ANALYSIS</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
N/A	N/A	N/A
Not applicable		

The “safety analysis” SCA 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. There is no specific requirement for conducting safety analysis in support of an application for a Waste Nuclear Substance Licence, such as that which governs the PGP.

### Physical design

RATINGS FOR PHYSICAL DESIGN		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “physical design” SCA at PGP as “satisfactory”. AECL continues to implement and maintain an internal verification process to ensure licence and legislative requirements for facility design are met.		

The “physical design” SCA relates to activities that impact the ability of SSCs to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

For the PGP, this SCA encompasses the following specific areas:

- Design governance
- Facility design

#### *Design governance*

All design and equipment changes are subject to the controls defined in the *PHAI Quality Assurance Plan*. Details on this plan can be viewed under the management system SCA.

#### *Facility design*

The detailed design documentation for the LTWMF and the WTP were assessed and accepted by CNSC staff prior to issuance of the licence, and are referenced in section 3.2.7 of the LCH.

The plan for active commissioning has been submitted by AECL, as required under section 3.2.7 of the LCH, and has been accepted by CNSC staff. Commissioning of the WTP is expected to take place during the summer of 2014.



**Fitness for service**

RATINGS FOR FITNESS FOR SERVICE		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “fitness for service” SCA at PGP as “satisfactory”. AECL continues to implement and maintain an acceptable program for maintenance at the Port Granby WMF.		

The “fitness for service” SCA 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.

For the PGP, this SCA encompasses the following specific areas:

- Equipment fitness for service / equipment performance (no significant observations to report)
- Maintenance
- Structural integrity
- Aging management (no significant observations to report)

As the existing WMF and WTP are replaced by the new LTWMF and WTP, reporting under specific areas not relevant during this review period is anticipated.

***Maintenance***

AECL continues to maintain the existing facilities in accordance with the previous licensee's (Cameco) operational procedures and protocols, as referenced in section 2.4.1 of the LCH.

For the new facilities (LTWMF and WTP), AECL will be required to develop new procedures which will be incorporated into the LCH.

***Structural integrity***

Geo-technical inspections are conducted semi-annually by AECL to ensure that the integrity of the existing WMF is not compromised by erosion or slope instability.



Port Granby Bluffs

Further assessments for remedial actions are triggered, if active erosion extends to within 15 metres horizontally of the upper fence line. Verification conducted by CNSC staff during the review period included desktop reviews of reports produced by AECL's geotechnical consultants. CNSC staff also conducted a geo-technical inspection in August 2013. Based on these verification activities, CNSC staff concluded that, for the review period, the integrity of the existing WMF was not at risk and no remedial actions were required.

## Radiation protection

RATINGS FOR RADIATION PROTECTION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the "radiation protection" SCA at PGP as "satisfactory". AECL continues to implement and maintain a radiation protection program to control radiological hazards, ascertain doses to workers, and estimate doses to the public.		

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 as low as reasonably achievable (ALARA).

For the PGP, 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

### *Application of ALARA*

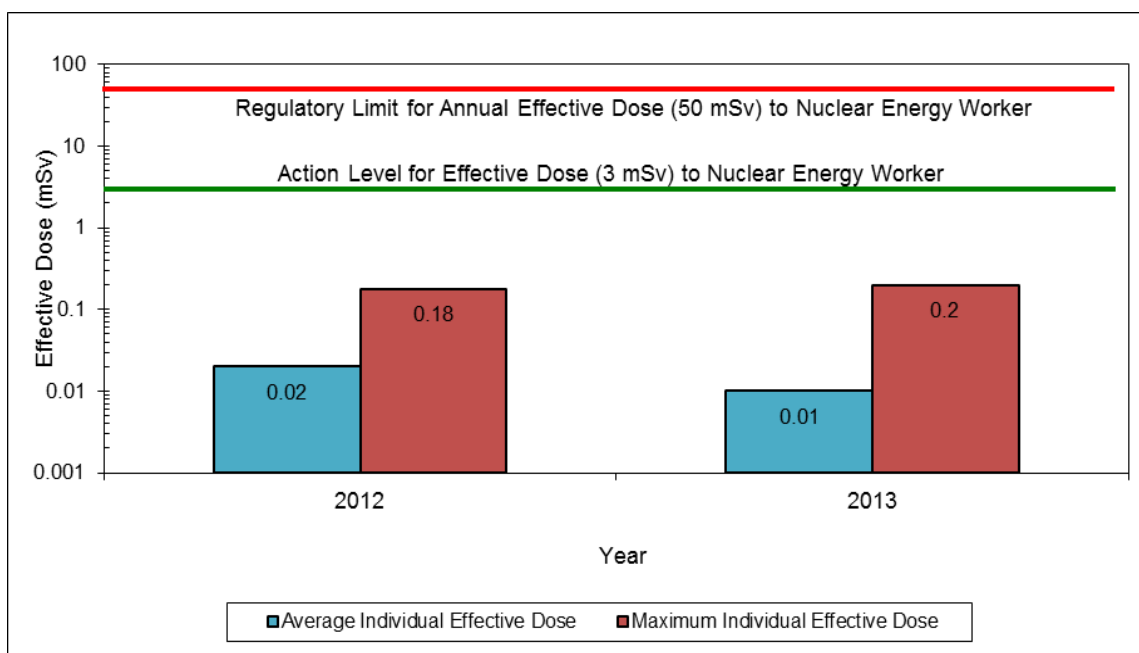
As required by the *Radiation Protection Regulations* and by its licence, AECL continues to implement the *PHAI Radiation Protection Plan* for the PGP. The *PHAI Radiation Protection Plan* defines the radiation protection measures applicable to PGP, consistent with AECL's corporate radiation protection program. The *PHAI Radiation Protection Plan* describes the basis for protection from ionizing radiation, and for ascertaining and recording radiation exposures and doses during the PGP activities. It also defines a management framework and processes designed to ensure that radiation exposures arising from project activities will be maintained below regulatory dose limits and ALARA.

### *Worker dose control*

The system to control radiation exposures and doses to workers is established in the *PHAI Radiation Protection Plan*, implemented for PGP. All employees working regularly at PGP wear TLDs for external radiation exposure monitoring, provided by AECL's in-house licensed dosimetry service. To date, AECL has not monitored worker doses independently between the two projects (see figures 14 and 16).

CNSC staff have concluded, following review of AECL's dose data, that AECL adequately controlled radiation doses to workers at PGP during the review period. The maximum doses to workers were 0.18 mSv and 0.20 mSv in 2012 and 2013, respectively; this is well below the CNSC's regulatory effective dose limit for nuclear energy workers.

**Figure 16: Effective dose statistics for nuclear energy workers at AECL's PGP**



### *Radiation protection program performance*

AECL is required by the *Radiation Protection Regulations* and licence condition 2.8, to implement and maintain a radiation protection program for the PGP. The *PHAI Radiation Protection Plan* is referenced in section 3.2.8 of the LCH and forms the primary compliance criteria for radiation protection. Action levels for occupational radiation exposure from Phase II activities are also referenced in the LCH.

AECL's performance in radiation protection has been assessed through various CNSC compliance activities including desktop reviews and inspections. CNSC staff's assessment is that, overall, AECL's compliance with the *Radiation Protection Regulations* and CNSC licence requirements has been acceptable.

As part of the *PHAI Radiation Protection Plan*, AECL has established a number of action levels. Radon monitors are deployed in five separate locations on site: at the boundaries of the buried waste, and near the lagoon. An action level for occupational radiation exposure of 50 Bq/m<sup>3</sup> for radon was established by AECL for Phase II construction and remediation activities; this action level was being applied to the ambient radon concentration in air measured by these monitors.

During the review period, AECL reported three exceedances of this action level at three of the five monitoring locations. An elevated radon concentration at the locations being monitored result in negligible risks to workers, since it occurs at locations where currently persons are not located for long periods of time. CNSC staff conclude that the radiation dose action levels for workers implemented by AECL are effective in the control of both internal and external components of radiation dose, and the *PHAI Radiation Protection Plan* assures that appropriate protective measures are in place for workers.

### ***Radiological hazard control***

Site specific contamination control requirements are implemented by AECL at PGP, consistent with the *PHAI Radiation Protection Plan*. These requirements include personal protective equipment and clothing requirements for workers and visitors, and contamination monitoring checks for personnel and equipment. During the review period, there were no incidents of personnel contamination that resulted in a risk to workers or members of the public.

### ***Estimated dose to the public***

Under the *Radiation Protection Regulations*, AECL is required to estimate dose to the public due to the PGP. Environmental TLDs posted on the perimeter fence at the Port Granby WMF are utilized for this purpose.

Monitoring results for the review period indicate an estimated dose to the public is well below the regulatory limit of 1 mSv/year.

## **Conventional health and safety**

<b>RATINGS FOR CONVENTIONAL HEALTH AND SAFETY</b>		
<b>Overall Performance Ratings</b>		
<b>2011</b>	<b>2012</b>	<b>2013</b>
SA	SA	SA
For the review period, CNSC staff continue to rate the “conventional health and safety” SCA at PGP as “satisfactory”. AECL continues to maintain an acceptable conventional health and safety program and has had no lost-time injuries at PGP during the review period.		

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

For the PGP, this SCA encompasses the following specific areas:

- Performance
- Practices
- Awareness (no significant observations to report)

### *Performance*

One of the key indicators of performance with respect to conventional health and safety is recordable lost-time injury incidents (RLTI). An RLTI 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. In reviewing RLTIs, CNSC staff must also consider the severity of these injuries (e.g., the total days lost) and the frequency as they relate to the size of the workforce. The severity rate is a measure of the total number of days lost due to injury for every 200,000 person-hours worked at a site and the frequency is the number of fatalities and injuries (lost time and medically treated) due to accidents for every 200,000 person-hours worked at a site.

As can be seen from table 13 below, AECL has had no lost-time injury incidents at PGP.

**Table 13: Recordable lost-time injuries (RLTI), frequency and severity at PGP, 2011-2013**

Year	RLTIs	RLTI Frequency	RLTI Severity
2011	0	0	0
2012	0	0	0
2013	0	0	0

### *Practices*

In addition to the *Nuclear Safety and Control Act* and its associated regulations, all project activities at the PGP must comply with Part II of the *Canada Labour Code*, the *Canada Occupational Health and Safety Regulations* and other applicable federal and provincial health and safety-related acts and regulations.

Under licence condition 2.9, AECL is required to have a program for occupational health and safety for the PGP. The *PHAI Occupational Safety and Health (OSH) Plan*, which is referenced in section 3.2.9 of the LCH, defines the OSH program applicable to the PGP. It is consistent with AECL's corporate OSH program which covers the company-wide procedures, training, oversight and reporting. The plan includes an oversight mechanism to ensure that all workers, including contractors, follow proper health and safety procedures.

The Port Hope/Port Granby Site Safety and Health Committee oversees site specific health and safety matters, meets a minimum of nine times per year, and conducts regular site inspections.

## Environmental protection

RATINGS FOR ENVIRONMENTAL PROTECTION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “environmental protection” SCA at PGP as “satisfactory”. AECL continues to implement and maintain an acceptable environmental program, to effectively monitor and control effluent releases.		

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.

For the PGP, this SCA encompasses the following specific areas:

- Effluent and emissions control (releases)
- Assessment and monitoring

### *Effluent and emissions control (releases)*

AECL is required, by the licence, to implement an environmental protection program and to monitor and control releases to the environment. This pertains specifically to liquid effluent releases as there are no atmospheric release limits for this site. AECL has implemented programs to meet these requirements at the PGP including the *Environmental Management and Protection Plan for On-Site Construction and Remediation Activities* and the *Environmental Monitoring Plan*, both of which are consistent with AECL's corporate environmental management system.

CNSC staff reviewed data submitted for the review period and found that all treated liquid effluent releases were monitored and no exceedances of the licence release limits occurred. Similarly, tests for toxicity conducted over the same timeframe demonstrated that the effluent was non-acutely lethal. Effluent monitoring results for this period can be found in appendix F.

CNSC staff conducted a general assessment during an inspection in October 2013. Analytical results for samples collected during that inspection were well below the release limits specified in the licence.

AECL reported a toxicity test failure for the WTP effluent in January 2013. Following an investigation (by AECL and CNSC staff), laboratory error was determined to be the cause. As a result of this event, AECL has developed a procedure for investigating toxicity test failures which has been reviewed and accepted by CNSC staff.

AECL is currently characterizing contaminants in the groundwater stream collected from the northern perimeter sub-drain in order to assess whether they could pose an unreasonable risk to the environment. This stream is combined with the treated effluent forming the total interceptor discharge stream which is monitored prior to release into Lake Ontario. The work is being done at the request of CNSC staff, based on observations of potentially elevated contaminant concentrations in this stream.

### *Assessment and monitoring*

AECL continues to implement environmental monitoring programs that establish baseline conditions around the site. These include groundwater monitoring, bluff seepage monitoring, geo-technical monitoring, and environmental assessment follow-up monitoring.

#### Groundwater monitoring

Groundwater monitoring for radium-226, arsenic, uranium, fluoride, nitrate and ammonium is conducted at the Port Granby WMF in order to identify changes in groundwater conditions around the site. The results of groundwater sampling conducted in 2012 and 2013 are consistent with the historical groundwater monitoring data.

#### Bluff seepage monitoring

Bluff seepage from the south bluffs at Port Granby WMF has been sampled for radium-226, arsenic, uranium and total suspended solids on a quarterly basis since June 2012, at the request of CNSC staff. Results submitted for the review period indicate there is no unreasonable impact to the aquatic environment.

#### Environmental assessment follow-up monitoring

As required under licence condition 2.12, AECL continues to conduct environmental assessment follow-up monitoring to obtain environmental baseline data, including offsite suspended particulate matter, noise, groundwater, soil, sediment, surface water and drainage water. CNSC staff have reviewed the results for the review period and found that the offsite environmental quality data were within environmental background level or below the PHAI cleanup criteria.

## Emergency management and fire protection

RATINGS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “emergency management and fire protection” SCA at PGP as “satisfactory”. AECL continues to implement an acceptable emergency response plan.		

The “emergency management and fire protection” SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.

For the PGP, this SCA encompasses the following specific areas:

- Conventional emergency preparedness and response
- Fire emergency preparedness and response

AECL is required, under licence condition 2.13, to have an emergency preparedness program for the PGP. The *PHAI Emergency Plan*, which is consistent with AECL’s corporate emergency preparedness program, describes planning and operational requirements for response to an emergency directly or indirectly affecting the PGP during Phase II activities. The *PHAI Emergency Plan* is referenced in section 3.2.11 of the LCH and forms the primary compliance criteria for emergency management and fire protection.

### *Conventional emergency preparedness and response*

In 2012, AECL signed emergency response agreements/memorandums of understanding with the Whitby Detachment of the Ontario Provincial Police, Durham Regional Police Service, Durham Region EMS and Clarington Fire Services. The PGP does not have dedicated security or fire personnel due to the size, location and nature of the project.

Subsequent to signing the emergency response agreements/memorandums of understanding, AECL developed the *PHAI Incident Response Coordination Procedure*. This procedure describes responsibilities of PHAI management office personnel and the processes used for planning and managing response to emergencies/incidents under the *PHAI Emergency Plan*.



***Fire emergency preparedness and response***

Fire has been identified as one of the potential hazards associated with PGP sites and buildings. However, as PGP is not a nuclear facility, the specific area of fire emergency preparedness and response is not addressed separately in this report. Mitigation measures and response to fire incidents are covered in the *PHAI Emergency Plan* and the emergency response agreements/memorandums of understanding as noted above.

**Waste management**

RATINGS FOR WASTE MANAGEMENT		
Overall Performance Ratings		
2011	2012	2013
N/A	N/A	N/A
Not applicable		

The “waste management” SCA covers internal waste-related programs that form part of the facility’s operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning. This SCA is not relevant to the PGP, because waste management is the core operation for the project. The PGP is a remediation project to provide suitably constructed, environmentally safe, socially acceptable and appropriately controlled long-term management for historic low-level radioactive waste.

**Security**

RATINGS FOR SECURITY		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “security” SCA at PGP as “satisfactory”. AECL continues to implement and maintain an acceptable security program for the PGP.		

The “security” SCA covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.

For the PGP, this SCA encompasses the following specific area:

- Security practices

### *Security Practices*

AECL is required, under section 3.2.12 of the LCH to have a security program for the PGP. In response, AECL has implemented the *PHAI Security Plan* that establishes the security arrangements required for the PHAI projects.

### **Safeguards and non-proliferation**

RATINGS FOR SAFEGUARDS AND NON-PROLIFERATION		
Overall Performance Ratings		
2011	2012	2013
N/A	N/A	N/A
Not Applicable		

The “safeguards and non-proliferation” SCA covers the programs and activities required for the successful implementation of the obligations arising from the Canada/IAEA safeguards agreements, as well as all other measures arising from the Treaty on the Non-Proliferation of Nuclear Weapons.

This SCA is not relevant to the PGP as the material that will be handled under this remediation project has no obligations arising from the Canada/IAEA safeguards agreement.

### **Packaging and transport**

RATINGS FOR PACKAGING AND TRANSPORT		
Overall Performance Ratings		
2011	2012	2013
SA	SA	SA
For the review period, CNSC staff continue to rate the “packaging and transport” SCA at PGP as “satisfactory”. AECL continues to implement and maintain an acceptable program for radioactive material in anticipation of waste transfer slated to begin in 2015.		

The “packaging and transport” SCA covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility.

For the PGP, this SCA encompasses the following specific area:

- Packaging and transport

***Packaging and transport***

AECL has implemented the *PHAI Radioactive Material Transportation Plan* to govern transport of radioactive material. The plan meets regulatory requirements and is consistent with AECL's corporate program for radioactive material transportation. Under this plan, contaminated material will be transported to the LTWMF via the prescribed internal haul routes. No waste will be transported on public roads. During the review period, no radioactive material was transported.

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## REFERENCES

- [1] *Nuclear Research and Test Establishment Operating Licence, Atomic Energy of Canada Limited*, NRTEOL-01.01/2016 (e-Doc 4419693).
- [2] NRTEOL-LCH-01, *Licence Conditions Handbook for Chalk River Laboratories*, Revision 1, February 15, 2013 (e-Doc 4073666).
- [3] Letter from C. Nache to T. Arthur, *Update Number 1 to the CRL Handbook NRTEOL-LCH-01, Revision 1*, dated August 14, 2013 (e-Doc 4113894).
- [4] CMD 13-M14: *Report for the Performance of Atomic Energy of Canada Limited Chalk River Laboratories*, dated February 2, 2013 (e-Doc 4033119).
- [5] CMD 19-M25: *Significant Development Report No. 2009-1*, dated June 11, 2009 (e-Doc 3382610).
- [6] CMD 13-M27: *Event Initial Report Atomic Energy of Canada Limited: NRU Reactor - Operator Error on February 27, 2013*, dated May 15, 2013 (e-Doc 4120367).
- [7] Record of Proceedings, Including Reasons for Decision in the Matter of Atomic Energy of Canada Limited, *Application for Approval to Operate the Fuel Packaging and Storage Facility*, March 18, 2014 (e-Doc 4404833).
- [8] AECL's Dosimetry Service Licence No. 20004-17-16.3 (e-Doc 4044699).
- [9] Event Initial Report: *AECL Dosimetry Licence: Late Submission of Dose Records to the National Dose Registry*, dated May 17, 2013 (e-Doc 4138036).
- [10] *Whiteshell Laboratories Decommissioning Licence*, NRTEDL-08.02/2018 (e-Doc 3987115).
- [11] CMD 12-M47: *Interim Status Report on the Progress of Decommissioning Activities at Whiteshell Laboratories* (e-Doc 3990749)
- [12] Legal Agreement between Natural Resources Canada, Town of Port Hope, Township of Hope and Municipality of Clarington, *An Agreement for the Cleanup and Long-Term Safe Management of Low-Level Radioactive Waste Situate in the Town of Port Hope, the Township of Hope and the Municipality of Clarington*, dated March 29, 2001 (amended October 2003, October 2006, and December 2009), available at <http://phai.ca/en/public-documents/protocols-agreements>.
- [13] *Waste Nuclear Substance Licence*, WNSL-W1-2310.00/2022, *Port Hope Long-Term Low-Level Radioactive Waste Management Project*, dated November 15, 2012 (e-Doc 3990347).
- [14] *Port Hope LTWMF Licence Conditions Handbook*, dated November 16, 2012 (e-Doc 3989304).
- [15] CMD 12-H10: *Application by Atomic Energy of Canada Limited for Amendment of Waste Nuclear Substance Licence for the Port Hope Long-Term Low-Level Radioactive Waste Management Project*, dated October 24, 2012 (e-Doc 3989283).

- [16] *Waste Nuclear Substance Licence WNSL-W1-2311.00/2021, Port Granby Long-Term Low-Level Radioactive Waste Management Project*, dated November 2011 (e-Doc 3767237).
- [17] *Port Granby LTWMF Licence Conditions Handbook*, dated March 30, 2012 (e-Doc 3846439).
- [18] *CMD 11-H10: Application by Atomic Energy of Canada Limited for a Waste Nuclear Substance Licence for the Port Granby Long-Term Low-Level Radioactive Waste Management Project*, dated September 27, 2011 (e-Doc 3767261).

## GLOSSARY

### Commission

A corporate body of not more than seven members, established under the *Nuclear Safety and Control Act* 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 DRL 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.

### Fissionable

Fissionable refers to the capability to undergo fission.

**Fissile Solution Storage Tank (FISST)**

A radioactive waste vessel used for the storage of fissile liquid waste resulting from the processing of irradiated targets for the production of medical isotopes (Molybdenum-99 and Xenon isotopes), from 1986 to 2003.

**Frequency Rate**

The number of fatalities and injuries (lost time and medically treated) due to accidents for every 200,000 person-hours (approximately 100 person-years) worked at a site.

**International Atomic Energy Agency (IAEA)**

An independent international organization related to the United Nations system. The IAEA, located in Vienna, works with its Member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies. The IAEA reports annually to the UN General Assembly and, when appropriate, to the Security Council regarding non-compliance by States with their safeguards obligations, as well as on matters relating to international peace and security.

**Lost-Time Incident**

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

**Severity Rate**

A measure of the total number of days lost due to injury for every 200,000 person-hours worked at a site.

**Severe Accident Management Program (SAMP)**

A document that establishes

- (a) actions to be taken during the course of a severe accident to prevent escalation of the accident into an event involving severe damage to the reactor core, to mitigate the consequences of the accident, or to achieve a safe, stable state of the reactor over the long term
- (b) preparatory measures necessary for implementation of such actions

Note: SAMPs are sometimes referred to as severe accident management guidelines.



## **APPENDIX A: SAFETY AND CONTROL AREA FRAMEWORK**

The CNSC evaluates how well licensees meet regulatory requirements and CNSC expectations for the performance of programs in 14 safety and control areas (SCAs), including the SCA for security. The specific areas within each SCA have been identified by CNSC staff. The specific areas are different for Chalk River Laboratories, Whiteshell Laboratories, the Port Hope project, and the Port Granby project. The 14 SCAs are grouped according to their functional area as management, facility and equipment, or core control processes.

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**A:1 Safety and Control Area Framework**

Functional area	Safety and control area	Definition	Chalk River Laboratories specific areas	Whiteshell Laboratories specific areas	Port Hope specific areas	Port Granby specific areas
Management	management system	Covers the framework that establishes the process 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"> <li>• Management System</li> <li>• Organization</li> <li>• Performance Assessment, Improvement and Management Review</li> <li>• Operating Experience</li> <li>• Change Management</li> <li>• Safety Culture</li> <li>• Records Management</li> <li>• Management of Contractors</li> <li>• Business Continuity</li> </ul>	<ul style="list-style-type: none"> <li>• Management System</li> <li>• Organization</li> <li>• Performance Assessment, Improvement and Management Review</li> <li>• Operating Experience</li> <li>• Change Management</li> <li>• Safety Culture</li> <li>• Configuration Management</li> <li>• Records Management</li> <li>• Management of Contractors</li> <li>• Business Continuity</li> </ul>	<ul style="list-style-type: none"> <li>• Management System</li> <li>• Operating Experience</li> <li>• Safety Culture</li> <li>• Records Management</li> <li>• Management of Contractors</li> </ul>	<ul style="list-style-type: none"> <li>• Management System</li> <li>• Operating Experience</li> <li>• Safety Culture</li> <li>• Records Management</li> <li>• Management of Contractors</li> </ul>
	human performance management	Covers activities that enable effective human performance through the development and implementation of processes that ensure that enough licensee staff 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"> <li>• Human Performance Program</li> <li>• Personnel Training</li> <li>• Personnel Certification</li> <li>• Work Organization and Job Design</li> <li>• Fitness for Duty</li> </ul>	<ul style="list-style-type: none"> <li>• Human Performance Program</li> <li>• Personnel Training</li> <li>• Personnel Certification</li> <li>• Work Organization and Job Design</li> <li>• Fitness for Duty</li> </ul>	<ul style="list-style-type: none"> <li>• Personnel Training</li> </ul>	<ul style="list-style-type: none"> <li>• Personnel Training</li> </ul>
	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"> <li>• Conduct of Licensed Activity</li> <li>• Procedures</li> <li>• Reporting and Trending</li> <li>• Outage Management Performance</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct of Licensed Activity</li> <li>• Procedures</li> <li>• Reporting and Trending</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct of Licensed Activity</li> <li>• Procedures</li> <li>• Reporting and Trending</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct of Licensed Activity</li> <li>• Procedures</li> <li>• Reporting and Trending</li> </ul>

Functional area	Safety and control area	Definition	Chalk River Laboratories specific areas	Whiteshell Laboratories specific areas	Port Hope specific areas	Port Granby specific areas
	<b>safety analysis</b>	Includes 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 preventive measures and strategies in reducing the effects of such hazards.	<ul style="list-style-type: none"> <li>• Deterministic Safety Analysis</li> <li>• Hazard Analysis</li> <li>• Probabilistic Safety Analysis</li> <li>• Criticality Safety</li> <li>• Severe Accident Analysis</li> <li>• Environmental Risk Assessment</li> </ul>	<ul style="list-style-type: none"> <li>• Deterministic Safety Analysis</li> <li>• Hazard Analysis</li> <li>• Criticality Safety</li> </ul>	Not Applicable	Not Applicable
<b>Facility and equipment</b>	<b>physical design</b>	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"> <li>• Design Governance</li> <li>• Site Characterization</li> <li>• Facility Design</li> <li>• Structure Design</li> <li>• System Design</li> <li>• Component Design</li> </ul>	<ul style="list-style-type: none"> <li>• Design Governance</li> <li>• Site Characterization</li> <li>• Facility Design</li> </ul>	<ul style="list-style-type: none"> <li>• Design Governance</li> <li>• Facility Design</li> </ul>	<ul style="list-style-type: none"> <li>• Design Governance</li> <li>• Facility Design</li> </ul>

Functional area	Safety and control area	Definition	Chalk River Laboratories specific areas	Whiteshell Laboratories specific areas	Port Hope specific areas	Port Granby specific areas
	fitness for service	Covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This 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"> <li>Equipment Fitness for Service/ Equipment Performance</li> <li>Maintenance</li> <li>Structural Integrity</li> <li>Aging Management</li> <li>Chemistry Control</li> </ul>	<ul style="list-style-type: none"> <li>Equipment Fitness for Service/ Equipment Performance</li> <li>Maintenance</li> <li>Structural Integrity</li> </ul>	<ul style="list-style-type: none"> <li>Equipment Fitness for Service/ Equipment Performance</li> <li>Maintenance</li> <li>Structural Integrity</li> <li>Aging Management</li> </ul>	<ul style="list-style-type: none"> <li>Equipment Fitness for Service/ Equipment Performance</li> <li>Maintenance</li> <li>Structural Integrity</li> <li>Aging Management</li> </ul>
Core control processes	radiation protection	Covers the implementation of a radiation protection program in accordance with the <i>Radiation Protection Regulations</i> . This program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled, and maintained as low as reasonably achievable (ALARA).	<ul style="list-style-type: none"> <li>Application of ALARA</li> <li>Worker Dose Control</li> <li>Radiation Protection Program Performance</li> <li>Radiological Hazard Control</li> <li>Estimated Dose to Public</li> </ul>	<ul style="list-style-type: none"> <li>Application of ALARA</li> <li>Worker Dose Control</li> <li>Radiation Protection Program Performance</li> <li>Radiological Hazard Control</li> <li>Estimated Dose to Public</li> </ul>	<ul style="list-style-type: none"> <li>Application of ALARA</li> <li>Worker Dose Control</li> <li>Radiation Protection Program Performance</li> <li>Radiological Hazard Control</li> <li>Estimated Dose to Public</li> </ul>	<ul style="list-style-type: none"> <li>Application of ALARA</li> <li>Worker Dose Control</li> <li>Radiation Protection Program Performance</li> <li>Radiological Hazard Control</li> <li>Estimated Dose to Public</li> </ul>
	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"> <li>Performance</li> <li>Practices</li> <li>Awareness</li> </ul>	<ul style="list-style-type: none"> <li>Performance</li> <li>Practices</li> <li>Awareness</li> </ul>	<ul style="list-style-type: none"> <li>Performance</li> <li>Practices</li> <li>Awareness</li> </ul>	<ul style="list-style-type: none"> <li>Performance</li> <li>Practices</li> <li>Awareness</li> </ul>

Functional area	Safety and control area	Definition	Chalk River Laboratories specific areas	Whiteshell Laboratories specific areas	Port Hope specific areas	Port Granby specific areas
Core control processes (Cont'd.)	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"> <li>Environmental Management System</li> <li>Effluent and Emissions Control</li> <li>Assessment and Monitoring</li> <li>Protection of the Public</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Management System</li> <li>Effluent and Emissions Control</li> <li>Assessment and Monitoring</li> <li>Protection of the Public</li> </ul>	<ul style="list-style-type: none"> <li>Effluent and Emissions Control</li> <li>Assessment and Monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Effluent and Emissions Control</li> <li>Assessment and Monitoring</li> </ul>
	emergency management and fire protection	Covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. This also includes any results of exercise participation.	<ul style="list-style-type: none"> <li>Conventional Emergency Preparedness and Response</li> <li>Nuclear Emergency Preparedness and Response</li> <li>Fire Emergency Preparedness and Response</li> </ul>	<ul style="list-style-type: none"> <li>Conventional Emergency Preparedness and Response</li> <li>Nuclear Emergency Preparedness and Response</li> <li>Fire Emergency Preparedness and Response</li> </ul>	<ul style="list-style-type: none"> <li>Conventional Emergency Preparedness and Response</li> <li>Fire Emergency Preparedness and Response</li> </ul>	<ul style="list-style-type: none"> <li>Conventional Emergency Preparedness and Response</li> <li>Fire Emergency Preparedness and Response</li> </ul>
	waste management	Covers internal waste-related programs which form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. Also covers the planning for decommissioning.	<ul style="list-style-type: none"> <li>Waste Characterization and Minimization</li> <li>Waste Management Practices</li> <li>Decommissioning Plans</li> </ul>	<ul style="list-style-type: none"> <li>Waste Characterization and Minimization</li> <li>Waste Management Practices</li> <li>Decommissioning Plans</li> </ul>	Not Applicable	Not Applicable

Functional area	Safety and control area	Definition	Chalk River Laboratories specific areas	Whiteshell Laboratories specific areas	Port Hope specific areas	Port Granby specific areas
	<b>security</b>	Covers the programs required to implement and support the security requirements stipulated in the regulations, in the facility's licence, in orders, or in expectations for the facility or activity.	<ul style="list-style-type: none"> <li>Facilities and Equipment</li> <li>Response Arrangements</li> <li>Security Practices</li> <li>Drills and Exercises</li> </ul>	<ul style="list-style-type: none"> <li>Facilities and Equipment</li> <li>Response Arrangements</li> <li>Security Practices</li> <li>Drills and Exercises</li> </ul>	<ul style="list-style-type: none"> <li>Security Practices</li> </ul>	<ul style="list-style-type: none"> <li>Security Practices</li> </ul>
	<b>safeguards and non-proliferation</b>	Covers the programs required for the successful implementation of the obligations arising from the Canada/IAEA Safeguards Agreement.	<ul style="list-style-type: none"> <li>Nuclear Material Accountancy and Control</li> <li>Access and Assistance to the IAEA</li> <li>Operational and Design Information</li> <li>Safeguards Equipment, Containment, and Surveillance</li> </ul>	<ul style="list-style-type: none"> <li>Nuclear Material Accountancy and Control</li> <li>Access and Assistance to the IAEA</li> <li>Operational and Design Information</li> <li>Safeguards Equipment, Containment, and Surveillance</li> </ul>	Not Applicable	Not Applicable
	<b>packaging and transport</b>	Includes programs that cover the safe packaging and transport of nuclear substances and radiation devices to and from the licensed facility.	<ul style="list-style-type: none"> <li>Package Design and Maintenance</li> <li>Packaging and Transport</li> </ul>	<ul style="list-style-type: none"> <li>Packaging and Transport</li> </ul>	<ul style="list-style-type: none"> <li>Packaging and Transport</li> </ul>	<ul style="list-style-type: none"> <li>Packaging and Transport</li> </ul>

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## APPENDIX 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.

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**APPENDIX C: TREND IN SAFETY AND CONTROL AREA RATINGS****Table C-1: AECL's CRL trend in safety and control area ratings**

Safety and control areas	2009 rating	2010 rating	2011 rating	2012 rating	2013 rating
Management system	BE	BE	BE	BE	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	UA	BE	BE	BE	BE
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 and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

**Table C-2: AECL's WL trend in safety and control area ratings**

Safety and control areas	2009 rating	2010 rating	2011 rating	2012 rating	2013 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	FS	FS	FS
Safeguards and non-proliferation	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA

**Table C-3: AECL's PHP trend in safety and control area ratings**

Safety and control areas	2009 rating	2010 rating	2011 rating	2012 rating	2013 rating
Management system	<i>Not Rated</i>			SA	SA
Human performance management				SA	SA
Operating performance				SA	SA
Safety analysis				N/A	N/A
Physical design				SA	SA
Fitness for service				SA	SA
Radiation protection				SA	SA
Conventional health and safety				SA	SA
Environmental protection				SA	SA
Emergency management and fire protection				SA	SA
Waste management				N/A	N/A
Security				SA	SA
Safeguards and non-proliferation				N/A	N/A
Packaging and transport				SA	SA

**Table C-4: AECL's PGP trend in safety and control area ratings**

Safety and control areas	2009 rating	2010 rating	2011 rating	2012 rating	2013 rating
Management system	<i>Not Rated</i>		SA	SA	SA
Human performance management			SA	SA	SA
Operating performance			SA	SA	SA
Safety analysis			N/A	N/A	N/A
Physical design			SA	SA	SA
Fitness for service			SA	SA	SA
Radiation protection			SA	SA	SA
Conventional health and safety			SA	SA	SA
Environmental protection			SA	SA	SA
Emergency management and fire protection			SA	SA	SA
Waste management			N/A	N/A	N/A
Security			SA	SA	SA
Safeguards and non-proliferation			N/A	N/A	N/A
Packaging and transport			SA	SA	SA

## APPENDIX D: FINANCIAL GUARANTEES

The following table outlines the costs of decommissioning AECL nuclear sites and projects as net present values.

**Table D-1: AECL financial guarantees listed per Nuclear Site/Projects**

<b>Facility</b>	<b>Canadian dollar amount</b>
<b>Chalk River Laboratories</b>	6 100 000 000 (December 2013)
<b>Whiteshell Laboratories</b>	1 636 800 000 (March 2013)
<b>Port Hope Project</b>	1 007 000 000 (January 2012)
<b>Port Granby Project</b>	273 000 000 (January 2012)
<b>Total financial guarantee for the four facilities</b>	<b>9 016 800 000</b>

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**APPENDIX E: WORKER DOSE DATA****Chalk River Laboratories****Table E-1: AECL's CRL EFFECTIVE DOSE (2009-2013)**

Dose statistics	2009	2010	2011	2012	2013	Regulatory Limit
Total persons monitored	4754	4745	4879	4903	5080	50 mSv/yr
Average annual effective dose (mSv)	0.66	0.55	0.43	0.44	0.39	
Maximum annual effective dose (mSv)	17.04	11.86	9.05	8.90	8.89	

**Table E-2: AECL's CRL EXTREMITY DOSE (2009-2013)**

Dose statistic	2009	2010	2011	2012	2013	Regulatory Limit
Total persons monitored	358	328	317	312	323	500 mSv/yr
Average annual extremity dose (mSv)	3.70	1.32	2.11	2.43	2.73	
Maximum annual extremity dose (mSv)	36.56	7.23	38.62	18.53	72.10	

**Table E-3: AECL-CRL SKIN DOSE (2009-2013)**

Dose statistic	2009	2010	2011	2012	2013	Regulatory Limit
Total persons monitored	4754	4745	4879	4903	5080	500 mSv/yr
Average annual skin dose (mSv)	0.81	0.66	0.52	0.50	0.46	
Maximum annual skin dose (mSv)	22.03	23.32	16.21	12.23	13.08	

## Whiteshell Laboratories

**Table E-4: AECL's WL WORKER EFFECTIVE DOSE (2009-2013)**

Dose statistics	2009	2010	2011	2012	2013	Regulatory Limit
Total persons monitored	781	798	771	746	846	50 mSv/yr
Average annual effective dose (mSv)	0.06	0.03	0.03	0.05	0.02	
Maximum annual effective Dose (mSv)	1.3	0.89	1.12	1.07	0.8	

**Table E-5: AECL's WL EXTREMITY DOSE (2009-2013)**

Dose statistic	2009	2010	2011	2012	2013	Regulatory Limit
Total persons monitored	37	27	33	34	10	500 mSv/yr
Average annual extremity Dose (mSv)	1.2	0.4	0.38	1.00	0.19	
Maximum annual extremity dose (mSv)	6.2	1.8	1.9	4.28	0.07	

**Table E-6: AECL's WL SKIN DOSE (2009-2013)**

Dose statistic	2009	2010	2011	2012	2013	Regulatory Limit
Total persons monitored	781	798	771	746	846	500 mSv/yr
Average annual skin dose (mSv)	0.08	0.03	0.03	0.07	0.03	
Maximum annual skin dose (mSv)	4.1	1.2	1.2	3.97	1.27	



## Port Hope Area Initiative (includes Port Hope and Port Granby Projects)

Table E-7: AECL's PHAI EFFECTIVE DOSE (2012-2013)

Dose statistic	2009	2010	2011	2012	2013	Regulatory Limit
Total persons monitored				60	118	50 mSv/yr
Average annual skin dose (mSv)				0.02	0.01	
Maximum annual skin dose (mSv)				0.18	0.2	

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**APPENDIX F: ENVIRONMENTAL DATA****TABLE F-1: AECL's CRL AIRBORNE & LIQUID NUCLEAR SUBSTANCE  
RELEASES AS COMPARED TO LICENCE LISTED RELEASE LIMITS (2012-2013)**

<b>Radionuclide</b>	<b>Release limit</b>	<b>2012</b>	<b>2013</b>
<b>Airborne releases (Bq/year)</b>			
Argon-41	6.60E+16	9.33E+15	8.46E+15
Carbon-14	2.14E+15	6.41E+11	5.74E+11
Tritium Oxide	1.25E+16	2.45E+14	2.46E+14
Iodine-131	3.96E+12	1.21E+11	1.38E+11
Mixed fision product noble gases (BqMeV/year)	4.96E+16	2.04E+15	5.72E+15
<b>Liquid releases (Bq/year)</b>			
Tritium Oxide	1.03E+17	3.21E+13	2.95E+13
Gross Alpha	1.32E+12	5.07E+08	5.60E+08
Gross Beta	2.70E+13	2.79E+10	5.28E+10

**TABLE F-2: AECL's CRL HAZARDOUS LIQUID EFFLUENT RELEASES AS COMPARED TO COMPLIANCE VERIFICATION CRITERIA (LCH) (2012-2013)**

Monitoring point	Parameter (mg/L)	Compliance verification criteria (monthly averages)	2012 average	2013 average
Waste Treatment Center Liquid Waste Evaporator Distillate (WTC_LWE)	Phosphorous	1	0.1	0.01
	Total Suspended Solids	25	2	0.34
	Oil/Grease	15	1	2.52
	Chromium	0.5	0.0012	0.00025
	Copper	0.5	0.0021	0.00106
	Lead	0.1	0.002	0.00042
	Mercury	0.001	0.00018	0.00028
	Nickel	0.5	0.0016	0.00083
	Zinc	0.5	0.00091	0.00009
Process Outfall (PRO) pH		6 to 9	7.11	7.08

**TABLE F-3: AECL's CRL HAZARDOUS AIRBORNE EFFLUENT RELEASES AS COMPARED TO COMPLIANCE VERIFICATION CRITERIA (LCH) (2012-2013)**

Emissions source	Criteria air contaminants (Mg)	Compliance verification criteria (annual)	2012 releases	2013 releases
Number 6 Heating Oil Burned at the Powerhouse	Carbon Monoxide	8.0	5.787	6.178
	Nitrogen Oxides	75.0	50.571	56.412
	Sulphur Dioxides	315.0	175.245	173.398
	Total Particulates Matter	24.0	13.985	14.126
	Particulate Matter < 10 µm	21.0	12.037	12.150
	Particulate Matter < 2.5 µm	15.0	7.841	7.907
	Volatile Organic Compounds	0.5	0.328	0.350

**TABLE F-4: AECL's WL AIRBORNE RADIOLOGICAL RELEASES AS COMPARED TO DERIVED RELEASE LIMITS (2011-2013)**

Radionuclide	Derived release limit	2011	2012	2013
Tritium (Bq/week)	7.64E+14	6.01E+08	3.66E+09	6.77E+08
Gross Alpha (Bq/week)	5.84E+08	2.23E+03	2.02E+03	1.78E+03
Gross Beta (Bq/week)	1.19E+10	6.47E+03	7.76E+03	4.41E+03

**TABLE F-5: AECL's WL LIQUID RADIOLOGICAL RELEASES AS COMPARED TO DERIVED RELEASE LIMITS (2011-2013)**

Radionuclide	Release limit	2011	2012	2013
Gross Alpha (Bq/month)	2.80E+11	7.960E+06	8.950E+06	9.500E+06
Strontium 90 (Bq/month)	1.46E+12	1.042E+07	9.900E+06	5.810E+06
Cesium 137 (Bq/month)	2.41E+11	7.991E+06	7.564E+06	5.330E+06

**TABLE F-6: AECL's PHP HAZARDOUS LIQUID EFFLUENT RELEASES AS COMPARED TO COMPLIANCE VERIFICATION CRITERIA (LCH) (2012-2013)**

Parameter	2012 <sup>1</sup>	2013	Release limits (monthly average)	% of release limit in 2013
Radium-226 (Bq/L)	0.058	0.048	0.37	13%
Arsenic (mg/L)	0.26	0.012	0.50	2.4%
pH	7.68	7.51	6 – 9	
Toxicity testing	Pass	Pass	Effluent cannot be toxic	

1. Sampling started April 2012

**TABLE F-7: AECL's PGP HAZARDOUS LIQUID EFFLUENT RELEASES AS COMPARED TO COMPLIANCE VERIFICATION CRITERIA (LCH) (2012-2013)**

<b>Parameter</b>	<b>2012<sup>1</sup></b>	<b>2013</b>	<b>Release limits (monthly average)</b>	<b>% of release limit in 2013</b>
Radium-226 (Bq/L)	<0.058	<0.057	0.37	< 15%
pH	7.68	7.8	6 – 9	
Toxicity testing	Pass	Pass	Effluent cannot be toxic	

1. Sampling started April 2012

**APPENDIX G: Status of Fukushima Actions****TABLE G-1: STATUS OF FUKUSHIMA ACTIONS FOR CHALK RIVER LABORATORIES**

Fukushima Safety Review Activities	Implementation Timelines		
	Short term (2011-2012)	Medium term (2013-2014)	Long term (2015-2016)
<b>Strengthening Reactor Defense-in-Depth</b>			
<b>1. Safety Assessment of NRU and Nuclear Facilities at CRL</b>	<ul style="list-style-type: none"> <li>Complete screening of safety features of NRU and nuclear facilities, based on lessons learned from the Fukushima nuclear event <b>Completed</b></li> </ul>	<ul style="list-style-type: none"> <li>Further evaluate / verify performance of safety features of NRU and nuclear facilities, based on developed guidelines <b>In progress</b></li> </ul>	<ul style="list-style-type: none"> <li>Implementation of identified safety control procedures and safety system component upgrades</li> </ul>
	<ul style="list-style-type: none"> <li>Upgrade the availability of safety-related equipments if necessary <b>Completed</b></li> </ul>	<ul style="list-style-type: none"> <li>Enhance modelling capabilities <b>In Progress</b></li> </ul>	<ul style="list-style-type: none"> <li>Training on newly implemented safety control procedures</li> </ul>
	<ul style="list-style-type: none"> <li>Develop guidelines for further evaluating / verifying safety features of NRU and nuclear facilities <b>Completed</b></li> </ul>	<ul style="list-style-type: none"> <li>Identify potential improvements in safety control procedures and safety system component upgrade <b>In progress</b></li> </ul>	
<b>2. Assessment of CRL Specific External Hazards</b>	<ul style="list-style-type: none"> <li>Assess CRL-specific external hazards (seismic, flooding, fire and extreme weather condition, etc.) <b>Completed</b></li> </ul>		

Fukushima Safety Review Activities	Implementation Timelines		
	Short term (2011-2012)	Medium term (2013-2014)	Long term (2015-2016)
<b>3. Assessment of Plant Equipment and Instrumentation and Potential Upgrades</b>		<ul style="list-style-type: none"> <li>Evaluate / verify existing safety qualified equipments and instruments</li> <li>Identify potential improvements in existing safety qualified equipments and instruments</li> </ul> <b>In progress</b>	<ul style="list-style-type: none"> <li>Implementation of identified improvements of existing safety qualified equipments and instruments</li> </ul>
<b>4. Severe Accident Management Program (including guidelines, procedures, implementations and training)</b>	<ul style="list-style-type: none"> <li>Develop plan / guidelines for Severe Accident Management Program</li> </ul> <b>Completed</b>	<ul style="list-style-type: none"> <li>Examine existing Severe Accident Assessments</li> <li>Develop procedures of Severe Accident Management Program (including interface with EOP)</li> </ul> <b>Completed</b>	<ul style="list-style-type: none"> <li>Implementation of Severe Accident Management Program</li> <li>Training on Severe Accident Management Program</li> </ul>
<b>Enhancing Emergency Response</b>			
<b>5. Assess Emergency Plans (On-site)</b>	<ul style="list-style-type: none"> <li>Re-examine existing onsite emergency plans</li> </ul> <b>Completed</b>		<ul style="list-style-type: none"> <li>Communication and implementation of updated Emergency Plans</li> </ul>



Fukushima Safety Review Activities	Implementation Timelines		
	Short term (2011-2012)	Medium term (2013-2014)	Long term (2015-2016)
<b>6. Update Emergency Facilities and Equipment (On-site)</b>	<ul style="list-style-type: none"> <li>Upgrade availability and performance of emergency facilities and equipments if necessary  <b>Completed</b></li> </ul>		<ul style="list-style-type: none"> <li>Complete review and improvement of emergency facilities and equipments</li> <li>Complete update the emergency procedures</li> </ul>

**TABLE G-2: STATUS OF FUKUSHIMA ACTIONS FOR WHITESHELL LABORATORIES**

Fukushima Safety Review Activities	Whiteshell Laboratories
<b>Strengthening Defence-in-depth</b>	<ul style="list-style-type: none"> <li>Revise Safety Analyses Reports  <b>In progress</b></li> </ul>
<b>Enhancing Emergency Response</b>	<ul style="list-style-type: none"> <li>Emergency response plans were reviewed and found adequate  <b>Completed</b></li> </ul>

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## APPENDIX H: CHANGES TO LICENCE AND LICENCE CONDITIONS HANDBOOK(S)

### H-1: AECL's CRL CHANGES TO LICENCE AND LICENCE CONDITIONS HANDBOOK

#### Licence

The CRL operating licence NRTEOL-01.01/2016 was amended once [1] to extend the due date for licence condition 16.3 regarding the submission of a plan for the future of NRU Reactor from June 30, 2014 to June 30, 2015.

At the time of drafting this report, AECL has expressed its intent to apply for

- amendment to the CRL site licence expiry date
- transfer of the CRL operating licence from AECL to a new operating organization

#### Licence Conditions Handbook

Revision 1 to the LCH for CRL, incorporating all previously CNSC approved updates, was issued on February 15, 2013 [2]. There was one CNSC approved update to Revision 1 of the LCH [3]. The more significant changes are shown in Table H-1.

**Table H-1: AECL's CRL CHANGES TO THE LCH**

Section	Description of change	Revision type
4.4	Added new compliance verification criteria (CVC) to clarify the requirements for decommissioning and the release for reuse and/or removal of decommissioned property.	Technical
4.16	Added new CVCs to clarify the requirements for reporting on chemistry and hours of work indicators.	Technical
5.1	Added the IAEA documents GSR-4 <i>Safety Assessment for Facilities and Activities</i> , SSG-20 <i>Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report</i> , and SSG-22 <i>Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors</i> , as well as the Department of Energy standard DOE-STD-3009-94 <i>Preparation Guide for U.S. Department of Energy Nonreactor Facility Documented Safety Analyses</i> that may be used as guidance in preparing the safety analyses for CRL facilities.	Technical
10.1	Added new CVC requiring the use of CSA standard N288.6, <i>Environmental Risk Assessment at Class I Nuclear Facilities and Uranium Mines and Mills</i> , when performing environmental risk assessment for CRL facilities.	Technical

Section	Description of change	Revision type
Appendix B	Updated the information on CRL facilities.	Administrative
Appendix D	Updated the information on licensing basis documents for CRL facilities.	Administrative
Appendix K	Updated the information to record AECL's progress to closing transitional provisions.	Administrative
Appendix M	Updated the information to record new approvals granted by the Commission or CNSC staff under various licence conditions.	Administrative

## **H-2: AECL's WL CHANGES TO LICENCE AND LICENCE CONDITIONS HANDBOOK**

### Licence

The WL decommissioning licence NRTEDL-08.02/2018 [10] has been amended twice since its issuance in 2008.

In April 2010, the licence was amended to:

- change the submission dates for the annual reports to align with the AECL Chalk River Laboratories (CRL) operating licence
- correct two errata in the appendices of the licence, as they were outdated and not representative of the facility and its conduct of operations

In July 2012, the licence was amended to:

- update the licensee's address
- update editions of codes and standards listed in licence condition
- make minor changes to three licence conditions
- update the reference to the revised action levels
- update appendices

### Licence Conditions Handbook

Currently, there is not an LCH for WL. CNSC staff are presently developing one for WL.

### **H-3: AECL's PHP CHANGES TO LICENCE AND LICENCE CONDITIONS HANDBOOK**

#### Licence

The Port Hope long-term low-level radioactive waste management project licence WNSL-W1-2310.00/2022 [13] was issued in November 2012. There have been no amendments to this licence since it was issued.

#### Licence Conditions Handbook

No changes to the PHP LCH [14] have taken place since licensing in November 2012. Documents listed within the LCH are currently being revised. The LCH will be updated to reflect the new versions in the fall of 2014.

### **H-4: AECL's PGP CHANGES TO LICENCE AND LICENCE CONDITIONS HANDBOOK**

#### Licence

The Port Granby long-term low-level radioactive waste management project licence WNSL-W1-2310.00/2021 [16] was issued in November 2011. There have been no amendments to this licence since it was issued.

#### Licence Conditions Handbook

No changes to the PGP LCH [17] have taken place since licensing in November 2012. Documents listed within the LCH are currently being revised. The LCH will be updated to reflect the new version in the fall of 2014.

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## APPENDIX I: LINKS TO LICENSEE WEBSITES

AECL Chalk River Laboratories

[aecl.ca/en/home/about/locations/](http://aecl.ca/en/home/about/locations/)

AECL Whiteshell Laboratories

[aecl.ca/en/home/environmental-stewardship/whiteshell](http://aecl.ca/en/home/environmental-stewardship/whiteshell)

PHAI Port Hope Project:

[phai.ca/en/port-hope-project](http://phai.ca/en/port-hope-project)

PHAI Port Granby Project:

[phai.ca/en/port-graby-project-2](http://phai.ca/en/port-graby-project-2)

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**APPENDIX J: ACRONYMS AND ABBREVIATIONS**

AECL	Atomic Energy of Canada Limited
ALARA	As Low As Reasonably Achievable
BE	Below Expectations
Bq	Becquerel
CMD	Commission Member Document
CNLL	Canadian Nuclear Laboratories Limited
CNSC	Canadian Nuclear Safety Commission
CPDP	Comprehensive Preliminary Decommissioning Plan
CRL	Chalk River Laboratories
CSA	Canadian Standards Association, now called the CSA Group
CVC	Compliance Verification Criteria
DDP	Detailed Decommissioning Plan
DFO	Department of Fisheries and Oceans
DRL	Derived Release Limits
EIR	Event Initial Report
FISST	Fissile Solution Storage Tank
FPS	Fuel Packaging and Storage Facility
FS	Fully Satisfactory
IAEA	International Atomic Energy Agency
IIP	Integrated Implementation Plan
LCH	Licence Conditions Handbook
LLW	Low-Level Waste
LLRW	Low-Level Radioactive Waste
LTWMF	Long-Term Waste Management Facility
MLW	Medium-Level Waste
mSv	millisievert
MPF	Molybdenum Production Facility
NLLP	Nuclear Legacy Liabilities Program
NRCan	Natural Resources Canada
NRF	Nuclear Response Force
NRU	National Research Universal
NRX	National Research Experimental
NSCA	<i>Nuclear Safety and Control Act</i>
NWMO	Nuclear Waste Management Organization
OPEX	Operating Experience
OSH	Occupational Safety and Health
PGP	Port Granby Project
PHAI	Port Hope Area Initiative
PHP	Port Hope Project
PIP	Public Information Program
PSA	Probabilistic Safety Analysis
PWGSC	Public Works and Government Services Canada
RCMP	Royal Canadian Mounted Police
RD	Regulatory Document

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RLTI	Recordable Lost-Time Injuries
SA	Satisfactory
SAMP	Severe Accident Management Program
SAR	Safety Analysis Report
SAT	Systematic Approach to Training
SCA	Safety and Control Areas
SLWC	Stored Liquid Waste and Cementation project
SMAGS	Shielded Modular Above Ground Storage
SSCs	Systems, Structures and Components
TLD	Thermo Luminescent Dosimeters
UA	Unacceptable
USL	Upper Sub-critical Limits
VLLW	Very Low-Level Waste facility
WL	Whiteshell Laboratories
WMA	Waste Management Area
WMF	Waste Management facility
WR-1	Whiteshell Reactor -1
WTP	Water Treatment Plant