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A Licence Renewal

Un renouvellement de permis

**Canadian Nuclear  
Laboratories**

**Laboratoires Nucléaires  
Canadiens Limitée**

**Chalk River Laboratories**

**Laboratoires de Chalk  
River**

Commission Public Hearing

Audience publique de la Commission

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Submitted by:  
CNSC Staff

Soumis par :  
Le personnel de la CCSN

**Summary**

This CMD presents information about the following matters of regulatory interest with respect to Canadian Nuclear Laboratories:

- Canadian Nuclear Laboratories application for the licensing of the Nuclear Research and Test Establishment Licence for the Chalk River Laboratories

The following actions are requested of the Commission:

- Renew the licence for the Chalk River Laboratories from April 1, 2018 to March 31, 2028.
- Accept the delegation of authority as set out in this CMD.

The following items are attached:

- The proposed licence, NRTEOL-01.00/2028
- The draft Licence Conditions Handbook
- The current licence, NRTEOL-01.00/2018
- The environmental assessment report

**Résumé**

Le présent CMD présente de l'information sur un ensemble de questions d'ordre réglementaire concernant Laboratoires Nucléaires Canadiens (LNC) :

- La demande de Laboratoires nucléaires canadiens de renouveler le permis d'exploitation d'un établissement de recherches et essais nucléaires pour les Laboratoires de Chalk River

La Commission pourrait considérer prendre les mesures suivantes :

- Renouveler le permis pour les Laboratoires de Chalk River du 1<sup>er</sup> avril 2018 au 31 mars 2028
- Accepter la délégation des pouvoirs telle qu'établie au présent CMD

Les pièces suivantes sont jointes :

- Le permis proposé, NRTEOL-01.00/2028
- Ébauche du Manuel des conditions de permis
- Le permis actuel, NRTEOL-01.00/2018
- Le rapport d'évaluation environnementale

**Signed/signé le**

10 November 2017



Haidy Tadros

**Director General**

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## EXECUTIVE SUMMARY

The current Chalk River Laboratories (CRL) licence, NRTEOL-01.00/2018 [1], is valid until March 31, 2018. Canadian Nuclear Laboratories (CNL) applied for a licence renewal with a period of ten years, until March 31, 2028.

The purpose of this Commission Member Document (CMD) is to provide the results of CNSC staff's assessment of the CNL application, including conclusions and recommendations to inform the Commission decision on the licence renewal. CNSC staff's assessment of the application reviewed all 14 safety and control areas (SCA) and took into consideration the licensee's past performance.

Based on this assessment, CNSC staff conclude that CNL has made and will continue to make adequate provisions for the protection of the environment and the health and safety of persons, and that there were no adverse effects on the health and safety of persons or the environment as a result of the operation of CRL.

CNL's application discusses a permanent waste disposal facility at CRL, known as the near surface disposal facility (NSDF). The operation of a permanent waste disposal facility is not included in the current licensing basis and therefore, CNL must seek Commission approval for the NSDF. CNL has prepared an Environmental Impact Statement and is currently undergoing the environmental assessment process under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) [2]. The proposed NSDF and its associated licensing requests are the subjects of a separate detailed application from CNL. CNL's request regarding the NSDF will be presented to the Commission for decision at a separate hearing later in 2018 due to the schedule associated with the environmental assessment process. As a result, the CNSC staff assessment of the NSDF has been carried out separate of this licence review. The NSDF is out of scope of this licence consideration.

This conclusion is supported by CNSC staff's conduct of an Environmental Assessment (EA) under the *Nuclear Safety and Control Act* (NSCA) [3] for the CRL licence. The EA report is attached as an addendum to this CMD.

The public, Indigenous groups and other stakeholders were invited to participate in the regulatory relicensing process. To enable their participation, up to \$75,000 was made available through the CNSC Participant Funding Program (PFP).

This CMD has two parts. Part one presents CNSC staff's review and assessment of CNL's licence application and a summary of CNL's performance operating CRL since 2012. Part two presents the CNSC staff proposed licence and licence conditions handbook (LCH).

The following table presents CNSC staff's ratings of CNL's performance operating the CRL by SCA since 2012.

### Performance Rating for Chalk River Laboratories from 2012 to 2017

Safety and control area	Rating					
	2012	2013	2014	2015	2016	2017 <sup>1</sup>
Management system	BE	SA	SA	SA	SA	SA
Human performance management	SA	SA	SA	SA	SA	SA
Operating performance	SA	SA	SA	SA	SA	SA
Safety analysis	SA	SA	SA	SA	SA	SA
Physical design	SA	SA	SA	SA	SA	SA
Fitness for service	BE	BE	BE	BE	BE	SA
Radiation protection	SA	SA	SA	SA	SA	SA
Conventional health and safety	SA	SA	SA	SA	SA	SA
Environmental protection	SA	SA	SA	SA	SA	SA
Emergency management and fire protection	SA	SA	SA	SA	SA	SA
Waste management	SA	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA	SA
Safeguards and non-proliferation	SA	SA	SA	SA	SA	SA
Packaging and transport	SA	SA	SA	SA	SA	SA

<sup>1</sup>For the period of January 1 to June 30, 2017

SA = Satisfactory; BE = Below Expectations

Notable improvements since 2012 have included:

- performance rating for management system SCA progressed from “Below Expectations” to “Satisfactory” in 2013 through the licensee’s successful implementation of CSA standard N286, *Management system requirements for nuclear power plants* as verified by CNSC staff
- performance rating for fitness for service SCA progressed from “Below Expectations” to “Satisfactory” as verified and reported by CNSC staff to the Commission in April 2017

CNSC staff recommend the Commission renew, pursuant to subsection 24(2) of the NSCA [3], the CRL licence to authorize CNL to continue to operate the CRL site for a period of ten years from April 1, 2018 to March 31, 2028.

Referenced documents in this CMD are available to the public upon request.



## **PART ONE**

This Commission Member Document (CMD) is presented in two parts.

Part One includes:

1. An overview of the matter being presented
2. Overall conclusions and overall recommendations
3. General discussion pertaining to the safety and control areas (SCAs) that are relevant to this submission
4. Discussion about other matters of regulatory interest
5. Addenda material that complements items 1 through 4

Part Two provides all available information pertaining directly to the current and proposed licence.

## 1. OVERVIEW

### 1.1 Background

Chalk River Laboratories (CRL) is located in the province of Ontario, 160 kilometres northwest of Ottawa. With a total area of 37 km<sup>2</sup> and a built-up area of approximately 0.4 km<sup>2</sup>, CRL represents the largest single complex within Canada's science and technology infrastructure. Canadian Nuclear Laboratories (CNL) operates the CRL site to produce medical isotopes, deliver various nuclear services and conduct a wide variety of research and development programs.



**Aerial view of Chalk River Laboratories**

The site includes 12 Class I nuclear facilities in an operational state and an additional five in extended shutdown or in storage with surveillance. These Class I facilities include research reactors (the National Research Universal (NRU) and Zero Energy Deuterium (ZED-2)), processing facilities Molybdenum Production Facility (MPF), fuel manufacturing facilities, and hot cells. The site also includes 13 different waste management areas, five in operation and eight in long-term monitoring, five Class I facilities undergoing decommissioning, four Class II nuclear facilities such as accelerators and irradiators, and more than 50 radioisotope laboratories, support facilities and offices. A complete list of the Class I and II facilities is provided in table 1. Additionally, CNL carries out construction, decommissioning and remediation activities at CRL to establish new facilities, modernize infrastructure, clean up portions of the site no longer in use and address legacy waste issues.

**Table 1: Class I and II Facilities at Chalk River Laboratories**

#	Facility Name	Class	Status
1	NRU Reactor	I	Operating
2	Nuclear Fuel Fabrication Facility	I	Operating
3	Recycle Fuel Fabrication Laboratories	I	Operating
4	ZED-2 Reactor	I	Operating
5	Building 234 Universal Cells	I	Operating
6	Molybdenum-99 Production Facility	I	Operating
7	Tritium Laboratory	I	Operating
8	Waste Treatment Centre and Associated Facilities	I	Operating
9	Fuels and Materials Cells	I	Operating
10	Waste Management Areas	I	Operating
11	Nuclear Fuel Fabrication Facility Building 405	I	Operating
12	Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation (CECEUD)	I	Operating
13	Multipurpose Applied Physics Lattice Experimental (Maple) Reactor 1	I	Extended Shutdown
14	Multipurpose Applied Physics Lattice Experimental (Maple) Reactor 2	I	Extended Shutdown
15	New Processing Facility	I	Extended Shutdown
16	NRX Reactor	I	Storage with Surveillance
17	Active Waste Disposal System	I	Storage with Surveillance
18	Waste Management Areas	I	Non-Operating
19	Plutonium Tower	I	Under Decommissioning
20	NRX Ancillary Buildings	I	Under Decommissioning
21	Waste Water Evaporator	I	Under Decommissioning
22	NRX Fuel Bays	I	Under Decommissioning
23	Plutonium Recovery Laboratory	I	Under Decommissioning
24	Health Physics Neutron Generator	II	Operating

#	Facility Name	Class	Status
25	Gamma Beam Irradiation Facility	II	Operating
26	Gamma Beam Irradiator	II	Operating
27	Van de Graaff Electron Accelerator	II	Operating

CNL operates CRL under licence NRTEOL-01.00/2018 [1]. CRL is a mature site with established programs to support its activities and a management system focused on continuous improvement. CNSC staff conduct regular oversight activities to ensure CNL continues to meet regulatory requirements.

### 1.1.1 Transition to Government Owned-Contractor Operated Model

CRL is owned and was historically operated by Atomic Energy of Canada Limited (AECL), a federal crown corporation. In 2013 the Government of Canada announced its decision to engage a private-sector contractor to manage operations at CRL under a government owned-contractor operated (Go-Co) business model [4]. CNL was established as a wholly-owned subsidiary of AECL in 2014 and at that time, CNL assumed responsibility for the day-to-day operations of CRL. In 2015, the management of CNL was contracted to Canadian National Energy Alliance (CNEA), completing the transition to the Go-Co model.

Under the Go-Co arrangement, AECL retains ownership of all the assets of CRL while CNL remains the licensee with a CNEA-selected executive team. AECL's role is now focused on the oversight of the Go-Co contract to ensure CNL's performance meets the government objectives for the contract.

## 1.2 Highlights

The current CRL site licence was issued by the Commission and was valid from November 1, 2011 to October 31, 2016. In 2016, CNL applied to the Commission for a licence amendment to align the licence expiry date with the Government of Canada's intent regarding the operation of the NRU reactor [6]. CNL's request was accepted and the Commission granted CNL a short term licence renewal [7]. The current CRL licence, NRTEOL-01.00/2018 [1], issued by the Commission, is valid for a period of 17 months from November 1, 2016 until March 31, 2018. In March 2017, CNL submitted its application for the renewal of the CRL licence with a period of ten years, until March 31, 2028 [8].

The purpose of this CMD is to provide the Commission with the results of CNSC staff's assessment of the CNL application. This CMD provides CNSC staff's conclusions and recommendations to inform the Commission decision on the licence application. CNSC staff's assessment of the application takes into consideration the results of CNSC staff's compliance verification activities, CNL's operational performance history and information submitted in support of the application.

CNL's application discusses a permanent waste disposal facility at CRL, known as the near surface disposal facility (NSDF). The operation of a permanent waste disposal facility is not included in the current licensing basis and therefore, CNL must seek Commission approval for the NSDF. CNL has prepared an Environmental Impact Statement and is currently undergoing the environmental assessment process under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) [2]. The proposed NSDF and its associated licensing requests are the subjects of a separate detailed application from CNL. CNL's request regarding the NSDF will be presented to the Commission for decision at a separate hearing later in 2018 due to the schedule associated with the environmental assessment process. As a result, the CNSC staff assessment of the NSDF has been carried out separate of this licence review. The NSDF is out of scope of this licence consideration.

CNSC staff typically present supporting information for the previous licence period in submissions regarding licence applications. In this case, since the previous licence period was only 17 months, CNSC staff have provided supporting information dating back to 2012 for more meaningful trending for the Commission. Since 2012 CNSC staff have previously presented information and CNSC staff's assessment of CNL's performance in:

- CNSC staff submission for CRL licensing in 2016 [9]
- performance oversight reports [10, 11]
- updates to the Commission on fitness for service at CRL [12, 13, 14, 15, 16, 17, and 18]

This CMD builds on the information provided in those documents.

This CMD provides a summary of CNSC staff's review of all safety and control areas (SCAs). Focused highlights are provided on the CNL management system particularly the implementation of Go-Co, decommissioning and clean-up of the CRL site; CNSC staff's assessment of CNL environmental performance and the conduct of an environmental assessment under the NSCA [3].

CNL's licence application identifies six key initiatives to be carried out during the proposed licence period:

- Shutdown and transition to storage with surveillance of the NRU Reactor
- Revision of the CNL Management System
- Improvements to the CRL site wide infrastructure
- Continuation of decommissioning and waste management
- Science and technology capabilities program
- Permanent waste disposal at a proposed Near Surface Disposal Facility (NSDF)

Further information related to these initiatives is provided in this CMD under section 2.1 and throughout section 3 as appropriate.

### 1.3 Overall Conclusions

CNSC staff have concluded the following with respect to paragraphs 24(4)(a) and (b) of the NSCA [3], in that the licensee:

1. is qualified to carry on the activity that the licence will authorize the licensee to carry on; and
2. will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

### 1.4 Overall Recommendations

CNSC staff recommend that the Commission:

1. accept CNSC staff's conclusions and exercise its authority under the NSCA [3] to renew the licence to authorize Canadian Nuclear Laboratories (CNL) to continue to operate the Chalk River Laboratories (CRL) from April 1, 2018 to March 31, 2028
2. authorize the delegation of authority as set out in subsection 4.8 of this CMD

## 2. MATTERS FOR CONSIDERATION

### 2.1 CNL Planned Initiatives for the Proposed Licence Period

CNSC staff requested that CNL identify its planned initiatives for the proposed licence period. This ensured CNSC staff could assess the impacts of these initiatives on the proposed licence.

CNL is mandated to transform and modernize the CRL site as directed by the Government of Canada through the terms of the Go-Co contract. These terms include delivery of a science and technology program to government and third-party customers, acceleration of onsite decommissioning and environmental remediation activities, and establishment of long-term waste management solutions for nuclear waste. Aligned with this mandate, CNL's long-term vision for CRL is to continue as a sustainable national nuclear laboratory with science and technology capabilities to meet current and future industry needs.

In order to deliver on the terms of the Go-Co contract, the CNL application identifies six key initiatives to be carried out during the proposed licence period. While CNL has identified these initiatives as areas of focus, the activities associated with these initiatives are within the licensing basis and are already being carried out at CRL with one significant exception.

CNL's application discusses a permanent waste disposal facility at CRL, known as the NSDF. The operation of a permanent waste disposal facility is not included in the current licensing basis and therefore, CNL must seek Commission approval for the NSDF. CNL has prepared an Environmental Impact Statement and is currently undergoing the environmental assessment process under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) [2]. The proposed NSDF and its associated licensing requests are the subjects of a separate detailed application from CNL. CNL's request regarding the NSDF will be presented to the Commission for decision at a separate hearing later in 2018 due to the schedule associated with the environmental assessment process. As a result, the CNSC staff assessment of the NSDF has been carried out separate of this licence review. The NSDF is out of scope of this licence consideration.

CNSC staff note that the approval of the NSDF does not impact CNL's licence renewal request or the planned activities at CRL. If the NSDF is not approved, CNL would carry out the planned decommissioning and waste management activities at CRL using interim storage methods instead of the permanent waste disposal facility.

Licence condition G.1 of the proposed licence requires the licensee to conduct the licensed activities in accordance with the licensing basis. Proposed licence condition G.2 requires the licensee to notify CNSC of changes to facilities or their operation, including modifications to design, operating conditions, policies, programs and methods, to ensure continued compliance with the licensing basis.

For future initiatives, CNSC staff will continue to review the information submitted by CNL to determine if the proposed activity is included in the licensing basis for CRL. CNSC staff will submit for Commission consideration any proposed activities that were not authorized by the Commission. If the Commission grants approval for such an activity, this activity would then be added to the licensing basis and reflected in updates to LCH.

### **2.1.1 Shutdown and transition to storage with surveillance of the NRU Reactor**

Aligned with the intent of the Government of Canada, CNL will permanently shut down the NRU reactor and fully cease the production of Molybdenum-99 (Mo-99) on March 31, 2018. During the proposed licence period, CNL will undertake the activities needed to transition NRU from operation to a safe shutdown state and then prepare for decommissioning. CNSC staff note that the shutdown activities are permitted as part of the current CRL licensing basis. CNSC staff also confirm that the approach described by CNL is consistent with the approach taken in 2009-2010 when NRU was shut down for the vessel repair. CNL therefore has operational experience with the activities needed to transition the NRU reactor from normal operation to a permanent shutdown state.

The activities associated with the shutdown are divided into five stages.

In stage 1, CNL will defuel the reactor, including the de-energization, isolation and shutdown of any systems not needed to support the reactor when it is defueled. During stage 1, CNL is required to meet all existing requirements as though the NRU reactor was defueling in normal operation. As CNL progresses through stage 1, operations will be updated to ensure operational requirements are reflective of the actual state of the NRU reactor.

In stage 2, systems and assemblies which are not required to support the reactor since it is shutdown and defueled will be isolated and removed.

In stage 3, the core cooling systems will no longer be required and moderator will then be drained. Purification circuits and back-up electrical power will be shut down. As CNL progresses through stage 3, operational limits and conditions will be updated to ensure requirements are reflective of the actual, lower risk state of the NRU reactor and to enable the final shutdown of the reactor safety systems.

In stage 4, remaining systems, including the heavy water systems are shut down.

In stage 5, all major systems will be shut down and systems will be dismantled with appropriate consideration for the removal of operational waste and hazards. CNSC staff will review and confirm that CNL has transitioned the facility into a state suitable for storage with surveillance. The NRU rod bays will continue to operate beyond stage 5 as a stand-alone facility.

As the NRU reactor transitions from normal operation to a shutdown state to storage with surveillance, the risk associated with the NRU facility and CRL site will continue to decrease and the regulatory focus for CRL will be adjusted accordingly.

CNSC staff have reviewed the plan for shutdown of the NRU reactor and conclude that it meets the applicable regulatory requirements and is consistent with the approach taken for the permanent shutdown of similar facilities. More information on the shutdown of NRU and its effects on CNSC's regulatory focus are provided throughout section 3 where appropriate.

### **2.1.2 Evolution of the CNL Management System**

CNL has undertaken an initiative to improve the CNL Management System and the processes to enable delivery of its missions under the Go-Co contract. The changes to the management system capture the evolution of the organization during the Go-Co transition, reaffirm the framework for safe operations and ensure regulatory requirements continue to be met.

As management system documents are updated, CNSC staff continue to review submitted documents in an ongoing basis. Additional information on the evolution of the management system is provided in section 3.1 of this document.



### **2.1.3 Improvements to the CRL site wide infrastructure**

CNL plans to continue with CRL site improvements throughout the duration of the proposed licence. These improvements are ongoing and carried out to modernize the site infrastructure, resulting in safety improvements across the site. The activities carried out range from the construction of new buildings and facilities, improvements to existing buildings, bridging activities to allow existing buildings to be used until new facilities are ready for use, upgrades to equipment, and upgrades to shared services and utilities.

Much of the infrastructure improvements are conventional building and construction activities. These activities represent a significant investment from the government of Canada into the CRL site and are within the current licensing basis of CRL. CNSC staff will continue to provide regulatory oversight of these activities to ensure that any potential impact on nuclear safety, is appropriately addressed by CNL.

### **2.1.4 Continuation of decommissioning and waste management**

In order to fulfil its mandate to transform and modernize the CRL site, CNL plans to continue decommissioning, environmental restoration and waste management projects. These projects are based on the current CNL programs for continuous improvement, waste management, decommissioning and environmental protection. The modernization and cleanup of the CRL site will address legacy waste issues, reduce Canada's radioactive waste and decommissioning liabilities and reduce the overall risk profile of the site by reducing or eliminating existing hazards. The activities proposed by CNL related to this initiative are permitted by the current CRL licensing basis. These activities have been ongoing at the CRL site and are not new activities, CNL plans to carry out these activities at an increased rate.

During the proposed licence period, over 120 buildings and structures are scheduled for decommissioning or demolition. Additionally, CNL plans to design and build long-term waste management and disposal facilities, process and store legacy waste, remove and process the stored radioactive liquid waste and decommission the associated tanks and structures, remediate some of the affected lands at CRL.

To facilitate these activities, CNL is implementing an Integrated Waste Strategy to ensure a holistic and unified approach to waste management. This strategy aligns with the current waste management and decommissioning programs for CRL.

CNSC staff will continue to provide regulatory oversight of these activities recognizing that adjustments to compliance oversight activities will be made as needed. Additional information on the waste management and decommissioning programs is available in section 3.11 of this document.

### **2.1.5 Science and technology capabilities program**

Over the proposed licence period, CNL plans to pursue science and technology objectives to strive toward its goal of establishing CRL as a nuclear laboratory of choice. To achieve this goal, CNL plans to build on existing programs, experience and research activities. CNL has identified several fields of science and technology development as objectives, including: energy, health sciences, safety and security, environment, materials and fuel research, radiobiology, radioecology, hydrogen and systems engineering.

In order to fulfil its science and technology objectives, CNL plans to construct an Advanced Nuclear Materials Research Center. This center will be an area of focus of CNL activities and built to the specifications of a modern laboratory, allowing CNL to consolidate existing, aging laboratories at CRL. This results in safety improvements by replacing multiple aged laboratories with a modern facility.

The research to be conducted in this facility is permitted under the current CRL licensing basis. CNSC staff will provide regulatory oversight of the activities conducted at this facility to ensure that if any proposed activity falls outside the licensing basis, CNL is directed to seek approval from the Commission as needed.

CNSC staff note that the CNL application expresses CNL's long term goal of demonstrating the viability of small modular reactors (SMR). No request related to a SMR has been made by CNL and therefore SMR is out of scope of this consideration. Any request related to SMR would be subject to the CNSC licensing process.

## **2.2 Environmental Assessment**

An Environmental Assessment (EA) under the CEAA 2012 [2] was not required for this licence renewal application, nor did section 67 of CEAA 2012 apply, as no new project (defined under section 66 of CEAA 2012) or physical activities are being authorized under the proposed licence. However, an EA under the NSCA [3] and its regulations was conducted for this application. More information can be found in the EA Report appended to this CMD (Addendum E). CNSC staff conclude that the licensee will make adequate provision for the protection of the environment and health of persons.

## **2.3 Relevant Safety and Control Areas (SCAs)**

CNSC regulatory oversight is performed in accordance with a standard set of 14 SCAs. SCAs are technical topics used across all CNSC regulated facilities and activities to assess, evaluate, review, verify and report on licensee regulatory requirements and performance. Each SCA is comprised of "specific areas" of regulatory interest; however, the specific areas associated with each SCA vary between facility types. Addendum C provides further information about the SCAs including definitions for each SCA and the specific areas for CRL.

Table 2 indicates the relevance of each SCA to this CMD and current rating level associated with CNL's performance related to each SCA at CRL. This CMD provides an evaluation of past performance of CRL over a period that extends from 2012 up to June 30, 2017. Further information about rating levels are provided in Addendum A of this CMD.

**Table 2: Safety and control areas relevant to the Chalk River Laboratories**

Functional Area	Safety and Control Area	Relevant to CMD?	Performance Rating*
<b>Management</b>	Management System	Yes	SA
	Human Performance Management	Yes	SA
	Operating Performance	Yes	SA
<b>Facility and Equipment</b>	Safety Analysis	Yes	SA
	Physical Design	Yes	SA
	Fitness for Service	Yes	SA
<b>Core Control Processes</b>	Radiation Protection	Yes	SA
	Conventional Health and Safety	Yes	SA
	Environmental Protection	Yes	SA
	Emergency Management and Fire Protection	Yes	SA
	Waste Management	Yes	SA
	Security	Yes	SA
	Safeguards and Non-Proliferation	Yes	SA
	Packaging and Transport	Yes	SA

\*As of June 30, 2017

## 2.4 Licence and Licence Conditions Handbook Format (LCH)

CNSC staff have recently developed a set of standardized licence conditions for Class I facilities in order to ensure consistency of language and improve clarity of requirements for licensees. The proposed licence is aligned with this initiative and consistent with other proposed licences brought before the Commission by CNSC staff in recent licensing hearings for Class I facilities and uranium mines and mills.

The LCH associated with the CRL licence provides compliance verification criteria used to determine whether the conditions listed in the licence have been met. The LCH provides details associated with each licence condition, such as: compliance verification criteria, applicable CSA standards and CNSC regulatory documents, regulatory interpretations, licensee documents requiring written notification of changes and guidance. This structure allows for continuous improvement and keeping documents up to date while remaining within the licensing basis.

The previous LCH for CRL was among the first of the LCHs established by CNSC. Since 2011, the CNSC approach to the format and content of the LCH has improved due to feedback from the Commission and operational experience gained from use of the LCH. The proposed LCH reflects the current CNSC approach to the format, content and document control framework of the LCH.

## **2.5 Other Matters of Regulatory Interest**

The following is a list of other matters of regulatory interest that are relevant to this CMD:

- Aboriginal Consultation
- Other Consultation
- Cost Recovery
- Financial Guarantees
- Public Information Program
- Nuclear Liability Insurance
- Fisheries Act Authorization
- Delegation of Authority

These other matters of regulatory interest are discussed in Section 4 of this CMD.

## **2.6 Regulatory and Technical Basis**

The regulatory and technical basis for the matters discussed in this CMD come directly from the NSCA [3], and its associated regulations as well as other regulatory requirements. Further information regarding the regulatory and technical basis for the matters discussed in this CMD are provided in Addendum B to this document.

### 3. GENERAL ASSESSMENT OF SCAS

The CNSC uses a risk-informed regulatory approach in the management and control of regulated facilities and activities. The depth of regulatory reviews of each SCA and the baseline frequency of regulatory compliance activities is informed by the risk ranking of that SCA. CNSC staff have therefore applied a graded approach in conduct of regulatory oversight activities based on the hazards and associated risks for each facility at CRL. CNSC staff assessments are presented in the following sections. These assessments are based on the review of CNL's licence application, its supporting documentation and verification activities carried out since 2012.

Consolidated performance ratings for previous years can be found in Addendum D to this document.

CNSC staff provide continuous regulatory oversight at the CRL. Table 3 below presents the compliance effort from CNSC staff for CRL in terms of person-days from 2012 to June 30, 2017. This effort includes staff from the CNSC Chalk River site office as well as head office staff in Ottawa.

**Table 3: Summary of CNSC staff licensing and compliance activities carried out at the Chalk River Laboratories since 2012**

	2012	2013	2014	2015	2016	2017 <sup>1</sup>
<b>Number of Inspections</b>	32	18	31	24	43	10
<b>Licensing Activities (Person days)</b>	504	411	1011	805	782	534
<b>Compliance Activities (Person days)</b>	2649	2662	2914	3164	3142	955

<sup>1</sup> For the period of January 1 to June 30, 2017

#### 3.1 Management System

The management system SCA covers the framework that establishes the processes and programs required to assure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.

The specific areas that comprise this SCA at CRL include:

- Management System
- Organization
- Performance Assessment, Improvement and Management Review
- Operating Experience (OPEX)
- Change Management
- Safety Culture
- Configuration Management
- Records Management

- Management of Contractors
- Business Continuity

### 3.1.1 Trends

The following table indicates the overall rating trends for the Management System SCA over the current licensing period:

TRENDS FOR MANAGEMENT SYSTEM					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
BE	SA	SA	SA	SA	SA
<b>Comments</b> CNL continue to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Management System performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.1.2 Discussion

CNL is required to implement and maintain a management system which focuses on safety in all business activities. Additionally, the management system establishes a commitment and adherence to a set of management system principles and, consistent with those principles, the implementation of planned and systematic processes that achieve expected results.

CNL satisfactorily addressed shortcomings identified in a gap analysis of its management system to satisfy the requirements of CSA N286-05, *Management system requirements for nuclear power plants*. This was followed by a further gap analysis against CSA N286-12 *Management system requirements for nuclear facilities*. The analysis revealed that the CNL management system is compliant to N286-12 and identified some areas for improvement which are currently being addressed. CNSC staff verified that changes to CNL's management system were made according to the CNL change management procedures. CNSC staff are satisfied that licensed activities at CRL are conducted safely in accordance with the CNL management system, and that the management system meets the appropriate CNSC regulatory requirements.

### 3.1.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA. Based on CNSC staff's assessment, there were no significant observations in the following specific areas:

- Change Management
- Configuration Management
- Records Management

- Management of Contractors
- Business Continuity

### **3.1.3.1 Past Performance**

#### **Management System**

CNL progressed from a 'Below Expectations' rating to a 'Satisfactory' rating in 2013. The CNSC staff evaluation of this progress was based heavily on a gap analysis conducted by CNL and updates to CNL's management system to be compliant with CSA N286-05. CNSC staff verified the completed actions and confirmed CNL compliance with CSA N286-05. Since then, CNL has performed a gap analysis between N286-05 and N286-12. CNSC staff verified that the CNL management system is compliant CSA N286-12. CNL has identified some internal recommendations for improvement and is carrying out activities to address these recommendations. CNSC staff have verified that CNL remains on track for completion of the self-identified areas for improvement.

As part of the Go-Co transformation management, CNL undertook a complete update and redesign of the management system, the majority of which was completed during 2016. CNL has introduced a new three level document hierarchy and new document types in transforming the management system framework:

- Level 1 governance documents, such as manuals, policies and executive management directives
- Level 2 interpretation documents, such as program description documents, program requirement documents, controlled lists, organizational documents
- Level 3 how-to documents, such as management control procedures, operating procedures, handbooks, functional work instructions

CNL has submitted level 1 and 2 documents as required. CNSC staff have reviewed a sample of the level 1 and 2 documents from a management system perspective for consistency and appropriateness. CNSC staff conclude that the changes to the CNL management system have met the appropriate CNSC requirements.

#### **Organization**

As part of the Go-Co transformation management, CNL created new:

- corporate profile, mission, vision and values
- governance model/Board of Directors/Executive Team
- organization structure
- roles, responsibilities, accountabilities and authorities

aligned to the restructured management system for future operations.

CNSC staff conducted regular compliance verification activities including meetings, interviews, and document reviews during the transformation period to ensure that changes related to the organization were understood by all levels of CNL management and workers. CNSC staff verified through these activities that CNL's change control procedures were applied appropriately. Based on these compliance verification activities and ongoing discussions, CNSC staff confirmed that CNL has appropriately documented the changes to the CNL organizations. CNSC staff has no concerns regarding the changes to the CNL organization and have confirmed CNL's organization is suitable to ensure continued safe operation and compliance with regulatory requirements.

### **Performance Assessment, Improvement and Management Review**

CNL has several mechanisms for internal review of performance including:

- Nuclear Performance Assurance Review Board, which reviews the performance of site-wide facilities and programs on a quarterly basis
- Corrective Action Review Board, which reviews the status of the corrective actions program and its outcomes
- Integrated Safety Management Review, which assesses various programs which contribute to overall safety management of the site
- Contractor Assurance System, which is used to integrate various performance measures and indicators to provide an evaluation of contractor performance

CNSC staff have verified that these mechanisms are in place to provide CNL senior management with the ability to assess the performance and effectiveness of the management system.

CNSC staff perform continuous review and verification of specific elements such as ImpAct (a problem identification and resolution mechanism) initiation, routing, trending, approval, and effectiveness. Additionally, as part of the ongoing engagement with CNL, CNSC staff engage in regular discussions to review the progress regarding the Go-Co Transformation. CNL continues to meet CNSC regulatory requirements in this area.

### **Operating Experience (OPEX)**

The CNL OPEX program is comprised of processes to ensure operating experience, both from within the organization and from industry, is used to improve the safety of operations, improve operational performance, and reduce the significance and the occurrence of unplanned events.

The CNL OPEX program matured significantly since 2012, when many recently introduced processes were still in early development. CNL increased the presence of the OPEX program and its overall contribution to safety, by integrating the program into existing processes, procedures, plans and operations. For example, CNL introduced a daily call for all employees to share events to promote immediate, open communication across all CNL sites. Additionally, CNL implemented a process to provide guidance for individuals on which questions to ask and information to gather following an event.



CNSC staff perform ongoing review and verification of OPEX program elements, such as weekly CANDU Owners Group (COG) screening meeting, review and dissemination of reports. These activities were carried out as part of the ongoing oversight of CNL consisting of regular information and progress meetings of the Go-Co transformation management. CNSC staff found that processes under the OPEX program, such as trending, internal and external sharing of safety issues, communication of safety information and benchmarking were effective and satisfactory.

### **Safety Culture**

The licensee developed the original Voyager program which was an internal improvement initiative. The Voyager was established as a way to “*move RTO (research and technology operations) toward nuclear power industry standards and practices, as a means of achieving the vision of ‘World-class performance – no compromise.’*” Following the 2009 NRU vessel leak event a second phase of that program was developed - Voyager II - to address areas of weakness identified in the root cause analysis. CNSC staff verified completion of each action in the Voyager II program through desk-top reviews and onsite verifications.

The licensee performed a detailed safety culture self-assessment in 2012 that identified several areas for improvement that were incorporated into corrective action plans. CNL reported all corrective actions have been completed in March 2014.

CNL performed a contractor-assisted abridged safety culture survey in 2015. In September 2016, CNL retained a third-party organization to conduct an employee survey under the culture shift process being developed and deployed as part of the Go-Co Transformation Management. CNSC staff have reviewed and discussed both survey results with CNL management. CNSC staff verified that CNL’s process to gather feedback and response to the survey results were appropriate. CNSC staff is satisfied with CNL’s actions to address the survey results and will continue to monitor CNL’s measures to address any areas of concern through regular oversight and review activities.

#### **3.1.3.2 Regulatory Focus**

CNSC staff will continue to monitor CNL’s performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation.

CNSC staff’s compliance oversight will continue to focus on Go-Co Transformation Management as CNL implements a new corporate profile, mission, vision and values underpinned with a revamped management system. CNSC staff continue to verify and evaluate that activities affecting safety are maintained according to regulatory requirements or improved.

### **3.1.3.3 Proposed Improvements**

CNL plans to continue aligning its management system with changes to regulatory requirements, and changes in its own business needs. This includes many improvements such as implementing, testing and maintaining a company-wide business continuity management program, and the development and use of feedback mechanisms such as the Contractor Assurance System to provide reasonable assurance the management systems' safety-related objectives are being accomplished, and systems and controls will be effective and efficient.

CNL plans to continue conducting employee engagement activities, including surveys, on a regular basis to strengthen CNL's safety culture.

CNSC staff will continue to closely monitor any developments that could affect the CRL site safety and compliance with the applicable requirements.

### **3.1.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to meet regulatory requirements in this SCA. CNSC staff conclude that CNL continues to assess opportunities to improve the effectiveness of the Management System.

### **3.1.5 Recommendation**

One licence condition is included in the proposed licence for this SCA. Licence condition 1.1 requires CNL to implement and maintain a management system. Compliance verification criteria for this licence condition are included in the draft LCH.

## **3.2 Human Performance Management**

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 have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

The specific areas that comprise this SCA at CRL include:

- Human Performance Program
- Personnel Training
- Personnel Certification
- Work Organization and Job Design
- Fitness for Duty

### 3.2.1 Trends

The following table indicates the overall rating trends for the Human Performance Management SCA over the current licensing period:

TRENDS FOR HUMAN PERFORMANCE MANAGEMENT					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continue to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Human Performance Management meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.2.2 Discussion

CNL has implemented and maintains human performance, training, and certification programs in order to ensure a sufficient number of qualified workers are available in all relevant job areas, and they have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties. CNSC staff conclude that programs related to CNL's Human Performance Management activities at CRL have met applicable regulatory requirements and CNSC expectations.

### 3.2.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration CNSC staff assessment in all specific areas included for CRL within this SCA. Based on CNSC staff's assessment, focused highlights are provided for the following specific areas:

- Human Performance Program
- Personnel Training
- Personnel Certification
- Fitness for Duty

#### 3.2.3.1 Past Performance

##### Human Performance Program

CNL made significant improvements to human performance through the Voyageur-II program (refer to Section 3.1.3.1, Safety Culture). The improvements included the implementation of a practical learning facility (PLF) which included practice stations for trainees on various operational activities. These activities include: use of harnesses, three-way communication, lock-out-tag-out (conventional safety procedures to ensure equipment is properly shutoff), foreign material exclusion, radiation protection, fire response, a control-actuation rig.

The PLF is also used for delivery of other types of training, such as Operator Fundamentals.

To minimize the impact on employees during the transformation activities, CNL has implemented several new initiatives including:

- Retain-Retrain-Redeploy for NRU employees and others connected with NRU operations;
- Resource Management functions with a Skills Inventory and Career Hub; and
- Oracle Human Capital Management System and Learning Management System.

CNSC staff performed a compliance inspection of the NRU Reactor related to CNL's human performance program in 2016. This inspection resulted in one action notice with low safety significance regarding the use of event free tools. CNSC staff verified the CNL activities to address this action were completed and closed the action notice in October 2016.

### **Personnel Training**

CNL has implemented and maintains a systematic approach to training (SAT) to provide assurance that personnel are trained and qualified for the work they do. Application of SAT-based training is mandatory for all personnel in direct operating positions (defined as personnel with hands-on responsibilities for the safe day-to-day operation of a facility) at CRL. The application of SAT-based training to non-direct operating personnel is graded based on the importance of the job to nuclear safety.

CNL's Training and Development program defines the requirement to follow a systematic approach to training. Since 2012, CNSC staff has conducted compliance verification activities to ensure CNL's training programs meet regulatory requirements and CNL's established training processes. Some low safety significance findings resulted from these verification activities. CNSC staff confirmed that CNL adequately addressed the findings.

### **Personnel Certification**

NRU reactor is the only facility at CRL which requires certain personnel to be certified by the CNSC. Initial certification examinations and requalification tests for NRU Health Physicists and the initial certification examinations for Senior Reactor Shift Engineers require CNSC approval. In approving these examinations, CNSC staff verify that the examinations are designed to discriminate between candidates who are competent to perform the duties of the position and those who are not. CNSC staff review the results of these examinations and requalification tests and certify personnel who demonstrate that they have the knowledge and skills to safely perform the duties of the position.

CNL continues to maintain the required number of certified senior reactor shift engineers and NRU health physicists for the remainder of NRU operations and throughout the shutdown period. As the NRU reactor transitions from operation to shutdown and eventually storage with surveillance, training and qualification requirements for NRU staff will align with changes to the NRU facility authorization.

CNSC staff are satisfied that CNL programs ensure certified personnel at the NRU facility possess the knowledge and skills required to perform their duties safely and competently.

### **Fitness for Duty**

CNL has a mature fitness-for-duty program which addresses fitness for duty in regards to employees fatigue, drugs and alcohol. The program provides strategies for mitigating and recognizing the effects of fatigue, drugs and alcohol in the workplace, including information for employees on how to access assistance at any location where CNL operates.

CNL has completed a gap analysis and developed implementation plan for REGDOC-2.2.4 *Fitness for Duty: Managing Worker Fatigue*. CNL has determined that with NRU shutdown the document would only apply to security staff at CRL. CNL has committed to implementing all regulatory requirements of REGDOC-2.2.4 *Fitness for Duty: Managing Worker Fatigue* by April 1, 2019. CNSC staff are satisfied with CNL's approach to implementation of REGDOC-2.2.4 and will continue to monitor CNL's progress in this area.

### **3.2.3.2 Regulatory Focus**

CNSC staff continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation.

Compliance oversight will continue to focus on activities that affect the safety performance of the workers at CRL.

CNSC staff note that as the NRU reactor transitions to permanent shutdown, CNL has enough certified staff to fulfill their operational needs and regulatory requirements. CNL does not anticipate the need for new certified staff and as a result CNSC staff does not expect to certify any additional staff for the NRU reactor.

CNSC staff will monitor implementation of new REGDOCs to ensure CNL appropriately addresses the regulatory requirements.

### **3.2.3.3 Proposed Improvements**

CNL's main focus over the proposed licence period is to support the various missions within its ten year plan including science and technology, infrastructure projects, and decommissioning and waste management, CNL continues to assess improvement opportunities for the human performance program, along with training and development initiatives to retrain and redeploy staff in facilities scheduled to close in 2018.

CNSC staff continue to closely monitor any developments that could affect the CRL site safety and compliance with the applicable requirements.

### **3.2.4 Conclusion**

Based on CNSC staff assessments of CNL's licence application, supporting documents and past performance, CNSC staff concludes that CNL continues to implement and maintain effective human performance management programs at CRL in accordance with regulatory requirements.

### **3.2.5 Recommendation**

Three licence conditions are included in the proposed licence for this SCA. Licence condition 2.1 requires CNL to implement and maintain a human performance program, condition 2.2 requires CNL to implement and maintain a training program, and condition 2.3 requires CNL to only appoint certified persons to the positions of Senior Reactor Shift Engineer and NRU Health Physicist. Compliance verification criteria for the three licence conditions are included in the draft LCH.

## **3.3 Operating Performance**

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

The specific areas that comprise this SCA at CRL include:

- Conduct of Licensed Activities
- Procedures
- Reporting and Trending
- Outage Management Performance
- Accident Management and Recovery
- Severe Accident Management and Recovery

### 3.3.1 Trends

The following table indicates the overall rating trends for the Operating Performance SCA over the current licensing period:

TRENDS FOR OPERATING PERFORMANCE					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Operating Performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.3.2 Discussion

CNSC staff confirm that CNL has implemented and maintains effective operational programs in order to ensure licensed activities are performed safely and in compliance with regulatory requirements. CNSC staff conclude that CNL's Operating Performance at CRL met all applicable regulatory requirements and CNSC staff's expectations. CNSC staff are satisfied that licensed activities at CRL are conducted in a safe manner.

### 3.3.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC staff's future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration CNSC staff's assessment in all specific areas included for CRL within this SCA. Based on CNSC staff's assessment, focused highlights are provided for the following specific areas:

- Conduct of Licensed Activities
- Procedures
- Reporting and Trending

#### 3.3.3.1 Past Performance

##### Conduct of Licensed Activity

Nuclear facilities at CRL are governed by CNL's Facility Authorization and facility-specific Conduct of Operations documents, which indicate the operational limits and conditions for the various facilities. Facilities in permanent safe shutdown state or undergoing active decommissioning are governed by storage-with-surveillance plans or decommissioning plans, respectively. These governing documents prescribe how each facility is operated and maintained to ensure nuclear safety and that the risk to the public remains low.

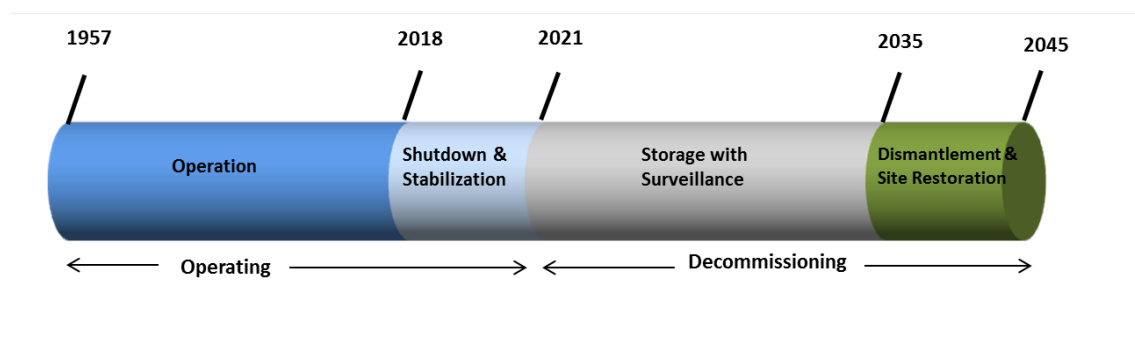
CNSC staff carried out many verification activities since 2012 on CNL's operations across the CRL site and found that overall all Class I nuclear facilities at CRL have been operating safely since 2012. As CNL transitions to its new management system structure, operating procedures and instructions are currently being revised to align to the new format.

CNL continues to provide information regarding the operational performance of nuclear facilities at CRL in annual reports submitted to CNSC staff. The following subsections provide further information on the operational status of facilities at CRL grouped by facility type.

#### Class I Nuclear Facilities

The NRU reactor is currently operating and is scheduled to be permanently shut down at the end of March 2018. Figure 2 below provides a visual representation of the NRU reactor lifecycle and the associated Molybdenum-99 Production Facility (MPF) is on stand-by for Molybdenum production until March 31, 2018. After March 31, 2018, the MPF will be shut down aligning with the shutdown of the NRU reactor (the source of Molybdenum production at the CRL site). CNL plans to prepare a storage with surveillance plan and detailed decommissioning plan in 2018 as CNL progresses through the phases of the NRU shutdown.

**Figure 2: Preliminary Schedule of NRU Reactor Shutdown**



The Nuclear Fuel Fabrication Facility was previously operated in two buildings and was consolidated to a single building in 2016. CNL plans to prepare the storage with surveillance and detailed decommissioning plans for the old building in 2018.

The Tritium Facility is scheduled to be transferred into a renovated building during the proposed licence period. Preparation of storage with surveillance and detailed decommissioning plans for the area previously occupied by the Tritium Facility is scheduled for the proposed licence period.

The ZED-2 reactor, Universal Cells, Fuels and Materials Cells and Recycle Fuel Fabrication Laboratory all continue to operate with no plans to end operation during the proposed licence period.



### Class II Nuclear Facilities

The Texas Neutron Generator was shut down in 2013. The instrument is currently awaiting removal from the Health Physics Neutron Generator facility. This low risk activity may be carried out at any time as it is permitted by the current licensing basis. A new neutron generator was installed in the facility and is currently undergoing commissioning activities.

A new irradiator was installed in the Gamma Beam Irradiator Facility and is now operational.

### Radioisotope Laboratories

CNL has made several changes to the radioisotope laboratories since 2012:

- three radioisotope laboratories have ceased operation
- seven radioisotope laboratories have been or are in the process of being renovated as part of the fume hood upgrade project
- three radioisotope laboratories, associated with the NRU reactor, will cease operation following reactor shutdown in March 2018

CNL has planned to relocate several radioisotope laboratories to the newly constructed laboratory building. The buildings where the laboratories were previously located are scheduled for demolition. Where appropriate, CNL plans to prepare storage with surveillance and detailed decommissioning plans for the obsolete buildings in 2018.

### **Summary of CNSC staff Assessments since 2012**

CNSC staff continuously monitored the work performed by CNL and reviewed the documentation related to several new facilities, new environmental restoration projects and site improvement projects, and new experimental work. Some examples are provided below.

### Fuel Packaging and Storage Facility

CNL 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). CNL designed and built the Fuel Packaging and Storage (FPS) facility in order to retrieve the spent fuel from specific tile holes and store them in a better controlled and monitored facility and designed to current standards.

CNSC staff reviewed the design requirements documents for the FPS and concluded it was designed to appropriate codes and standards and meets regulatory requirements. The licensee requested and was granted Commission approval in March 2014 for the operation of the FPS as it was outside the licensing basis. [[19](#)]

### Modification to the Molybdenum-99 Production Facility

The spent highly-enriched uranium (HEU) fuel currently stored in the CRL waste management areas is being repatriated to the United States as part of the global threat reduction initiative, a broad international effort to consolidate HEU inventories in fewer locations around the world.

The purpose of the modification to the Molybdenum-99 Production Facility is to facilitate the removal of target residue material from the Fissile Solution Storage Tank and transfer it into a certified radioactive material transport package. CNSC staff reviewed the design package for the proposed modification and concluded the design follows the appropriate codes and standards and meets regulatory requirements.

### Fume Hood Upgrades

The fume hoods are power-ventilated enclosures where hazardous chemicals and radioactive materials can be safely handled. The intended function of a fume hood is to contain contaminants and prevent their escape into the work environment.

CNL has initiated a project to review all fume hoods at CRL for compliance with the *National Fire Code of Canada* [20], and upgrade those found to be noncompliant. CRL has more than 350 fume hoods in 28 buildings. A large number of fume hoods had to be upgraded to meet current industry standards. As of June 2017, 197 fume hoods have been upgraded which represents 79.4% of the project scope.

### **Procedures**

CNL Management System consists of high level documentation supported by lower level procedures. CNL maintains a comprehensive suite of procedures across all programs and facilities at the CRL site. Since 2012, CNL continually updated the facility-specific procedures relating to operations, maintenance, and emergency response as needed and to support ongoing process improvements at CRL.

CNSC staff review procedure level documents as part of ongoing compliance verification activities. Based on these reviews, CNSC staff conclude that the changes made to CNL procedures were carried out in accordance with CNL's change control process and there were no significant changes to operating documentation that could have affected the safe operation of the facilities at CRL.

### **Reporting and Trending**

Detailed requirements for reporting unplanned situations or events at CRL to the CNSC are included in the CRL LCH. CNL has complied with the requirements for submission of these reports since 2012.

Events reported to the CNSC by CNL are presented in table 4:

**Table 4: Reportable Events for CRL (2012-2017)**

	2012	2013	2014	2015	2016	2017 <sup>1</sup>
<b>Total</b>	153	166	111	93	90	39

<sup>1</sup> For the period of January 1 to June 30, 2017

CNSC staff review all reported events to identify if there are any regulatory concerns and report significant events to the Commission at public meetings of the Commission. There were seven event initial reports (EIR) presented to the Commission since 2012 [21, 22, 23, 24, 25, 26, and 27]. Table 5 provides a summary of the EIRs. The actions associated with these seven EIRs have all been completed and there are no outstanding issues.

**Table 5: Event Initial Reports at Chalk River Laboratories Since 2012**

<b>EIR</b>	<b>Event Summary</b>
<b>12-M27</b>	Medical emergency in a parking lot at the Chalk River Laboratories site. After receiving emergency aid, an AECL employee was transported to the local hospital. The employee was later pronounced dead.
<b>13-M27</b>	During a controlled shut down of the NRU reactor, the Rods Supervisor started to close the main heavy water pump isolation valves when they were tasked with closing the process water valves. Facility Manager in the control room at the time noticed the error and proceeded to stop the close of the main heavy water pump outlet isolation valves. Due to this there was a near miss Loss of Flow Accident.
<b>14-M86</b>	A contractor fell approximately 20 feet onto a scissor lift. The worker was wearing all applicable personal protective equipment, however, it was discovered that the fall arrest harness was incorrectly anchored.
<b>16-M9</b>	Confidential
<b>16-M27</b>	A basket loaded with HEU National Research Experimental (NRX) fuel was dropped in the NRU rod fuel bay.
<b>16-M28</b>	ZED-2 research reactor CNL staff noted a discrepancy between the amount of heavy water in the ZED-2 tanks and the total known inventory. It was determined that the heavy water was in the ventilation system and has been evaporating at a rate of 20 L/month.
<b>16-M59</b>	Death of person following a fall from the roof of the National Research Universal (NRU) Building 150.

CNL also submits annual reports on compliance monitoring and operational performance of facilities at CRL, as required by condition 4.16 of the current CRL licence. CNSC staff reviewed these reports as they were submitted and no significant regulatory issues were identified during the review.

### **3.3.3.2 Regulatory Focus**

CNSC staff continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation.

CNSC staff will focus compliance verification activities on operational activities at CRL, including construction, decommissioning and demolition activities.

### **3.3.3.3 Proposed Improvements**

CNL has identified key initiatives to be carried out during the proposed licence period. Information on these initiatives can be found in Section 2.1 of this CMD. CNSC staff will continue to closely monitor operational changes at the CRL site to ensure CNL's continued compliance with regulatory requirements.

### **3.3.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain effective operational programs for CRL in accordance with regulatory requirements.

### **3.3.5 Recommendation**

Two licence conditions are included in the proposed licence for this SCA. Licence condition 3.1 requires CNL to implement and maintain an operating program. Licence condition 3.2 requires CNL to implement and maintain a program for reporting to the CNSC. Compliance verification criteria for both licence conditions are included in the draft LCH.

## **3.4 Safety Analysis**

The safety analysis SCA covers the maintenance of the safety analyses that supports the overall safety case. 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.

The specific areas that comprise this SCA at CRL include:

- Deterministic Safety Analysis
- Hazard Analysis
- Probabilistic Safety Analysis
- Criticality Safety
- Severe Accident Analysis

### 3.4.1 Trends

The following table indicates the overall rating trends for the Safety Analysis SCA over the current licensing period:

TRENDS FOR SAFETY ANALYSIS					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>(1)</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continue to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Safety Analysis performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.4.2 Discussion

CNL is required by the *Class I Nuclear Facilities Regulations* to prepare formal Safety Analysis Reports (SAR) for Class I nuclear facilities. CNL has implemented a safety analysis program that ensures systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and to consider the effectiveness of preventative measures and strategies in reducing the effects of such hazards.

CNSC staff conducted desktop reviews of CNL's safety analysis documentation and conclude that CNL's Safety Analysis SCA at CRL met applicable regulatory requirements and CNSC expectations.

### 3.4.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC staff's future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration CNSC staff assessment in all specific areas included for CRL within this SCA. Based on CNSC staff's assessment, focused highlights are provided for the following specific areas:

- Deterministic Safety Analysis
- Probabilistic Safety Analysis
- Criticality Safety
- Severe Accident Analysis

### 3.4.3.1 Past Performance

#### Deterministic Safety Analysis

The safety analyses for CRL facilities are primarily deterministic complemented as appropriate by probabilistic safety analysis (PSA). CNL maintains SARs for all Class I nuclear facilities at CRL including the SAR for the NRU reactor, which is the most significant due to NRU's complexity and level of risk. CNL maintains similar documentation for Class II nuclear facilities and Class II prescribed equipment.

The SARs are updated by CNL over time as operational requirements change and the updates are carried out in accordance with the requirements of the licensing basis. When the SARs are updated, they are provided to CNSC staff for review and CNSC staff monitor these changes to ensure continued compliance with the licensing basis.

Since 2012, CNSC staff's verification activities in this area were focused on the NRU reactor. CNL has recently revised the NRU SAR. The revised SAR incorporated and integrated results of previously submitted analyses which CNSC staff had reviewed and provided feedback to CNL during the course of the NRU SAR update process. CNL submitted a final NRU SAR in March 2016. CNSC staff reviewed the SAR and concluded that it meets regulatory requirements.

#### Probabilistic Safety Analysis (PSA)

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

For CRL, PSA was conducted to support the safety analysis of the NRU reactor only. CNL 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 and accepted CNL's PSA. Applying a graded approach, CNL plans to perform an assessment to determine if an update to the PSA provides any safety benefit. This assessment is scheduled to be completed in December 2017. Work on the assessment is ongoing and CNSC staff are engaged in discussion with CNL on the PSA.

#### Criticality Safety

CNL is required to implement and maintain a nuclear criticality safety program compliant with RD-327, *Nuclear Criticality Safety*. CNL has developed a suite of nuclear criticality safety program documents acceptable to CNSC staff. CNL maintains its criticality safety documents (CSD), some temporary amendments and is in the process of finalizing one additional CSD for use. CNL continuously develops other CSDs to address future potential operations with fissionable materials at CRL.

CNSC staff reviewed CNL's criticality safety program and changes to the CSDs as they were updated by CNL. Based on the reviews, CNSC staff confirm that CNL continues to make changes and updates to CSDs that are in accordance with the requirements of RD-327. Therefore, CNSC staff conclude that CNL's criticality safety measures meet the regulatory requirements.

### **Severe Accident Analysis**

Regulatory document REGDOC-2.3.2, *Accident Management*, version 2, describes how a licensee should respond to any credible reactor accident in order to:

- Prevent the escalation of the accident
- Mitigate the consequences of the accident
- Achieve a long-term safe stable state after the accident

This specific area is applicable only to the NRU reactor. CNL updated the severe accident analysis for the NRU reactor as part of the CNL response to lessons learned from Fukushima. The results of the severe accident analysis were incorporated into the development of NRU severe accident management program which was implemented in 2015.

CNSC staff have reviewed the NRU severe accident management program against the appropriate regulatory requirements and found it to be acceptable. Additionally, CNSC staff verified that all actions related to the lessons learned from Fukushima have been completed by CNL.

### **3.4.3.2 Regulatory Focus**

As the NRU reactor transitions from operation to shutdown then storage with surveillance, the focus of CNSC staff related to the Safety Analysis SCA will change significantly. As CNL progresses through the stages of the shutdown of the NRU reactor, CNL will provide revisions to the safety analyses and operational documents as appropriate. After the NRU reactor is shutdown, defueled and dewatered, the scope of credible reactor accidents will decrease significantly and the PSA will eventually be phased out.

CNL will be required to continually update its safety analyses to reflect the current operational state of all facilities on site. CNSC staff will continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation, of new and/or revised safety analyses and criticality safety documents.

### **3.4.3.3 Proposed Improvements**

CNL is in the process of updating the safety analysis and nuclear criticality safety procedures to align with the new management system structure.

CNL plans to construct new buildings to relocate existing facilities in support of CNL's science and technology goals. CNL will continue to prepare safety analyses in support of the design, construction, commissioning, and operation of nuclear facilities for CNSC staff verification that CNL continues to operate within the licensing basis. These safety analyses will be prepared in an ongoing basis during the proposed licence period.

CNSC staff continue to review all these changes for compliance with the regulatory requirements and the licensing basis.

#### **3.4.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain an effective safety analysis program at CRL in accordance with regulatory requirements.

#### **3.4.5 Recommendation**

CNSC staff are implementing the standardized licence conditions for this licence. Two licence conditions are included in the proposed licence for this SCA. Licence condition 4.1 requires CNL to implement and maintain a safety analysis program. Licence condition 4.2 requires CNL to implement and maintain a nuclear criticality safety program. Compliance verification criteria for both licence conditions are included in the draft LCH.

### **3.5 Physical Design**

The physical design SCA 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.

The specific areas that comprise this SCA at CRL include:

- Design Governance
- Site Characterization
- Facility Design
- Structure Design
- System Design
- Component Design



### 3.5.1 Trends

The following table indicates the overall rating trends for the Physical Design SCA over the current licensing period:

TRENDS FOR PHYSICAL DESIGN					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continue to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Physical Design performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.5.2 Discussion

CNL is required to implement and maintain a design program that design of facilities is managed using a well-defined systematic approach. Implementing and maintaining a design program confirms that safety-related structures, systems and components (SSC) and any modifications to them continue to meet their design bases given new information arising over time and taking changes in the external environment into account. It also confirms that SSCs continue to be able to perform their safety functions under all facility states. An important cross-cutting element of a design program is design basis management.

CNSC staff confirm that CNL has implemented and maintained a design program to ensure the ability of systems, components and structures to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account. CNSC staff conclude that CNL's physical design measures at the CRL met all applicable regulatory requirements and CNSC expectations.

### 3.5.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA. Based on CNSC staff's assessment, focused highlights are provided for the following specific areas:

- Design Governance
- Site Characterization
- Facility Design

### **3.5.3.1 Past Performance**

#### **Design Governance**

CNL's conduct of design engineering document and associated procedures and instructions are intended to ensure:

- 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

Since 2012, CNSC staff reviewed CNL's conduct of design engineering documents and found that they are suitable to meet their intended purpose.

#### **Site Characterization**

CNSC staff reviewed the CNL documentation, which provides details on the CRL site characteristics most commonly used as a basis for the preparation of other documentation, such as safety analysis reports. The information in this documentation could also be used in the design of new and modification of existing nuclear facilities at CRL or CRL site infrastructure. CNSC staff also reviewed the CNL document which provides information on environmental characteristics of the CRL site.

Based on the review of these documents, CNSC staff conclude that the CNL site characterization documentation is up to date and appropriately characterizes the site.

#### **Facility Design**

Since 2012, CNSC staff reviewed elements related to the design of facilities ahead of requests for licensing actions. These reviews are focused on CNL's application of appropriate sets of codes and design standards for the new facilities or design changes. Additionally, CNSC staff reviewed designs associated with new experimental work, new environmental restoration and site improvement projects. Some reviews carried out by CNSC staff include:

- Shielded Modular Above-Ground Storage Building No. 3
- Fuel Packaging and Storage Facility
- Modification to the Molybdenum-99 Production Facility to facilitate the removal of target residue material from the Fissile Solution Storage Tank
- Construction of Class C radioisotope Laboratory Complex at CRL (Building 350)
- Installation of Natural Gas Pipeline at CRL

In all cases, CNSC staff concluded CNL met regulatory requirements related to the design of its facilities. CNSC staff verified that new buildings are designed to modern codes and standards.

### **3.5.3.2 Regulatory Focus**

CNSC staff will continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation, review of designs for new or modified facilities.

### **3.5.3.3 Proposed Improvements**

CNL is updating the lower level design engineering procedures to align with the new management system structure.

Over the proposed licence period, CNL proposes several improvements including:

- Establishing a formal design review board within the office of chief engineer
- Re-establishing an engineering field office
- Improving quality and availability of specialty engineering services

### **3.5.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain effective design programs at CRL in accordance with regulatory requirements.

### **3.5.5 Recommendation**

Two licence conditions are included in the proposed licence for this SCA. Licence condition 5.1 requires CNL to implement and maintain a design program. Licence condition 5.2 requires CNL to implement and maintain a pressure boundary program and have a formal agreement with an authorized inspection agency. Compliance verification criteria for both licence conditions are included in the draft LCH.

## **3.6 Fitness for Service**

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 verify all equipment is available to perform its intended design function when called upon to do so.

The specific areas that comprise this SCA at CRL include:

- Equipment Fitness for Service / Equipment Performance
- Maintenance
- Aging Management
- Structural Integrity
- Chemistry Control
- Periodic Inspection and Testing

### 3.6.1 Trends

The following table indicates the overall rating trends for the Fitness for Service SCA over the current licensing period:

TRENDS FOR FITNESS FOR SERVICE					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
BE	BE	BE	BE	BE	SA <sup>2</sup>
<b>Comments</b> CNL is currently rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Fitness for Service performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

<sup>2</sup> CNL Improved to 'Satisfactory' in April 2017

### 3.6.2 Discussion

CNL has implemented and maintains a fitness for service program to cover activities that impact on the physical condition of systems, components and structures to ensure that they remain effective over time.

CNSC staff has previously rated CNL performance as "Below Expectations" due to identified shortcomings in the specific areas that comprise the Fitness for Service SCA for both NRU reactor and CRL site as a whole. Since 2012, CNL prioritized improvement activities in this SCA in order to progress toward a "Satisfactory" performance rating. These improvements were carried out under several initiatives including execution of the integrated implementation plan (IIP) for the NRU reactor, closure of the Fukushima action items, and implementation of new programs.

CNSC staff carried out frequent verification activities related to this SCA. CNSC staff conducted desktop reviews of documentation related to the fitness for service SCA and conducted field verification activities to confirm the status of various improvement initiatives discussed in the following subsections. As stated in section 1.2 of this CMD, CNSC staff presented status updates to the Commission on CNL's progress toward a "Satisfactory" rating at public meetings of the Commission in 2016. In April 2017, CNSC staff's reviews and evaluations of the improvement activities confirmed that that CNL achieved a "Satisfactory" rating for the CRL site including the NRU reactor in all specific areas.

CNSC staff conclude that CNL's Fitness for Service SCA at the CRL meets applicable regulatory requirements and CNSC expectations. CNSC staff note that while many of the improvements associated with Fitness for Service are closely tied to operation of NRU, CNL's performance in this SCA provides CNSC staff with confidence in CNL's ability to identify particular issues and resolve them.

### 3.6.3 Summary

A summary of the licensee's past performance for each specific area in this SCA, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA.

#### 3.6.3.1 Past Performance

##### **Equipment Fitness for Service / Equipment Performance**

Since 2012, CRL experienced challenges related to the state of equipment and systems on site due to effects of aging. However, CNL implemented many initiatives to address these effects and improve site wide conditions.

Through the execution of the IIP, CNL significantly improved the operation of the NRU reactor. The IIP includes physical improvements (for example, refurbishment of NRU systems such as Class I, II and III power systems and the rod monitoring system), as well as programmatic improvements (for example, the establishment of systematic equipment reliability programs). Additionally, performance metrics associated with operation of the NRU reactor have improved. Since 2012, the NRU reactor mean time between trips and unplanned shutdowns (an indicator of reactor operability) improved significantly, from 173 hours to 361 hours.

Regarding site wide conditions, CNL previously experienced operational challenges with many of the systems shared by multiple facilities due to aged conditions. Since 2012, activities to improve these shared systems were carried out by the licensee. These improvements included upgrades to the steam/condensate system, class IV power system, compressed air systems, and natural gas pipeline. Other systems such as the fire water system have been improved with additional mitigation and compensatory measures put in place to address any outstanding weaknesses.

CNSC staff have verified that CNL has appropriate measures to ensure equipment fitness for service for CRL based on the safety significance and risk of the activities being carried out. CNSC staff note that all risk significant elements related to fitness for service have been assessed during the development of the IIP which resulted in risk based prioritization of the improvement activities.

CNSC staff conclude that conditions at CRL have improved and where the aging conditions have not been fully addressed by replacement and refurbishment, CNL has suitable risk control measures in place.

##### **Maintenance**

CNSC staff reviewed CNL's governing documents for the conduct of maintenance at CRL and concluded that the program meets regulatory requirements. CRL previously experienced significant challenges with the conduct of timely maintenance due to the effects of aging at the site. Since 2012, CNL has focused on ensuring maintenance activities are effective and proactive.

CNSC staff's updates to the Commission in 2016 stated that the number of overdue preventative maintenance (PM) jobs is an indicator of the ability of a licensee to carry out its preventive maintenance. CNL was previously carrying over a large number of overdue preventative maintenance jobs from month to month. By 2016, CNL demonstrated its capability for systematic and realistic maintenance work planning by meeting internal preventative maintenance targets each month. CNSC staff conducted a review of CNLs overdue PMs in November 2016, focusing on the nature of the PM jobs being carried over month to month to confirm there are no safety significant implications. CNSC staff determined that safety significant work was carried out in a timely manner. The CNSC staff review found that though CNL will continue to have a number of overdue PMs, these overdue PMs are of negligible safety significance and CNL has made significant progress in minimizing the number of overdue PMs.

Additionally, CNL has made improvements in other aspects of this specific area such as the maintenance of master equipment lists, procurement of critical spare parts and the implementation of system health reporting for critical and non-critical systems of the NRU reactor.

Based on inspection results and reviews conducted of CNL submitted information, CNSC staff conclude that CNL has met and will continue to meet the regulatory requirements related to this specific area.

### **Aging Management**

The aging management program was revised since 2012 to align with CNSC requirements and to implement a full life-cycle approach to aging management.

CNL's system health reports document the status, reliability concerns and the proposed improvement actions of the most important systems in NRU reactor. The planned improvements are implemented during the NRU reactor outages. The status of NRU vessel aging management activities is reported annually in the update to the vessel fitness for service assessment report. The activities have included:

- The reduction of water and oxygen ingress into the J-rod annulus
- Improvements to the J-rod annulus carbon dioxide delivery system
- Laboratory corrosion testing to improve the understanding of factors that could contribute to vessel corrosion and better define corrosion rates
- Material testing to confirm the level of conservatism in the strength, ductility, fracture toughness and welding residual stress values used in the vessel structural integrity assessment
- Visual inspections and non-destructive wall thickness measurements of the vessel, which provide confirmation that activities to manage vessel corrosion are effective

CNSC staff have determined that site wide aging management of nuclear systems carries less safety significance than aging management of the NRU reactor due to the associated risks of the facilities involved. Across the site, CNL has identified which SSCs may be run to failure with no added risk to health and safety of workers and the public, or the environment. The remaining SSCs fall under the aging management programs and continue to be monitored by CNL for obsolescence. Additionally, CNL continues to carry out activities related to replacing and modernizing aging infrastructure.

Based on inspections and reviews conducted by CNSC staff conclude that CNL has implemented effective aging management strategies for the CRL site including the NRU vessel.

### **Structural Integrity**

Structural integrity of the majority of the fluid boundary components required for safe operation of the NRU reactor is confirmed via the CNL Periodic Inspection Programs (PIPs), which are discussed under the Periodic Inspection and Testing specific area. Based upon reviews of annual inspection reports and the licensee's dispositions of inspection findings, CNSC staff has concluded that CNL has adequately assessed the structural integrity of the fluid boundary components under the scope of the PIPs and determined that components remain fit for continued service.

To provide on-going confirmation of vessel structural integrity following the extensive repairs completed in 2009 and 2010 due to the vessel leak, CNL has implemented an NRU vessel in-service inspection program. The results of the vessel inspection program have been subject to regular CNSC staff review since 2011 along with a review of annual updates to the vessel fitness for service assessment report. Based on the inspection results obtained since 2011 there has been no observed degradation of the vessel that would reduce structural integrity margins assessed at the time of the vessel return to service.

Aside from the NRU reactor, fluid boundaries and civil structures present very little risk for the remainder of the CRL site with the exception of the Fissile Solution Storage Tank (FISST). While the aged condition of the FISST has been an area of focus for CNSC staff, based on ongoing CNSC staff inspections and review, there is no safety concern on a near term basis and CNL is engaged in a long term solution of emptying the FISST via repatriation to the United States.

Based on inspection results and desktop reviews of CNL submissions, CNSC staff conclude that CNL is taking appropriate action to ensure suitable structural integrity of the CRL site.

### **Chemistry Control**

CNL has implemented a chemistry control program which monitors and analyzes chemistry parameters to demonstrate compliance with limiting conditions for operation of NRU and the FISST.

Several NRU reactor systems are covered under CNL's chemistry control program. The frequency, chemistry specifications and sampling points are specified for each system. The goal of sampling is to ensure the systems are not subjected to degrading conditions and identification and monitoring of changes in chemistry control.

Additionally, CNL has established specifications and control methods for the FISST and diesel stockpile for emergency generator to ensure there is no degradation and to monitor changes. The contents of the FISST and the diesel stockpile are sampled frequently to ensure that they are within required specifications and no additional degradation has occurred.

Based on the performance of the chemistry control program, CNSC staff conclude that CNL has the appropriate oversight in place and continues to meet regulatory requirements for this specific area.

### **Periodic Inspection and Testing**

For CRL, the PIPs are applied only to the NRU reactor. PIPs are focused on the NRU fluid boundary components based on the guidance from CSA N285.4-05, *Periodic inspection and testing of CANDU pressure boundary components*. Since the NRU is not a CANDU reactor, a graded approach is used to adapt the CSA N285.4-05 program requirements to NRU systems.

CNL has implemented PIPs based on 6-year cycles with all in-scope components scheduled for inspection at least once in each cycle. During the early implementation stages, the licensee had challenges completing inspections on schedule and meeting program regulatory reporting requirements. Since 2012, CNL has made significant progress in regards to completing inspections according to the program schedule, revising and maintaining PIP documentation, improving program record keeping and regulatory reporting.

Based on recent performance, CNSC staff conclude that CNL has the appropriate program oversight in place to continue to meet regulatory requirements for this specific area.

### **3.6.3.2 Regulatory Focus**

Previously, CNSC staff focused on the Fitness for Service of the NRU reactor. As the NRU reactor progresses through the stages from operation to shutdown then storage with surveillance, the focus of CNSC staff related to the Fitness for Service SCA will change significantly.

As the NRU reactor is shutdown, defueled and dewatered, the scope of programs related to Fitness for Service will be adjusted to focus CNL attention where there is safety benefit. CNSC staff oversight activities will continue to monitor the adjustments by CNL to ensure they are made in accordance with regulatory requirements.



CNL will continue to be required to ensure the operability of all applicable facilities, systems, structures and components on site. CNSC staff will continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation.

### **3.6.3.3 Proposed Improvements**

After the NRU reactor is shut down, CNL plans to maintain the fitness for service program for the remaining CRL facilities and utilize the outputs to continue improvement of equipment reliability.

CNL plans to continue to assess the applicability of the structural integrity and chemistry control programs to other existing and new facilities at CRL and maintain these programs as appropriate. Additionally, critical equipment of CRL facilities will continue to be assessed against the requirements of aging management and obsolescence management applying a risk informed approach.

CNL has planned a number of site wide infrastructure improvements, including removal of aging facilities and replacement or upgrade of shared site-wide systems.

### **3.6.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain effective fitness for service programs at CRL in accordance with regulatory requirements.

### **3.6.5 Recommendation**

One licence condition is included in the proposed licence for this SCA. Licence condition 6.1 requires CNL to implement and maintain a fitness for service program. Compliance verification criteria for this licence condition are included in the draft LCH.

## **3.7 Radiation Protection**

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

The specific areas that comprise this SCA at CRL include:

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

### 3.7.1 Trends

The following table indicates the overall rating trends for the Radiation Protection SCA over the current licensing period:

TRENDS FOR RADIATION PROTECTION					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Radiation Protection performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.7.2 Discussion

The *Radiation Protection Regulations* require licensees to establish a radiation protection program to keep exposures ALARA, taking social and economic factors into account, through the implementation of a number of control programs, including:

- management control over work practices
- personnel qualification and training
- control of occupational and public exposures to radiation
- planning for unusual situations

During the current licensing period, CNL has implemented an RP program at CRL that protected the health and safety of persons and ensured occupational exposures were below regulatory dose limits and maintained ALARA.

CNSC staff conclude that CNL's Radiation Protection SCA at CRL met all applicable regulatory requirements and CNSC expectations. CNSC staff are satisfied that licensed activities at CRL are conducted in a safe manner.

### 3.7.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration CNSC staff's assessment in all specific areas included for CRL within this SCA.

#### 3.7.3.1 Past Performance

##### Application of ALARA

CNL has a documented ALARA program which identifies the strategies and processes in place at CRL to control dose and minimize exposures. This program integrates ALARA into design, planning, management and control of radiological activities, and is based on current industry best practices and operating experience.

CNL's application of ALARA within the RP program includes management commitment and oversight, personnel qualification and training, design analyses of facilities and systems, provision of protective equipment and clothing, and ALARA assessments and reviews of radiological activities.

Key performance indicators for parameters such as the number of workers receiving doses above the dose limits and/or above the action levels, number of unposted hazards and number of personnel skin contamination are used by CNL to demonstrate the effectiveness of the RP program.

In addition, radiological work assessments and radiological work plans/procedures are used to demonstrate that work activities at CRL are consistent with the ALARA principle. These documents incorporate radiological control hold points, expected individual and collective doses, and control measures.

CNSC staff are satisfied with the implementation of CNL's RP program at CRL, and confirm that the program meets all applicable regulatory requirements and expectations related to the application of ALARA.

### **Worker Dose Control**

The RP program at the CRL has been effectively implemented to ensure doses received by workers are controlled, monitored and maintained well below regulatory limits.

CNL operates a CNSC licensed dosimetry service to monitor, assess, record and report doses received by employees and contractors as a result of licensed activities at the CRL. The available types of dosimetry, as well as the criteria and procedures for use are implemented through the RP program. The implementation of the RP program relating to personnel dosimetry meets CNSC regulatory requirements and is found to be satisfactory.

At CRL, workers, including CNL employees and contractors conducting work activities which present a reasonable probability of receiving an occupational dose greater than 1 millisievert (mSv)/year are considered Nuclear Energy Workers (NEWs). Workers, whose job functions do not present a reasonable probability of receiving an occupational dose greater than 1mSv/year, are considered non-NEWs.

During the period from January 1, 2012 to June 30, 2017, no radiation exposures reported at the CRL site exceeded a regulatory dose limit for a NEW:

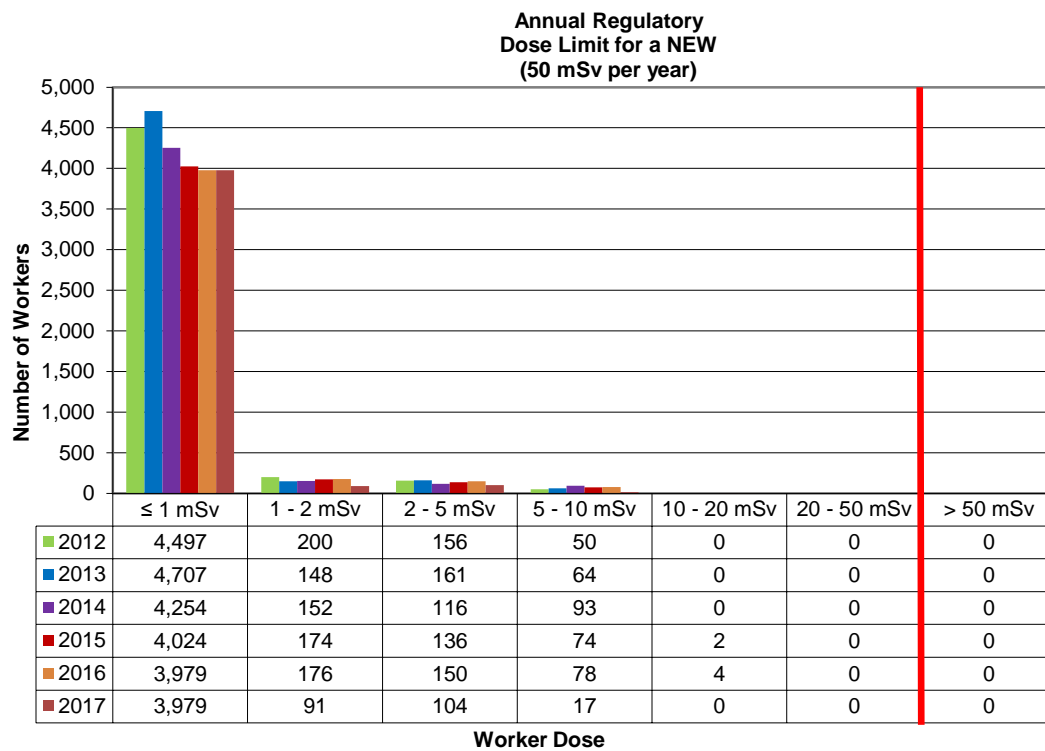
- the maximum annual effective dose received by a NEW over this period was 12.24 mSv (approximately 24% of the annual 50 mSv dose limit). This dose was received in 2016 by a nuclear operator of the NRU reactor.
- the maximum equivalent (skin) dose received by a NEW over this period was 21.73 mSv (approximately 4% of the annual 500 mSv dose limit). This dose was received in 2014 by a nuclear operator of the NRU reactor.

- the maximum equivalent (extremity) dose received by a NEW over this period was 72.10 mSv (approximately 14% of the annual 500 mSv dose limit). This dose was received in 2013 by a radiation surveyor trainee working in the Molybdenum-99 Production Facility.
- the maximum individual effective dose received by a NEW during the 5-year dosimetry period of 2011 – 2015 was 37.78 mSv (38% of the 100 mSv per 5-year dose limit) by a nuclear operator of the NRU reactor.

During the period from January 1, 2012 to June 30, 2017, no radiation exposures reported at the CRL site exceeded a regulatory dose limit for a non-NEW. From January 1, 2012 to June 30, 2017, effective dose was assessed for approximately 10,500 non-NEWs. The maximum effective dose received by a non-NEW was 0.49 mSv per year or approximately 49 percent of the regulatory limit for effective dose of 1 mSv in a one-year dosimetry period.

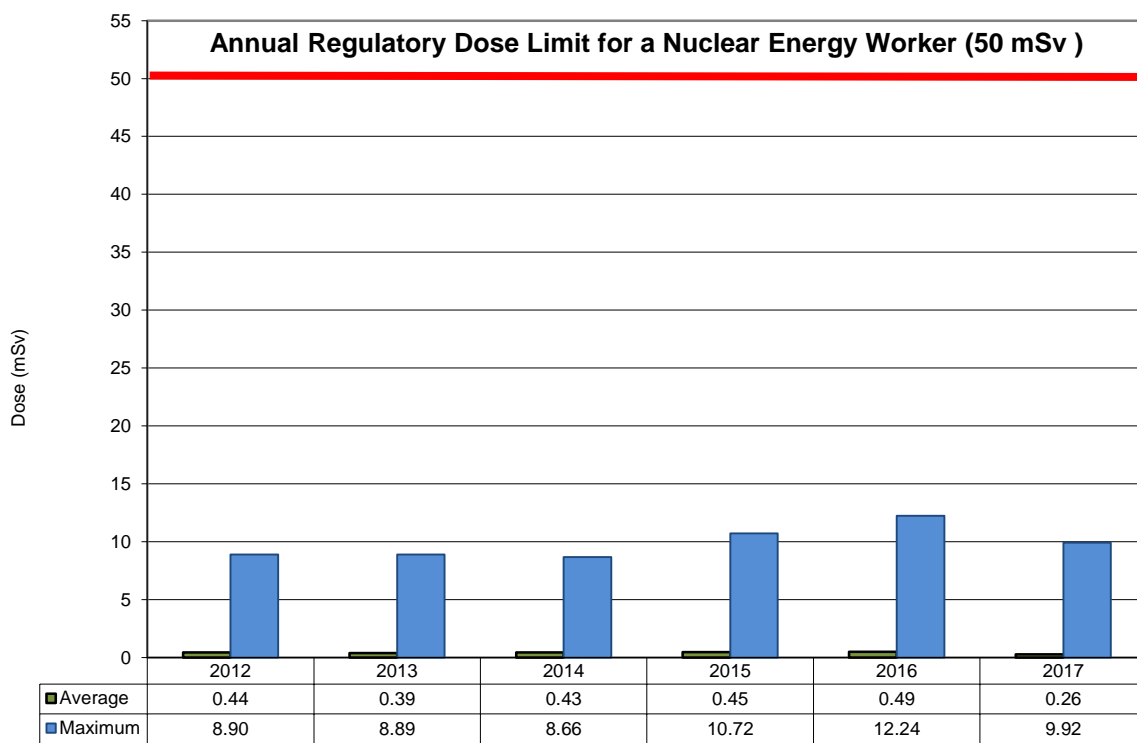
Figure 3 illustrates the distribution of annual effective doses to CNL-CRL's workers for the years 2012 – 2017 while figure 4 illustrates the average and maximum effective doses to CNL-CRL's workers for the years 2012 – 2017. Annual average and maximum equivalent (extremity and skin) doses for the years 2012 – 2017 are provided in tables 6 and 7, respectively.

The average and maximum effective and equivalent doses, along with the effective dose distribution data demonstrate that CNL-CRL is maintaining control over worker exposures; on average, approximately 92% of the monitored workers received less than 1 mSv of effective dose per year for January 1, 2012 to June 30, 2017.

**Figure 3: Effective dose distribution to CNL-CRL workers from 2012 to 2016**

**Note: 2017 figures are based on half year data to July 15, 2017.**

**Figure 4: Average and maximum effective doses to CNL-CRL workers from 2012 to 2017**



Note 1: average dose values are based on the non-zero dose results.

Note 2: 2017 is based on half year data to June 30, 2017.

**Table 6: Extremity doses to CNL-CRL's workers from 2012 to 2017**

Dose Statistic	2012	2013	2014	2015	2016	2017	Annual Regulatory Dose Limit for a NEW
Average extremity dose in mSv	2.43	2.73	3.26	2.84	3.71	4.76	500 mSv/yr
Maximum extremity dose in mSv	18.53	72.10	22.50	29.32	41.59	75.43	

\*2017 data covers period from January 1, 2017 to July 15, 2017

**Table 7: Skin doses to CNL-CRL's workers from 2012 to 2017**

Dose Statistic	2012	2013	2014	2015	2016	2017	Annual Regulatory Dose Limit for a NEW
Average skin dose in mSv	0.50	0.46	0.53	0.55	0.60	0.31	500 mSv/yr
Maximum skin dose in mSv	12.23	13.08	21.73	15.75	16.54	14.33	

\*2017 data covers period from January 1, 2017 to July 15, 2017

Note: The 273 mSv skin dose received in 2011 and the 62 mSv skin dose received in 2016 from the events discussed in the section entitled *Radiation protection program performance* are excluded from the table.

CNSC staff are satisfied with the implementation of CNL's RP program at CRL, and confirm that the program meets all applicable regulatory requirements and expectations related to worker dose control.

### **Radiation Protection Program Performance**

CNL has effectively implemented the RP program at the CRL site. This program satisfies the requirements of the *Radiation Protection Regulations* and includes a number of performance indicators to continuously monitor RP program performance.

In 2016, CNL began revising RP documentation in order to reflect and support the radiological activities performed at all CNL sites and to harmonize it with CNL's revised company-wide management system.

CNL has established action levels for effective dose, equivalent dose, internal exposure and skin exposure due to a skin contamination event. If any of the action levels are reached or exceeded, CNL must notify the CNSC staff and conduct an investigation of the circumstances so that corrective actions can be taken well before a regulatory dose limit is exceeded.

Since 2012, one action level exceedance for skin exposures from contamination was reported by CNL. No regulatory dose limit was exceeded but, a worker received an equivalent (skin) dose in excess of the action level of 50mSv/event.

The exceedance occurred in 2016, as a result of a local skin exposure due to contamination on the neck of a worker in the NRU facility, which resulted in a skin dose of 62 mSv, below the equivalent regulatory dose limit to the skin for a nuclear energy worker of 500 mSv per year.

As required by the *Radiation Protection Regulations*, for both events, CNL conducted an investigation and completed several corrective actions in the areas of equipment design, work practices and contamination control. In each case, the affected workers did not have and are not expected to have any health effects as a result of the localized exposure to the skin. Based on the result of the investigations and compliance verification, CNSC staff concluded that CNL has taken appropriate measures to prevent reoccurrence.

CNSC staff are satisfied with the implementation of the RP program at the CRL. The program meets regulatory requirements and adequate oversight is being applied by the licensee to monitor the implementation and the performance of the RP program.

### **Radiological Hazard Control**

CNL's radiation protection program ensures there are adequate measures in place to monitor and control radiological hazards. This includes, but is not limited to: contamination control, radiation dose rate control, and airborne monitoring and control.

Contamination control at the CRL ensures contamination is prevented from leaving radiologically controlled areas, and the spread of contamination within these areas is minimized. This is achieved by establishing radiological zones with prescribed contamination limits, classifying areas according to their radiation hazard potential, restricting access to authorized personnel, ensuring each radiological area is posted, routine monitoring of workplaces for contamination, minimizing contamination levels, and monitoring personnel and material prior to leaving contaminated or potentially contaminated areas.

In 2014, CNL proposed to change the way in which the CRL site was organized and controlled. Based on historic approaches implemented prior to 2014, personal dosimetry and RP controls were required to access the administrative buildings and other areas which were at background radiation levels. Following careful review of CNL's proposal to redefine the CRL site for a more risk-informed approach to access controls and required dosimetry, CNSC staff accepted the change. The new CRL site design facilitates access of persons to radiologically safe and stable areas of the site and has programmatic provisions in place to estimate doses to persons in select areas.

CNSC staff are satisfied with the implementation of CRL's radiation protection program at CRL, and the program meets all applicable regulatory requirements and expectations related to radiological hazard control.

### **Estimated Dose to the Public**

CNL implements an environmental program to prevent the uncontrolled release of contaminants or radioactive materials from the site.

Table 8 provides doses to the public at CRL over the since 2012.



**Table 8: Maximum Effective Dose to a Member of the Public from 2012 to 2017**

MAXIMUM EFFECTIVE DOSE TO A MEMBER OF THE PUBLIC							
Dose Statistic	2012	2013	2014	2015	2016	2017	Annual Regulatory Limit for a Member of the Public
Maximum Effective Dose <sup>1</sup> (mSv)	0.063	0.064	0.081	0.081	0.064	0.049	1mSv/year

<sup>1</sup> Maximum dose to a member of the public is based on all radioactive releases from CRL

The maximum dose of 0.081 mSv/year (81  $\mu$ Sv/year) occurred in 2014 and 2015, and represents approximately 8% of the dose limit of 1 mSv/year (1000  $\mu$ Sv/year). The contributions to the public dose from all operations at the CRL site are well below the CNSC dose constraint set by the Commission of 0.3 mSv/year and the regulatory dose limit of 1mSv/year.

The NRU reactor and Molybdenum-99 production facility together account for about 97% of all CRL radioactive releases. CNSC staff expect that the maximum dose to a member of a public will decrease significantly after NRU reactor shutdown and permanent end of Mo-99 production.

### 3.7.3.2 Regulatory Focus

Since 2012, CNL focused on monitoring and improving the radiation protection program documentation. In the coming years, several buildings and facilities at CRL are scheduled for decommissioning and/or reuse and purpose of the buildings and facilities will change. CNSC staff will continue to evaluate the processes used by CNL to verify that the protection of the workers is optimized and that the radiological exposures remain ALARA. As CNL updates the RP program, CNSC staff conduct desktop reviews to ensure the requirements of the *Radiation Protection Regulations* continue to be met.

### 3.7.3.3 Proposed Improvements

Amendments to the *Radiation Protection Regulations* were proposed in 2013 in order to harmonize the Regulations with updated international standards, clarify requirements and address gaps based on lessons learned since the regulations came into force. As the regulations are amended, CNL will review the RP program to ensure continued compliance with the revised regulations.

CNL will continue to update radiation protection documentation in response to changes in future work planned at CRL. As many facilities and buildings are planned to be decommissioned and/or repurposed, CNL will continue to re-evaluate the radiological hazards in these areas to ensure the workers' protection is optimized.

CNSC staff continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and reviews of relevant program documentation.

### 3.7.4 Conclusion

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain an effective radiation protection program at CRL in accordance with regulatory requirements.

### 3.7.5 Recommendation

One licence condition is included in the proposed licence for this SCA. Licence condition 7.1 requires CNL to implement and maintain a radiation protection program which includes a set of action levels. Compliance verification criteria for this licence condition are included in the draft LCH.

## 3.8 Conventional Health and Safety

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

The specific areas that comprise this SCA at CRL include:

- Practices
- Awareness
- Performance

### 3.8.1 Trends

The following table indicates the overall rating trends for the Conventional Health and Safety SCA over the current licensing period:

TRENDS FOR CONVENTIONAL HEALTH AND SAFETY					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continue to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Conventional Health and Safety performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30

### 3.8.2 Discussion

CNL has implemented and maintains a conventional health and safety program to manage workplace safety hazards and to protect personnel and equipment. CNSC staff conclude that CNL's Conventional Health and Safety SCA at CRL met all applicable regulatory requirements and CNSC expectations.

### 3.8.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA.

#### 3.8.3.1 Past Performance

##### Practices

In addition to the NSCA [3] and its associated regulations, CNL's activities must comply with Part II: *Occupational Health and Safety* of the *Canada Labour Code* [28], its *Canada Occupational Health and Safety Regulations*, and other applicable federal and provincial health and safety acts and regulations.

CNL's occupational health and safety program applies to all work performed by CNL employees, and to work performed by others on sites and work places controlled by CNL. The occupational health and safety program covers over 40 documented processes on the various aspects of conventional health and safety. Under this program, CNL conducts approximately 200 health and safety inspections every year. The majority of findings are minor non-compliances with codes and standards or CNL governing documents. Several CNL self-assessments are conducted annually and actions resulting from the self-assessments are managed and tracked to completion through CNL's corrective actions program.

CNSC staff verified CNL safety practices during compliance inspections and site walk downs. CNSC staff are satisfied with CNL's performance at CRL in the aspects related to conventional health and safety.

##### Awareness

CNL actively promotes conventional health and safety through the provision of information, training, instructions, and supervision. Employees are encouraged to participate, and to report concerns (e.g., unsafe conditions, non-compliances, or events) in order to identify hazards and ensure measures are put in place to prevent injury and illness.

Since 2012, CNL improved aspects of the conventional health and safety program based on industry best practices and the results of internal focused audits, self-assessments, effectiveness reviews and health and safety inspections.

The findings from these reviews, audits, inspections and self-assessments resulted in internal actions being raised to improve site wide health and safety performance. These internal actions focused on continuing to increase awareness of occupational hazards and the potential for injury to workers, as well as on methodologies to reduce the frequency of occurrence.

CNSC staff monitors CNL employee reports of safety concerns through the initiation of ImpActs as stated in section 3.1.3.1. CNSC staff are satisfied with CNL's promotion of health and safety awareness at CRL.

## Performance

The key performance indicators for conventional health and safety are the number of recordable lost-time injuries (RLTI) that occur per year, RLTI severity and RLTI frequency. An RLTI is defined as an injury that takes place at work, and results in the worker being unable to return to work and carry out their duties for a period of time. The RLTI frequency and RLTI severity are both based on 100 full time workers (100 FTE = 200,000 hours worked).

$$RLTI \text{ frequency} = 200,000 \text{ hrs} \times \frac{\# \text{ of lost time injuries}}{\text{person hours worked}}$$

$$RLTI \text{ severity} = 200,000 \text{ hrs} \times \frac{\# \text{ of working days lost}}{\text{person hours worked}}$$

Data on RLTI, RLTI Frequency and RLTI Severity since 2012 is included in table 9 below.

**Table 9: Recordable lost-time injuries (RLTI), frequency and severity at CRL**

Year	RLTIs	RLTI Frequency	RLTI Severity
2012	21	0.68	5.65
2013	18	0.56	2.68
2014	9	0.29	1.18
2015	2	0.06	0.22
2016	6	0.19	1.47
2017 <sup>1</sup>	1	0.05	0.09

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.8.3.2 Regulatory Focus

CNSC staff will continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant program documentation.

CNSC staff will focus regulatory oversight in this area on the construction, operation, decommissioning and demolition activities planned by CNL. As the CNL occupational health and safety program is updated, CNSC staff conduct desktop reviews to ensure regulatory requirements continue to be met.

### 3.8.3.3 Proposed Improvements

CNL's plans for the next licence period in this SCA include

- Integration of conventional health and safety in all planning cycles

- Enhancement of methods to collect and evaluate contractor safety performance information, and use of this information as an input for future procurement decisions
- Implementation of a software to support the workplace hazardous materials information system and manage chemical inventories
- Establishment and maintenance of an ISO standard certification once ISO 45001, *Occupational health and safety management system*, is issued

### **3.8.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain an effective conventional health and safety program at CRL in accordance with regulatory requirements.

### **3.8.5 Recommendation**

One licence condition is included in the proposed licence for this SCA. Licence condition 8.1 requires CNL to implement and maintain a conventional health and safety program. Compliance verification criteria for this licence condition are included in the draft LCH.

## **3.9 Environmental Protection**

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

The specific areas that comprise this SCA at CRL include:

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

### 3.9.1 Trends

The following table indicates the overall rating trends for the Environmental Protection SCA over the current licensing period:

TRENDS FOR ENVIRONMENTAL PROTECTION					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude that CNL's Environmental Protection performance meets regulatory requirements.					

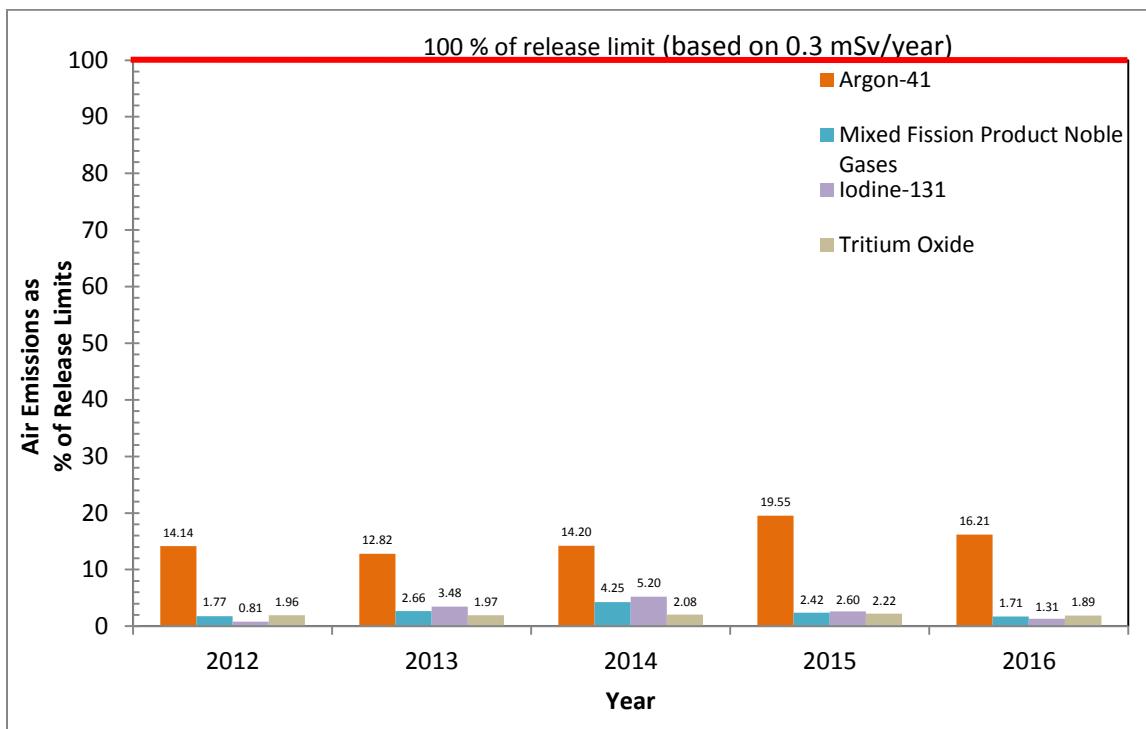
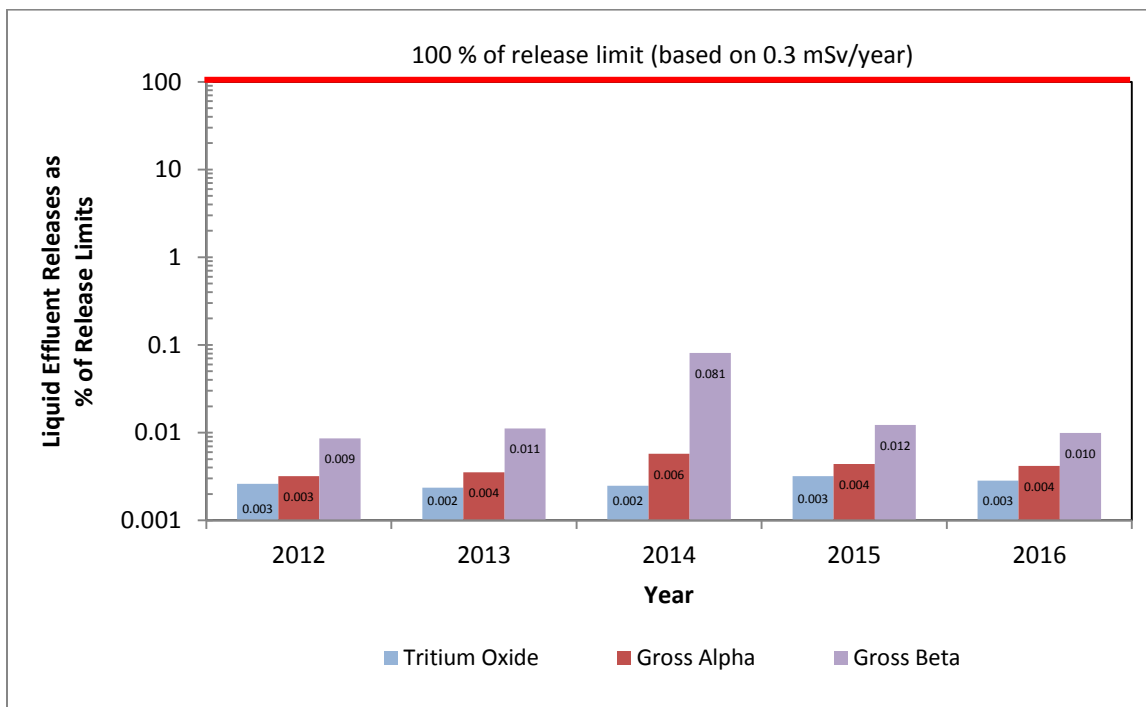
<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.9.2 Discussion

CNL's environmental protection program includes policies, work instructions, methods and procedures to identify, control and monitor releases of nuclear and hazardous substances from CRL facilities into the environment, and to protect the health and safety of people and the environment.

An EA under the NSCA [3] was conducted for CRL and the CNSC EA Report is attached as Addendum E.

The Commission introduced annual liquid and airborne effluent release limits for CRL in 2011. These limits are based on a dose constraint limit of 0.3 mSv per year to the critical group from the sum of all releases from CRL. Since 2012, reported radiological and non-radiological releases at CRL have remained below their respective regulatory limits. Figures 5 and 6 provide additional data on airborne and liquid environmental releases from CRL, respectively.

**Figure 5: CRL airborne nuclear substance releases (2012-2016)****Figure 6: CRL liquid nuclear substance releases (2012-2016)**

Note: Graph uses logarithmic scale.

Since 2012, CNL has demonstrated compliance with CSA N288.4, *Environmental monitoring programs at class I nuclear facilities and uranium mines and mills*, CSA N288.5, *Effluent monitoring programs at class I nuclear facilities and uranium mines and mills* and CSA N288.6, *Environmental risk assessments at class I nuclear facilities and uranium mines and mills*.

The CNSC staff review of CNL's submissions indicates that CNL continues to maintain an environmental protection program that complies with applicable regulatory requirements.

### 3.9.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA.

#### 3.9.3.1 Past Performance

##### Effluent and Emissions Control (Releases)

CNL has implemented and maintained an effluent verification monitoring program at CRL. CNL's reported radiological and non-radiological releases at CRL during the licensing period have remained below their respective regulatory limits. CNL completed the implementation of CSA N288.5, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* in December 2013.

In 2015, CNSC staff conducted a review of this program and concluded that the control, monitoring and reporting of releases at CRL are adequate and in compliance with regulatory requirements. In 2016, CNSC staff conducted an inspection of CNL's environmental protection program focused on airborne and liquid effluent verification monitoring. CNSC staff found no items of non-compliance.

An action level is a performance indicator that is used to inform both the licensee and regulator of a potential reduction in effectiveness of the environmental protection program by indicating a potential deviation from normal operation. CNSC staff note that exceeding an action level is not a non-compliance as they are expected to occur.

In 2013, CNL had a number of action level exceedances related to single I-131 incidence which was previously presented to the Commission in the CNL performance update [11]. In both 2014 and 2016, CNL reported two action level exceedances. These action level exceedances did not result in an exceedance of regulatory limits for worker dose or environmental releases. For each exceedance, CNL took appropriate action by notifying the Commission, conducting an investigation, and implementing suitable corrective actions to restore the effectiveness of the program. CNSC staff are satisfied with CNL's responses. CNL continues to make adequate measures to protect the environment.



Based on review and assessment of the results presented in CNL reports and compliance verification activities, CNSC staff conclude that the effluent verification monitoring program currently in place for CRL continues to provide adequate protection of the environment.

### **Environmental Management System (EMS)**

CNL has established and implemented an EMS for CRL which assesses environmental risks associated with its nuclear activities to ensure these activities are conducted in a way that prevents or mitigates adverse environmental effects.

CNSC staff reviewed the CNL EMS and concluded that the CNL EMS is integrated into the CNL Management System, and meets the applicable requirements of the CNSC REGDOC 2.9.1, *Environmental Protection Policies, Programs and Procedures*. Additionally, the CNL EMS is registered to the CSA ISO 14001: 2004 Standard, *Environmental Management Systems – Requirements with Guidance for Use*.

### **Assessment and Monitoring**

CNL maintains a comprehensive environmental monitoring program (EMP) for CRL to verify that radiation doses to members of the public as a result of radioactive releases from the CRL site remain ALARA, social and economic factors being taken into account. CNL completed the implementation of CSA N288.4, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* in May 2013.

The objectives of CNL's EMP include:

- Assessment of the risk on human health and safety, and the potential biological effects in the environment of the contaminants and physical stressors of concern arising from the facility
- Demonstration of compliance with limits on the concentration and/or intensity of contaminants and physical stressors in the environment or their effect on the environment
- Independent verification of effluent monitoring, the effectiveness of containment and effluent control, and provision of public assurance of the effectiveness of containment and effluent control
- Refinement and verification of predictions made by other sources such as an environmental risk assessment (or equivalent), Derived Release Limit (DRL) model, and Environmental Assessments (EA)
- Generation of data to inform site restoration programs, site operations, future planning (e.g., decommissioning), and accident response and recovery

CNL provides EMP results in annual reports submitted to CNSC staff to confirm compliance with applicable regulatory requirements. CNSC staff's review of the CNL EMP results since 2012 indicate that the concentration of radionuclides in the environment resulted in very low levels of dose to the public. The estimated maximum effective radiation dose to the public from CRL operations continues to be well below regulatory dose limit of 1mSv/year and the dose to public from the sum of all releases from CRL in licensing period did not exceed 0.3 mSv per year (dose constraint). Further information on the estimated dose to the public is presented in section 3.7.3.1 of this CMD.

#### Groundwater Monitoring

CNL's groundwater monitoring program (GWMP) uses groundwater monitoring wells located throughout the CRL site. Groundwater from these wells is sampled on an annual or semi-annual frequency and analyzed for various radionuclides. The radioactive and non-radioactive contaminants that appear in groundwater downgradient of the CRL waste management areas (WMAs) and other sites subject to groundwater monitoring are the result of legacy waste storage practices that did not provide sufficient containment relative to the current practices at the site. The following paragraphs highlight these key areas.

Through review of CNL's submitted results, CNSC staff verified that there was a significant decrease in tritium concentrations in groundwater immediately downgradient of WMA-C. This result is reflective of the improvements made at CRL as well as decay and dispersion of tritium in the groundwater.

CNSC staff's review also found a decrease in groundwater tritium concentrations in the NRU rod bay plume. This decrease followed the replacement of the bay water in 2012, with decreases in the flux of tritium discharged to the Ottawa River from groundwater.

There is some gradually increasing concentration of tritium at some locations in the southern and southeastern region of WMA-B. The increasing trend is an indication of plume migration rather than new sources of tritium into the ground. CNSC staff will continue to monitor CNL's results of the GWMP in this area.

NRX has a rod bay that was used for spent fuel storage and previously leaked, producing a plume of tritium and Sr-90 which discharges to the Ottawa River via groundwater and a storm sewer.

The bays have been out of service since 1993 and have been emptied of all fuels and other materials since 1995. Tritium inputs to the NRX bays were removed in 2000 and tritium effectively disappeared from the plume flow path in 2003. The leaking portions of the NRX bays were entirely drained in 2006.

CNL completed the field work related to the NRX Rod Bay plume update in 2015 and produced a report in 2016. CNSC staff reviewed this report and are satisfied that CNL has sufficiently addressed the issues in this area. Although the plume does not pose a significant risk to human health and the environment, CNSC staff will continue to monitor CNL's results of the GWMP in this area. CNSC staff have no concern in this area and will continue to monitor CNL's results of the GWMP in this area.

Additional information on groundwater monitoring is provided in the EA Report, in Addendum E.

#### Other Monitoring

To complement ongoing compliance activities, the CNSC has implemented its Independent Environmental Monitoring Program (IEMP) at the CRL site. The IEMP results verify that the public and the environment in the vicinity of the CRL are protected. The IEMP results for CRL are published on the CNSC's website. Additional IEMP information is provided in the EA Report (Addendum E).

Additionally, other monitoring initiatives also occur in the area around the CRL site including the Minister of Ontario Environment and Climate Change Drinking Water Surveillance Program and the Health Canada Radiation Monitoring Network, along with a Fixed Point Surveillance system. Further discussion and information on these monitoring programs are provided in the EA Report (Addendum E). These programs provide further confirmation that the environment around the CRL site is safe and protected from releases from the CRL site.

#### **Protection of the Public**

CNSC staff review of the results of CNL's non-radiological effluent verification monitoring program found that there were no licence limits exceedances and the controls for the release of potentially hazardous substances currently in place at CRL, either through treatment systems or procedures, continue to provide adequate protection to the environment.

#### **Environmental Risk Assessment**

An environmental risk assessment (ERA) is prepared by licensees and is a systematic process used to identify, quantify and characterize the risk posed by contaminants and physical stressors in the environment on biological receptors, including the magnitude and extent of the potential effects associated with the facility. The objectives of the ERA are to evaluate the risk to relevant human and non-human biota receptors resulting from exposure to contaminants and stressors related to the site and its activities, and to recommend further action or assessment based on the results. The ERA is reviewed on a five-year cycle or when major changes occur to facilities on site.

CNL submitted an ERA in December 2013, based on environmental data collected prior to 2012. CNSC staff reviewed the ERA and confirmed that it met the requirements outlined in CSA standard N.288.6, *Environmental Risk Assessment at Class I Nuclear Facilities and Uranium Mines and Mills*. From the review, CNSC staff identified three key topics:

- fish impingement and entrainment at the NRU cooling water intake
- chimney swift nesting and roosting at the CRL site
- remediation of a riverbed sediment from a small area of Ottawa River exposed to historical releases from the NRX reactor which has since been shut down

*Fisheries Act* [29] considerations regarding impingement and entrainment are discussed further in section 4.7. With respect to the NSCA [3], CNSC staff have concluded that there is no unreasonable risk to fish populations from impingement and entrainment.

There were concerns regarding dose to chimney swifts from exposure to noble gases, and potential impact on the stack where some individuals are nesting and roosting. In September 2017, CNL submitted a synopsis of the revised dose assessment for chimney swifts which showed that potential dose to this species is well below the UNSCEAR radiological dose screening benchmark for terrestrial organisms, and therefore radionuclides pose a negligible risk to this species. CNL has subsequently submitted additional information supporting these dose estimations. CNSC staff are currently reviewing the additional information submitted by CNL. CNSC staff will provide an update to the Commission at the hearing in January 2018.

CNL submitted a remediation option assessment in 2016 which identified natural attenuation with monitoring of the contaminated sediment as a remedial measure for the contaminated riverbed sediment. CNSC staff reviewed this assessment using federal government guidance for the assessment of alternatives and concluded that it was acceptable. CNSC staff also determined that monitoring of natural recovery of the riverbed sediment was an acceptable option given that the localized contaminated sediment in the Ottawa River posed a low risk to people and the environment.

CNSC staff reviewed the ERA for the CRL site and based on the outcomes of that review, conclude that CNL has taken adequate measures to protect the public and the environment. Current risks to humans and the environment as a result of CRL operations are also determined to be low.

### **3.9.3.2 Regulatory Focus**

CNSC staff will continue to monitor CNL's performance in this SCA through regulatory oversight activities including onsite inspections and desktop reviews of relevant environmental protection program documentation.

### **3.9.3.3 Proposed Improvements**

During the proposed licence period, CNL has committed to plans for improvement for CRL environmental protection program through:

- implementation of CSA N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills*;
- implementation of CSA N288.8-17, *Establishing and implementing action levels for releases to the environment from nuclear facilities*;
- update of the environmental risk assessment for CRL as per the five-year cycle; and
- a major project for disposal of radioactive waste at CRL.

### 3.9.4 Conclusion

Based on CNSC staff assessments of CNL's safety and control measures at CRL regarding the elements of the Environmental Protection SCA and review of CNL's licence application, supporting documentation and past performance, CNSC staff conclude that there are no significant concerns related to the protection of health and safety of persons and the environment. CNL continues to maintain and implement an effective environmental protection program at CRL in accordance with CNSC requirements.

### 3.9.5 Recommendation

One licence condition is included in the proposed licence for this SCA. Licence condition 9.1 requires CNL to implement and maintain an environmental protection program. Compliance verification criteria for this licence condition are included in the draft LCH.

## 3.10 Emergency Management and Fire Protection

The emergency management and fire protection SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions.

The specific areas that comprise this SCA at CRL include:

- Conventional Emergency Preparedness and Response;
- Nuclear Emergency Preparedness and Response; and
- Fire Emergency Preparedness and Response.

### 3.10.1 Trends

The following table indicates the overall rating trends for the Emergency Management and Fire Protection SCA over the current licensing period:

TRENDS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<p style="text-align: center;"><b>Comments</b></p> <p>CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude CNL's Emergency Management and Fire Protection performance meets regulatory requirements.</p>					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.10.2 Discussion

The current licence requires CNL to implement and maintain an emergency preparedness program and conduct exercises. The approach to Emergency Preparedness and Fire Protection for the CRL site is based on a combination of detailed planning and hazard identification and risk assessments at all facilities. CNSC staff have assessed that CNL continues to meet regulatory requirements and is performing satisfactorily with respect to this SCA.

### 3.10.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA.

#### 3.10.3.1 Past Performance

##### Nuclear Emergency Preparedness and Response

To evaluate the emergency preparedness of a licensee, CNSC staff assess the licensee emergency plan and preparedness program as well as the results of emergency exercises. Emergency preparedness at CRL is governed by the CNL document CRL-508730-ERP-001, *Chalk River Laboratories Site Emergency Response Plan*. The CRL Site Emergency Response Plan deals with emergency situations involving releases of radioactive materials that endanger the safety of onsite staff, the environment and the public, and outlines the interfaces with the Provincial Nuclear Emergency Response Plan.

CNSC staff have reviewed the Site Emergency Response Plan and concluded it meets the current regulatory requirements and expectations as contained in CNSC REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*, version 2.

Over the current licensing period, CNSC staff have verified CNL implementation of a number of initiatives pertaining to this SCA, including:

- Upgrades in the CRL Emergency Management Operations Center including enhancements to communications equipment, visual displays and furniture
- Enhancements to its Command and Control Structure by adopting the Ontario Provincial Incident Management System to ensure interoperability and use of consistent terminology
- Installation of an automated near boundary radiation monitoring system around the site boundary to provide real-time radiation measurement
- Use of WebEOC, a web based tool for information sharing and capturing during emergency and other events
- Successful completion in 2015 of KI distribution within the Primary Zone and stockpiling of KI in the Secondary Zone
- Construction of sirens within the Primary Zone (7 sirens in Laurentian Hills and 1 siren in Deep River)

- Acquiring portable Emergency Mitigation Equipment and infrastructure to ensure water and power can be supplied in an emergency situation
- Participation in and conduct of major exercises over the current licensing period

CNSC staff have performed emergency preparedness inspections over the licensing period with no outstanding items of noncompliance.

### **Fire Emergency Preparedness and Response**

The CNL CRL fire emergency preparedness and response program identifies how fire response is achieved on the site. CNL's fire response program meets regulatory requirements.

Over the current licensing period, performance of the industrial fire brigade (IFB) has been enhanced by using the outcomes of training and drills to evaluate the effectiveness of the fire response which improves operations on the fire ground. CRL also trains and drills with its mutual aid partners (Laurentian Hills and Deep River fire departments) thus ensuring seamless integration and interoperability when they arrive on site. The IFB has also changed its response structure to ensure the presence of a Platoon Chief, Captain, and 6 firefighters on every shift.

During the current licensing period, CRL has carried out significant physical and programmatic fire protection upgrades, including the following:

- Implementing an enhanced medical and job-physical testing program for all IFB members
- Revisions to the firefighter training program and the drill program to ensure all competencies for firefighting are maintained
- Construction and use of a Live Fire Fighting Training facility

CNSC staff have carried out inspections over the current licensing period and observed that firefighting skills and competencies were being maintained through the drill, education and training program. All firefighting equipment is well maintained and in good condition. The fire response program at CRL meets regulatory requirements.

### **Conventional Emergency Preparedness and Response**

CNL continues to maintain effective conventional emergency response programs. Emergency response personnel are available on site 24 hours a day to respond to any type of emergency. Training and equipment continue to be maintained for medical response, hazardous materials and other conventional hazards that may be present. CNSC staff conclude CNL's conventional emergency response programs meet regulatory requirements.

#### **3.10.3.2 Regulatory Focus**

CNSC staff will continue to monitor CNL emergency response programs and their performance in drills and exercises to ensure continuous learning and improvement, are maintained in CNL's emergency response capabilities.

CNL continues to demonstrate it has satisfactory emergency preparedness and fire protection programs. CNL has enhanced its emergency preparedness and response capabilities by using lessons learned from the Fukushima event and OPEX from its industry peers.

CNSC staff will continue with focus on the site emergency plan during regular compliance activities to ensure the plan remains scalable and flexible to respond to any emergency at site and changing infrastructure at site.

### **3.10.3.3 Proposed Improvements**

CNL will continue to implement emergency preparedness improvements as new needs arise and good practices are identified. Some of the proposed activities are:

- Testing and maintenance of contingency plans developed in accordance with the results of the hazard identification and risk assessment
- Implementation of a company-wide business continuity management program to enhance organizational resiliency. This aspect of the program will apply to a wide range of events including loss of information, loss of buildings, or loss of staff

### **3.10.4 Conclusion**

CNL has sufficient provisions in place for emergency preparedness and response capability that would mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment and the health and safety of persons. CNSC staff are satisfied that CNL has made sufficient preparations to respond to any emergency that may arise on the CRL site. Based on CNSC staff assessment, CNSC staff conclude that CNL emergency management and fire protection programs meet regulatory requirements.

### **3.10.5 Recommendation**

Two licence conditions are included in the proposed licence for this SCA. Licence condition 10.1 requires CNL to implement and maintain an emergency preparedness program. Licence condition 10.2 requires CNL to implement and maintain a fire protection program. Compliance verification criteria for both licence conditions are included in the draft LCH.

## **3.11 Waste Management**

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.

The specific areas that comprise this SCA at CRL include:

- Waste Characterization
- Waste Minimization
- Waste Management Practices
- Decommissioning Plans



### 3.11.1 Trends

The following table indicates the overall rating trends for the Waste Management SCA over the current licensing period:

TRENDS FOR WASTE MANAGEMENT					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude CNL's Waste Management performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.11.2 Discussion

The Waste Management SCA includes a waste management program and a strategy for the decommissioning of the CRL site. CNL has implemented and maintains a waste management program to document the activities involved in waste management lifecycle. CNSC staff conclude that CNL's Waste Management SCA at the CRL met all applicable regulatory requirements and CNSC expectations.

### 3.11.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA.

#### 3.11.3.1 Past Performance

##### Waste Characterization

CNL has demonstrated a commitment to segregation and characterization of wastes generated as a result of ongoing operation. CNL programs are in place involving detailed characterization of wastes from early operations at CRL to better manage historic or legacy wastes.

CNSC staff review of the waste characterization practices found that decommissioning waste is integrated into the site-wide waste management processes. CNSC staff found the process allows CNL to minimize wastes requiring long-term storage or disposal and better define outgoing waste streams.

CRL Radioactive Waste Characterization Services continues to develop processes and equipment to help evaluate and characterize wastes for both onsite and offsite management.

### **Waste Minimization**

Since 2012 CNL has completed as well as initiated a number of initiatives designed to minimize the amount of waste being managed onsite. These include:

- reclassification of some historic wastes and shipping offsite to appropriate waste management facilities;
- better waste management practices for facilities generating waste; and
- introduction of reusable materials when practical (e.g., cotton coveralls instead of Tyvek, facility specific footwear instead of booties).

CNSC staff have reviewed CNL's initiatives regarding waste minimization and are satisfied that they will improve the processes carried out at CRL.

### **Waste Management Practices**

CNSC staff have verified that CNL carried out a number of improvements in the waste management practices at CRL including:

- Completion of a project to retrieve radioactive liquids from Active Liquid Waste Tanks 1 and 2
- Construction of a permeable reactive barrier to treat Sr-90 plume emanating from the Waste Management Area (WMA) A
- Ongoing inspection of tile holes in WMA B
- Completion of processing radioactive PCB liquid waste
- Retrieval of historic storage containers from WMA B and transfer to the Fuel Packaging and Storage Facility
- Treatment of Sr-90 contaminated water
- Processing of compactable waste at the Waste Handling Building (Building 591A)
- Installation of an engineered cover at WMA C to minimize infiltration of water into the waste fill
- Characterization and recycling of steel stored in WMA D
- Performing a radiological survey of WMA E
- Construction and operation of a third Shielded Modular Above Ground Storage building (SMAGS-3)

CNL continues to carry out their Integrated Waste Strategy and has addressed the fundamental principles of waste management throughout their documentation described in their waste management program description document. CNSC staff has assessed the effectiveness of implementing these programs through desktop reviews of reports reflecting the results of these programs. CNSC staff are satisfied that CNL is effective in their waste management practices.

## **Decommissioning Plans**

CNL has plans for decommissioning and demolition of facilities and buildings at the CRL site while other sections of the site are still in operation.

Decommissioning work is carried out in a planned, orderly way to minimize impact on shared services and adjacent buildings or services. Where possible, CNL applies a prompt decommissioning approach and in all cases, buildings are decontaminated to a state allowing for general demolition. Currently, waste generated from ongoing decommissioning work is stored onsite in existing waste management facilities until a permanent disposal facility is available.

Contaminated lands and groundwater will be managed in-situ if the contaminants will have decayed or attenuated to a level which will meet the end-state criteria within a 300 year period. The small volumes of contaminants which will not meet the end-state criteria for the site by 2400 will be retrieved and placed in an appropriate disposal facilities. Contaminated groundwater which will not meet the end-state criteria by 2400, will be remediated using either pump-and-treat or permeable reactive barrier technologies.

CNSC staff have assessed the effectiveness of this decommissioning strategy as part of compliance inspections and through desktop reviews of reports reflecting the results of these activities. CNSC staff note that for environmental remediation jobs that would generate large volumes of radioactive waste, CNL will defer this work until an appropriate disposal facility is authorized.

### **3.11.3.2 Regulatory Focus**

CNSC staff will continue to carry out verification activities as CNL fulfills the terms of the Go-Co contract involving the revitalization of CRL, waste management and accelerated decommissioning. CNSC staff will continue to monitor CNL's performance in this SCA through compliance verification activities including onsite inspections and desktop reviews of relevant program documentation.

### **3.11.3.3 Proposed Improvements**

CNL continuously reviews its processes to identify opportunities for improvement as they become available. For example, the amalgamation of previously separate groups for historic waste management, waste management, and decommissioning management has allowed CNL to better integrate waste management strategies for materials coming out of decommissioning.

### **3.11.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain an effective waste management program at CRL in accordance with regulatory requirements.

### 3.11.5 Recommendation

Two licence conditions are included in the proposed licence for this SCA. Licence condition 11.1 requires CNL to implement and maintain a waste management program. Licence condition 11.2 requires CNL to maintain a decommissioning plan. Compliance verification criteria for both licence conditions are included in the draft LCH.

## 3.12 Security

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.

The specific areas that comprise this SCA at CRL include:

- Facilities and Equipment
- Response Arrangements
- Security Practices
- Drills and Exercises

### 3.12.1 Trends

The following table indicates the overall rating trends for the Security SCA over the current licensing period:

TRENDS FOR SECURITY					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
Comments					
CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude CNL's Security performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

### 3.12.2 Discussion

CNL has implemented and maintains a security program to fulfill the security requirements and expectations stipulated in the *Nuclear Security Regulations*, licence and LCH for facilities and activities conducted on the CRL site. CNSC staff conclude that CNL's Security SCA at CRL met all applicable regulatory requirements and CNSC staff expectations. CNSC staff are satisfied that licensed activities at CRL are conducted in a safe and secure manner.

Since 2012, CNL had a number of reportable events related to security. The events ranged from procedures that needed updating and errors that were administrative in nature to electrical failures, software upgrade issues, and equipment failing to function as required. In all cases, the events were either minor in significance and closed upon corrective actions being implemented or administrative in nature which resulted in negligible risk. There are no outstanding issues in this SCA.

### 3.12.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA.

#### 3.12.3.1 Past Performance

##### Facilities and Equipment

CNL is required to maintain security devices and equipment in accordance with manufacturer specifications. CNL reported some equipment deficiencies where devices were affected for brief periods resulting in CNL implementing compensatory measures until repairs were undertaken. All events were related to issues of minor significance. Based on CNL's response to these issues, CNSC staff conclude that CNL demonstrated the effective maintenance of facilities and equipment, and has met regulatory requirements in this area.

Since 2012, CNL has purchased new X-ray screening equipment and are presently testing a full-body detector as upgrades to access control measures. Additionally, CNL implemented new security access control measures at Building 700. CNL has also taken the initiative to install new vehicle barriers to allow for more efficient operability. Based on these upgrades, CNSC staff conclude that CNL continues to meet regulatory requirements and implement upgrades to access control measures.

CNL re-established ZED-2 reactor as a Category I Nuclear Material operating facility and upgraded its security infrastructure accordingly to continue to meet the *Nuclear Security Regulations*. CNL has also constructed a facility inside the protected area to house the target residue material removal and transportation process. CNSC staff inspected and confirmed that this facility meets and exceeds the security requirements for a temporary Category I nuclear material facility.

Since 2012, CNSC staff have conducted inspections and security exercises at CRL on a regular basis. Findings related to facilities and equipment were technical in nature, relating to labeling and maintenance. All findings have been closed to the satisfaction of CNSC staff.

## Security Practices

CNL is required to control access to the CRL site through physical and administrative security measures. CNL continues to maintain good practices through corporate governance. CNL is also updating the security procedures to align with the new management system structure. CNSC staff will review the updated procedures for acceptability as they are brought into the new management system structure.

CNSC staff reported findings during security inspections and security exercises conducted since 2012. Various procedural issues with respect to Site Access Security Clearances were in need of review and updating. CNL has modernized procedures to enhance the security program and findings have been closed to the satisfaction of CNSC staff.

### Cyber security:

Since 2012, CNL performed a company-wide cyber assets inventory and identified those that should be considered cyber essential assets. To support the ongoing implementation and management of cyber security, CNL has developed a company-wide cyber security program (based on modern Canadian and international standards) which is aligned with CNL's management system framework. The cyber security program covers all cyber assets owned and/or operated by CNL, within two distinct groups:

- Business network (all networks, infrastructure, servers, laptops, PCs, mobile devices, and other types of cyber assets that are used for day to day CNL business)
- Controlled area computing (protection of any cyber asset that is deemed critical to nuclear safety, security, safeguards, or emergency preparedness)

CNSC staff reviewed the governing documents of the cyber security program and have no concerns in this area.

## Response Arrangements

CNL maintains a qualified Nuclear Response Force (NRF) to meet the requirements of the *Nuclear Security Regulations* and of REGDOC-2.12.1, *High Security Sites: Nuclear Response Force* (document contains prescribed information).

In the past, CNL sent NRF recruits to the Bruce Power basic officer training course. Since 2012, CRL has conducted in-house NRF training courses. This change allowed CNL to produce CRL-specific training that resulted in skilled members who are familiar with the CRL site.

CNSC staff inspections related to response arrangements found some issues related to equipment and Nuclear Security Officer (NSO) training documentation. CNL's files were reviewed and corrections were made to the satisfaction of CNSC staff.

## **Drills and Exercises**

CNL is required to hold drills every 30 days and an exercise every two years. CNL is an industry leader in conducting security exercises inside the Protect Area at a frequency above CNSC regulatory requirements.

CNSC staff have completed the fourth cycle of performance testing program at high-security nuclear facilities in Canada, which included CRL. The last Force on Force security exercise at CRL took place in December 2016. Most findings have been closed to the satisfaction of CNSC staff. Outstanding findings from this recent exercise and one from the 2015 exercise are tracked by CNSC staff to ensure CNL's corrective actions and response are acceptable. The details of the findings and corrective actions are prescribed information. CNL has committed to closing these findings by November 2017. These action items will remain open until the corrective actions have been fully implemented and addressed to the satisfaction of CNSC staff.

### **3.12.3.2 Regulatory Focus**

CNSC staff will continue to monitor CNL's performance in this SCA through regulatory oversight activities, including onsite inspections and desktop reviews of relevant program documentation. In particular, CNSC staff will focus verification activities on changes to security measures and equipment, conduct of security exercises and security document reviews.

### **3.12.3.3 Proposed Improvements**

CNL will continue to implement security improvements during the proposed licence period including:

- Enhancing security structures to increase longevity of security equipment and to reduce exposure to elements and threats
- Upgrades to security lighting and security monitoring system
- Continued participation in force-on-force exercises
- Purchase, testing and installation of new security screening equipment
- Installation of new protected area barriers at strategic locations

### **3.12.4 Conclusion**

Based on CNSC staff assessments of CNL's application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain an effective security program at CRL in accordance with regulatory requirements.

### **3.12.5 Recommendation**

One licence condition is included in the proposed licence for this SCA. Licence condition 12.1 requires CNL to implement and maintain a security program. Compliance verification criteria for this licence condition are included in the draft LCH.

### 3.13 Safeguards and Non-Proliferation

The safeguards and non-proliferation SCA covers the programs and activities required for the successful implementation of the obligations arising from the Government of Canada and the IAEA safeguards agreements as well as other measures arising from the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and bilateral Nuclear Cooperation Agreements. This SCA comprises a safeguards program and a non-proliferation program.

The scope of the non-proliferation program for CNL is limited to the tracking and reporting of foreign obligations and origins of nuclear material. This tracking and reporting assists the CNSC in the implementation of Canada's bilateral Nuclear Cooperation Agreements with other countries. The import and export of controlled nuclear substances, equipment and information identified in the *Nuclear Non-proliferation Import and Export Control Regulations* requires separate authorization from the CNSC, consistent with subsection 3(2) of the *General Nuclear Safety and Control Regulations*.

The specific areas that comprise this SCA at CRL include:

- Nuclear Material Accountancy and Control
- Access and Assistance to the IAEA
- Operational and Design Information
- Safeguards Equipment, Containment and Surveillance

#### 3.13.1 Trends

The following table indicates the overall rating trends for Safeguards and Non-Proliferation SCA over the current licensing period:

SAFEGUARDS AND NON-PROLIFERATION					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude CNL's Safeguards and Non-Proliferation performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017

#### 3.13.2 Discussion

CNL continues to maintain and implement effective safeguards and non-proliferation programs at CRL that are required by the CNSC to meet Canada's international obligations and commitments arising from the NPT. Pursuant to the NPT, Canada has entered into a Comprehensive Safeguards Agreement and Additional Protocol with the IAEA (hereafter, the safeguards agreements).



The CNSC provides the mechanism, through the NSCA [3], its associated regulations, and a licence condition for the IAEA to verify implementation of the safeguards agreements at CRL. Conditions for the application of IAEA safeguards are contained in the licence, and criteria in order to meet the conditions are contained in the LCH and in regulatory document RD-336 *Accounting and Reporting of Nuclear Material*. Compliance includes the timely provision of reports on the movement and location of all nuclear materials, the provision of access and assistance to IAEA staff for safeguards activities, and the submission of annual operational information, additional protocol updates as well as accurate design information on plant operations and procedures.

### 3.13.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA.

#### 3.13.3.1 Past Performance

##### **Nuclear Material Accountancy and Control**

Since 2012, CNL provided the CNSC and IAEA with the required nuclear material accounting reports and information. While the submitted information met regulatory requirements, the CNSC is working with CNL to improve the accuracy of submissions so as to avoid the need for corrections.

Reports are now submitted electronically through the CNSC's Nuclear Materials Accountancy Reporting (NMAR) portal. CNL worked with the CNSC to ensure that their accounting system could fully support the electronic submission requirements and acted as the test pilot for this new system. NMAR was fully implemented in 2016.

##### **Access and Assistance to the IAEA**

CNL continues to grant access and assistance to the IAEA for inspection activities, verification of nuclear material transfers and for the routine maintenance of the IAEA equipment installed at CRL as required. From 2012 to 2017, the IAEA conducted in total 190 inspections at various facilities at CRL.

Details of the IAEA inspections can be found below in table 9:

**Table 9: IAEA verification activities at CRL**

Year	SNRI	PIV	DIV	UI	Total
2012	10	12	10	8	40
2013	13	7	6	5	31
2014	12	11	13	6	42
2015	10	6	7	6	29
2016	15	6	9	4	34
2017 <sup>1</sup>	2	5	6	1	14
Total Inspections					190

<sup>1</sup> For the period of January 1 to June 30, 2017

SNRI – Short Notice Random Inspection

PIV – Physical Inventory Verification

UI – Unannounced Inspection

DIV – Design Information Verification

In addition to inspections, the IAEA also performs equipment maintenance and is present to verify selected nuclear material transfers. Given the quantity and safeguards significance of the nuclear material involved, IAEA inspectors are present for all HEU transfers offsite. This has led to an increase in IAEA inspector presence over the last two years. However, efforts by CNL and the IAEA to integrate transfer schedules and coordinate IAEA inspector presence have led to efficiency gains for both parties.

The IAEA inspection results for CRL for the licensing period were satisfactory. In 2016, there were two locations where the IAEA requested additional activities be performed to verify the nuclear material inventory. These activities were successfully completed for both facilities and IAEA concluded that Canada is in compliance with its international obligations under the safeguards agreements.

### **Operational and Design Information**

During the licensing period, CNL submitted annual Operational Programs and quarterly updates as required. These documents provide a forward-looking plan of CNL's activities at CRL which assists the IAEA in planning inspections.

CNSC staff reviewed Design Information Questionnaire (DIQ) documents, which provide specific information on the design and operation of a facility, as they were updated as required for various facilities. CNSC staff have confirmed that these DIQ documents are acceptable and meet regulatory requirements.

CNL has also provided timely annual Additional Protocol submissions to CNSC staff which include a description of each building on CRL site, the scale of its operations, and future plans for nuclear fuel research and development activities.

### **Safeguards Equipment, Containment and Surveillance**

CNL continues to provide assistance to the IAEA for the installation and maintenance of IAEA equipment at CRL.

During the licensing period, the IAEA installed remotely monitored safeguards equipment in the Target Residue Material processing facility and the Fuel Package and Storage Facility. The cameras in the NRU reactor hall were upgraded and battery operated cameras were installed in the NRU Rod Bays.

### **3.13.3.2 Regulatory Focus**

CNSC staff will continue to monitor CNL's performance in this SCA through regulatory oversight activities, including onsite inspections and desktop reviews of relevant program documentation. In particular, CNSC staff continue to monitor CNL's use of the NMAR portal and other reporting tools.

### **3.13.3.3 Proposed Improvements**

CNL is updating the nuclear materials and safeguards management procedures to align with the new management system structure.

At the beginning of 2017, CNL commenced the use of the new IAEA reporting tool, Protocol Reporter 3. This software is an updated version of software needed to compile information for inclusion into Canada's annual Additional Protocol update. Previously, sensitive nuclear material accounting information was placed on a stand-alone accounting system as a security improvement. During the next licensing period, CNL will adopt a single nuclear material inventory management system for all CRL facilities. This will increase efficiency and reduce errors resulting from manual data entry.

### **3.13.4 Conclusion**

Based on CNSC staff's assessments of the CNL application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain an effective safeguards and non-proliferation program at CRL in accordance with regulatory requirements.

### **3.13.5 Recommendations**

One licence condition is included in the proposed licence for this SCA. Licence condition 13.1 requires CNL to implement and maintain a safeguards program. Compliance verification criteria for this licence condition are included in the draft LCH.

## **3.14 Packaging and Transport**

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

The specific areas that comprise this SCA at CRL include:

- Packaging and Transport
- Package Design and Maintenance
- Registration for Use

### 3.14.1 Trends

The following table indicates the overall rating trends for Packaging and Transport SCA over the current licensing period:

PACKAGING AND TRANSPORT					
Overall Compliance Ratings					
2012	2013	2014	2015	2016	2017 <sup>1</sup>
SA	SA	SA	SA	SA	SA
<b>Comments</b> CNL continues to be rated SA in this SCA at the Chalk River Laboratories. CNSC staff conclude CNL's Packaging and Transport performance meets regulatory requirements.					

<sup>1</sup> For the period of January 1 to June 30, 2017.

### 3.14.2 Discussion

CNL has developed and implemented a packaging and transport program to ensure compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015* and the *Transportation of Dangerous Goods Regulations, 2015* for all shipments to and from CRL. This program covers elements of package design, package maintenance, and the registration for use of certified packages as required by the regulations.

Since 2012, CNSC staff inspected CNL's radioactive material transportation program to verify compliance with 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.

As committed by the Government of Canada, CNL continues work to repatriate waste containing HEU to the United States. CNSC staff verified that CNL's processes for handling this material met all safety and regulatory requirements. Additional information on the transport of high level waste is available on the CNSC website [\[30\]](#).

### 3.14.3 Summary

A summary of the licensee's past performance, proposed improvements, and CNSC future regulatory focus are presented in the following subsections. The compliance rating for this SCA takes into consideration the CNSC staff assessment in all specific areas included for CRL within this SCA. Based on CNSC staff's assessment, highlights are provided for the Packaging and Transport specific area.

### **3.14.3.1 Past Performance**

#### **Packaging and Transport**

CNL continues to demonstrate compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015* and the *Transportation of Dangerous Goods Regulations* and have been rated “Satisfactory” in the Packaging and Transport SCA for the period of 2012 to 2017.

CNL’s Radioactive Material Transportation Program was renamed the Transportation of Dangerous Goods Program, and expanded to include all nine classes of dangerous goods.

CNSC staff have verified that CNL’s Transportation of Dangerous Goods Program meets all the requirements of the *Packaging and Transport of Nuclear Substances Regulations, 2015*, and Transport Canada’s *Transportation of Dangerous Goods Regulations*. This program is implemented at all CNL’s sites including CRL.

The *Packaging and Transport of Nuclear Substances Regulations, 2015* do not apply to onsite transport of packages. CNSC staff have verified that CNL has measures in place at CRL that provide an equivalent level of safety to workers, public and the environment as is required for offsite transportation.

### **3.14.3.2 Regulatory Focus**

CNSC staff will continue to monitor CNL’s performance in this SCA through regulatory oversight activities, including onsite inspections and desktop reviews of relevant program documentation.

### **3.14.3.3 Proposed Improvements**

As Transport Canada amends the *Transportation of Dangerous Goods Regulations*, CNL will be required to review and as appropriate, make adjustments to the packaging and transport program to ensure continued compliance with the revised regulations.

### **3.14.4 Conclusion**

Based on CNSC staff’s assessments of the CNL application, supporting documents and past performance, CNSC staff conclude that CNL continues to implement and maintain an effective packaging and transport program at CRL in accordance with regulatory requirements.

### **3.14.5 Recommendations**

One licence condition is included in the proposed licence for this SCA. Licence condition 14.1 requires CNL to implement and maintain a packaging and transport program. Compliance verification criteria for this licence condition is included in the draft LCH.

## 4. OTHER MATTERS OF REGULATORY INTEREST

### 4.1 Aboriginal Consultation

The common law duty to consult with Aboriginal groups applies when the Crown contemplates actions that may adversely affect potential or established Aboriginal and/or treaty rights. The CNSC ensures that all of its licensing decisions under the NSCA [3] uphold the honour of the Crown and consider Aboriginal peoples' potential or established Aboriginal and/or treaty rights pursuant to section 35 of the *Constitution Act, 1982* [31].

#### 4.1.1 Discussion

CNSC staff have identified First Nation and Métis groups who may have an interest in the proposed licence decision. The Algonquin of Ontario (Algonquins of Pikwàkanagàn), Kitigan Zibi Anishinabeg, Algonquin of Quebec (Algonquin Anishinabeg Tribal Council), the Union of Ontario Indians and the Métis Nation of Ontario were identified because all have previously expressed interest in being kept informed of CNSC licensed activities occurring in their asserted traditional territories.

CNSC staff sent letters of notification in July 2017 to the identified groups above, providing information regarding the proposed licence renewal decision, the availability of participant funding to facilitate participation in the hearing process and details on how to participate in the January 2018 Commission's public hearing process. Follow-up phone calls were conducted with the identified groups above to ensure they had received the letters and to answer any questions about the regulatory process and how to get involved in the Commission proceedings. No issues related to potential impacts on Aboriginal or treaty rights as a result of the licence application have been raised by the identified First Nation and Métis groups.

CNSC REGDOC-3.2.2 *Aboriginal Engagement*, published in February 2016, sets out requirements and guidance for licensees whose proposed projects may raise the Crown's duty to consult. While the CNSC cannot delegate its obligation, it can delegate procedural aspects of the consultation process to licensees. The information collected and measures proposed by licensees to avoid, mitigate or offset adverse impacts from the proposed licence renewal may be used by CNSC staff in meeting its consultation obligations.

As CNL's licence application does not propose any new activities, regulatory requirements set out in CNSC REGDOC-3.2.2 pertaining to formal consultation do not apply. However, CNSC staff encourage CNL to continue to engage with interested Aboriginal communities on the licence application and on-going activities of interest to the communities.

### **4.1.2 Conclusion**

Based on the information received and reviewed, CNSC staff determined that the CRL is an existing site with restricted access and CNL is not proposing any changes to the facility's footprint or current licensing basis. This licence application will not cause adverse impacts to any potential or established Aboriginal and/or treaty rights.

Therefore, CNSC staff are of the opinion that the decision on the licence renewal for CRL before the Commission does not raise the duty to consult. To date, no issues have been raised by identified Aboriginal groups. These groups have the opportunity to raise issues directly with CNSC staff and have been invited to participate in the Commission hearing to express any concerns that they may have in relation to this licence renewal application.

## **4.2 Other Consultation**

The CNSC continues to proactively implement a robust public notification process for all files going before the Commission. CNSC staff have informed the public via the CNSC's website, email subscription list, social media channels, and print advertisements in local communities in proximity to CRL of the public Commission hearing pertaining to CNL's licence renewal application for CRL and availability of participant funding.

The CNSC made available up to \$75,000 through its PFP to assist members of the public, Indigenous groups, and other stakeholders in providing value-added information to the Commission through informed and topic-specific interventions. This funding was offered to review CNL's application and associated documents and to prepare for and participate in the Commission's public hearing.

### **4.2.1 Discussion**

The public, Indigenous groups and other stakeholders were informed of the availability of participant funding through a series of public communications:

- posting of the PFP funding announcement on the PFP section of the CNSC website
- public information bulletin to subscribers of the CNSC website
- advertisements in on-line and local print media
- notification by letter to potentially interested Indigenous groups

The deadline for applications was September 15, 2017. A Funding Review Committee (FRC), independent from CNSC staff, reviewed the funding applications received, and made recommendations on the allocation of funding to eligible applicants. Based on recommendations from the FRC, the CNSC awarded participants up to \$72,199 in funding to the following recipients, who are required to submit a written intervention and make an oral presentation at the Commission's public hearing in January 2018:

- Algonquins of Ontario
- Concerned Citizens of Renfrew County
- Métis Nation of Ontario
- Northwatch
- William Turner
- Women in Nuclear

#### **4.2.2 Conclusion**

The CNSC continues to actively promote ongoing communication and dissemination of regulatory and scientific information through social media channels, open houses and postings on the [CNSC web site](#). The CNSC has various mechanisms and processes such as the PFP and mail outs to encourage the public to participate in the Commission's public hearing, as described above. The CNSC has offered assistance to interested members of the public, Indigenous groups, and other stakeholders, through the PFP, to prepare for and participate in the Commission's public hearing.

### **4.3 Cost Recovery**

Paragraph 24(2)(c) of the NSCA [3] requires that a licence application is accompanied by the prescribed fee. The *Cost Recovery Fees Regulations* (CRFR) set out the specific requirements based on the activities to be licensed. An applicant for a Class I facility licence is subject to "Part 2" of CRFR, which is based on "Regulatory Activity Plan Fees".

#### **4.3.1 Discussion**

Through review of CNSC records, CNSC staff have determined that CNL is in good standing with respect to CRFR requirements for CRL. CNL has paid their cost recovery fees in full.

#### **4.3.2 Conclusion**

CNSC staff conclude that CNL is in good standing with respect to CRFR requirements for CRL. Based on CNL's payment history, CNSC staff do not have concerns regarding payment of future cost recovery fees.



## 4.4 Financial Guarantees

The CRL licence requires CNL to maintain in effect a financial guarantee for decommissioning of CRL that is acceptable to the Commission. CNSC Regulatory Guides G-219, *Decommissioning Planning for Licensed Activities* and G-206, *Financial Guarantees for Decommissioning of Licensed Activities* provides guidance on calculating the financial guarantees.

### 4.4.1 Discussion

Although the operation of the site is managed by CNL, AECL retains ownership of the CRL site and all its assets.

With respect to financial guarantee referred to by paragraph 3(1)(l) of the *General Nuclear Safety and Control Regulations*, AECL is a Schedule III, Part 1 Crown Corporation under the *Financial Administration Act* [32] and is an agent of Her Majesty in Right of Canada. Therefore, AECL's liabilities are ultimately liabilities of Her Majesty in Right of Canada. These liabilities have been officially recognized by the Federal Minister of Natural Resources in a letter dated July 31, 2015 [33].

### 4.4.2 Conclusion

CNSC staff conclude that the financial guarantees are sufficient for the decommissioning of the CRL site.

## 4.5 Licensee Public Information Program

A public information and disclosure program (PIDP) is a regulatory requirement for licence applicants. CNSC document RD/GD-99.3 *Public Information and Disclosure*, sets out the requirements for public information and disclosure. The primary goal of the program, as it relates to the licensed activities, is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities are effectively communicated to the public. This information promotes transparency and improves the public's understanding of the licensed activities and operations. The program includes a commitment to and protocol for ongoing, timely communication of information related to the licensed facility during the course of the licence period.

CNSC expectations of a licensee's public information program and disclosure protocol are commensurate with the public's perception of risk and the level of public interest in the licensed activities. The program and protocol may be further influenced by the complexity of the nuclear facility's lifecycle and activities, and the risks to public health and safety and the environment perceived to be associated with the facility and activities.

### 4.5.1 Discussion

Licence condition G.6 in the proposed licence requires CNL to implement and maintain a PIDP. CNSC staff have reviewed CNL's PIDP and determined that it:

- identifies clear goals and measurable objectives in terms of dissemination of information to targeted audiences
- is available to the public and is posted on the licensee's web site
- targets multiple audiences such as local residents, elected and government representatives, media, business leaders, youth, interest groups, and community organizations
- recognizes the importance of actively providing updates and briefings to First Nations and Métis leaders and communities
- is informed by ongoing dialogue with elected representatives and media monitoring activities, thereby gauging the level of public interest and perception
- provides contact information for members of the public who want to obtain additional information

Additionally, CNL participates in routine engagement with the community through the environmental stewardship council meetings which are attended by indigenous groups, non-governmental organizations, community leaders, and elected representatives.

CNSC staff will continue to monitor CNL's compliance with CNSC RD/GD-99.3 and ongoing implementation of the PIDP.

### 4.5.2 Conclusion

CNSC staff conclude that CNL's PIDP meets the regulatory requirements of RD/GD-99.3 *Public Information and Disclosure*. CNSC staff continue to oversee CNL's implementation of the PIDP to ensure that CNL meets its obligations regarding dissemination and notifying the public and indigenous communities on its licensed activities. CNSC staff also encourage CNL to refine and update the PIDP on a regular basis to meet the changing information needs of their target audiences.

## 4.6 Nuclear Liability Insurance

CNL has maintained nuclear liability insurance for CRL under the *Nuclear Liability Act* [34] and continues to maintain nuclear liability insurance under the *Nuclear Liability and Compensation Act* (NLCA) [35] which came into force on January 1, 2017.

The CRL site is currently designated, pursuant to section 7 of the NLCA, as a nuclear installation in Item 6 of the Schedule (Section 2) of the *Nuclear Liability and Compensation Regulations* (NLCR). The CRL site contains several facilities which are authorized to contain nuclear material as defined in the NLCA. These facilities fall under various risk categories, as defined in paragraph 4(1) of the NLCR, and are listed in Column 4 of Item 6 in the Schedule. Because the NRU Reactor is a “Single-unit reactor of over 7 MW”, it is the facility in this list with the highest risk. As a result, the CRL site falls under the “Reactor of over 7 MW Class” pursuant to paragraph 4(2) of the NLCR, and the operator’s liability amount is prescribed at \$180 million pursuant to paragraph 5(a) of the NLCR.

After the NRU reactor has transitioned to a state of storage with surveillance, CNSC staff expect that CNL will seek a reclassification such that the CRL site should no longer fall into the “Single-unit reactor of over 7 MW Class” for the purposes of the NLCR. Any change in the classification of CRL as a nuclear installation must take into consideration the facility with the highest risk on the CRL site. This would likely be the nuclear fuel waste processing facilities, which would result in the CRL nuclear installation site being reclassified as a “Nuclear Fuel Waste Processing Facility Class”, pursuant to paragraph 4(2) of the NLCR. The operator’s liability amount prescribed for this class is \$40 million pursuant to paragraph 5(b) of the NLCR.

Following a request by CNL for the reclassification of the CRL nuclear installation site, Natural Resources Canada would consult with the CNSC in making a recommendation to the Governor in Council to amend CRL’s designation accordingly.

## 4.7 Fisheries Act Authorization

In 2015, CNL completed a self-assessment of the NRU cooling water intake at the CRL site on fish impingement and entrainment which concluded that “serious harm to fish” as defined in the *Fisheries Act* is occurring [29]. CNSC staff requested that CNL submit the information, data and calculations used to support this conclusion and that CNL review their self-assessment taking into consideration the implications of the NRU shutdown. CNL provided tentative plans for a reduction in the water intake rate beginning in March 2018 due to the shutdown of NRU. Due to uncertainties in future water use, CNL concluded that a revised self-assessment could only be submitted once the post NRU shutdown water use profile was established. Until that time, CNL continues to operate under the existing self-assessment.

CNL has subsequently submitted additional information supporting the production foregone estimates for fish species impinged at the NRU reactor, entrainment data and analysis. CNSC staff are currently reviewing the additional information submitted by CNL in order to make a recommendation to DFO as to whether an Application for Authorization under Paragraph 35(2)(b) of the *Fisheries Act* is required. CNSC staff will provide an update to the Commission at the hearing in January 2018.

## 4.8 Delegation of Authority

The Commission may include in a licence any condition it considers necessary for the purposes of the NSCA [3]. The Commission may delegate authority to CNSC staff with respect to the administration of licence conditions, or portions thereof.

There is one proposed licence condition in the proposed licence that contains the phrase “the Commission or a person authorized by the Commission”, licence condition 3.2 on reporting.

CNSC staff recommend the Commission delegate its authority for the purposes described in the above licence condition to the following staff:

- Director, Nuclear Laboratories and Research Reactors Division
- Director General, Directorate of Nuclear Cycles and Facilities Regulation
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch

## 5. OVERALL CONCLUSIONS AND RECOMMENDATIONS

CNSC staff have concluded the following with respect to paragraphs 24(4)(a) and (b) of the *Nuclear Safety and Control Act* (NSCA) [3], in that CNL:

1. is qualified to carry on the activities authorized by the licence; and
2. will in carrying out the licensed activities, has made, and will continue to make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

Therefore, CNSC staff recommend that the Commission:

1. accept CNSC staff’s conclusions and exercise its authority under the NSCA [3] to renew the licence to authorize Canadian Nuclear Laboratories to continue to operate the Chalk River Laboratories from April 1, 2018 to March 31, 2028
2. authorize the delegation of authority as set out in subsection 4.8 of this CMD

## REFERENCES

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3. *Nuclear Safety and Control Act*, S.C. 1997, c. 9. <http://laws-lois.justice.gc.ca/eng/acts/N-28.3/FullText.html>
4. Announcement from Natural Resources Canada, “*The Harper Government Announces New Direction for Nuclear Laboratories*”, February 2013, <http://www.nrcan.gc.ca/media-room/news-release/2013/1773>
5. Announcement from Natural Resources Canada, “*Minister Rickford Announces the Final Step in the Restructuring of Atomic Energy of Canada Limited*”, June 2015, <http://news.gc.ca/web/article-en.do?nid=992209>
6. Announcement from Natural Resources Canada, “*Government of Canada Announces Extension of National Research Universal Reactor (NRU)*”, February 2015, <http://news.gc.ca/web/article-en.do?nid=929189>
7. Record of Decision, *Application to Renew and Amend the Nuclear Research and Test Establishment Operating Licence for Chalk River Laboratories*, April 6, 2016, e-Doc 5031924
8. Letter D. Cox to M. Leblanc, *Application for Renewal of the Nuclear Research and Test Establishment Operating Licence for the Chalk River Laboratories – 2018*, dated March 30, 2017, e-Doc 5220249
9. CMD 16-H2, *Submission from CNSC Staff on a Licence Renewal for Canadian Nuclear Laboratories’ Chalk River Laboratories*, e-Doc 4929171
10. CMD 13-M14, *Report on the Performance of Atomic Energy of Canada Limited Chalk River Laboratories*, e-Doc 4033119
11. CMD 14-M79, *Annual Performance Report for AECL’s Nuclear Sites and Projects*, e-Doc 4528291
12. CMD 16-M32, *Status Report on Fitness for Service for the Chalk River Laboratories*, e-Doc 5025645
13. CMD 16-M42, *Status Report on Fitness for Service for the Chalk River Laboratories*, e-Doc 5058733
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17. CMD 17-M6, *Status Report on Fitness for Service for the Chalk River Laboratories*, e-Doc 5171343
18. CMD 17-M21, *Status Report on Fitness for Service for the Chalk River Laboratories*, e-Doc 5226454
19. Record of Decision, *AECL Application for Approval to Operate the Fuel Packaging and Storage Facility*, March 18, 2014, e-Doc 4404833 National Fire Code of Canada [https://www.nrc-cnrc.gc.ca/eng/publications/codes\\_centre/2015\\_national\\_fire\\_code.html](https://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2015_national_fire_code.html)
20. National Fire Code of Canada, [https://www.nrc-cnrc.gc.ca/eng/publications/codes\\_centre/2015\\_national\\_fire\\_code.html](https://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2015_national_fire_code.html)
21. CMD 12-M27, *Early Notification Report – Workplace Fatality Reported at AECL’s Chalk River Laboratories*, May 3, 2012, e-Doc 3921539
22. CMD 13-M27, *Early Notification Report – NRU Reactor Operator Error on February 27, 2013*, May 15, 2013, e-Doc 4120367
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24. CMD 16-M9, *Event Initial Report – Incident during a Security Related Training Exercise*, January 28, 2016, e-Doc 4925787 (confidential, prescribed information)
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35. *Nuclear Liability and Compensation Act* <http://www.laws.justice.gc.ca/eng/acts/N-28.1/FullText.html>

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37. Letter, G. Dolinar to J. LeClair, Response to CNSC Enquiry on Status of CRL ERA Recommendations, September 22, 2017, e-Doc 5345711

## ACRONYMS

Acronym	Definition
AECL	Atomic Energy of Canada Limited
ALARA	As Low As Reasonably Achievable
CECEUD	Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation
CMD	Commission Member Document
CNEA	Canadian National Energy Alliance
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
COG	CANDU Owners Group
CRFR	Canadian Nuclear Safety Commission Cost Recovery Fees Regulations
CRL	Chalk River Laboratories
CSA	Canadian Standards Association
CSD	Criticality Safety Document
DIQ	Design Information Questionnaire
DRL	Derived Release Limits
EA	Environmental Assessment
EIR	Event Initial Report
EMP	Environmental Monitoring Program
EMS	Environmental Management System
EOC	Emergency Operations Centre
ERA	Environmental Risk Assessment
FISST	Fissile Solution Storage Tank
FPS	Fuel Packaging and Storage
FRC	Funding Review Committee
Go-Co	Government Owned – Contractor Operated
GWMP	Groundwater Monitoring Program
HEU	Highly Enriched Uranium
IAEA	International Atomic Energy Agency
IEMP	Independent Environmental Monitoring Program
IFB	Industrial Fire Brigade
IIP	Integrated Implementation Plan



Acronym	Definition
KI	Potassium Iodide
LCH	Licence Conditions Handbook
MAPLE	Multipurpose Applied Physics Lattice Experimental (reactor)
MPF	Molybdenum-99 Production Facility
NEW	Nuclear Energy Worker
NLCR	Nuclear Liability and Compensation Regulations
NMAR	Nuclear Material Accountancy Reporting
NPT	Treaty of the Non-Proliferation of Nuclear Weapons
NRF	Nuclear Response Force
NRU	National Research Universal
NRX	National Research Experimental
NSCA	Nuclear Safety and Control Act
NSO	Nuclear Security Officer
NSDF	Near Surface Disposal Facility
OPEX	Operating Experience
PCB	Polychlorinated Biphenyl
PFP	Participant Funding Program
PIDP	Public Information and Disclosure Program
PIP	Periodic Inspection Program
PLF	Practical Learning Facility
PM	Preventative Maintenance
PSA	Probabilistic Safety Assessment
RP	Radiation Protection
SAR	Safety Analysis Report
SAT	Systematic Approach to Training
SCA	Safety and Control Area
SMAGS	Shielded Modular Above Ground Structures
SMR	Small Modular Reactor
SSC	Structure, System, Component
WMA	Waste Management Area
ZED	Zero Energy Deuterium

## GLOSSARY

For definitions of terms used in this document, see REGDOC-3.6 Glossary of CNSC Terminology, which includes terms and definitions used in the *Nuclear Safety and Control Act* (NSCA) [\[3\]](#) and the regulations made under it, and in CNSC regulatory documents and other publications. REGDOC-3.6 is provided for reference and information.

## **A. RATING LEVELS**

### **The licensee performance rating levels are defined by CNSC staff as: Fully Satisfactory (FS)**

Compliance with regulatory requirements is fully satisfactory. Compliance within the area exceeds requirements and CNSC expectations. Compliance is stable or improving, and any problems or issues that arise are promptly addressed.

### **Satisfactory (SA)**

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)**

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)**

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.

## B. BASIS FOR THE RECOMMENDATION(S)

### B.1 Regulatory Basis

The recommendations presented in this CMD are based on compliance objectives and expectations associated with the relevant SCAs and other matters. The regulatory bases for the matters that are relevant to this CMD are as follows.

#### Management System

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 3(d) that an application for a licence for a Class I nuclear facility shall contain the proposed management system for the activity to be licensed, including measures to promote and support safety culture.
- The *General Nuclear Safety and Control Regulations* require that an application for a licence shall contain, under the following paragraph:
  - 3(1)(k), the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the NSCA [3] and the Regulations made under the NSCA, including the internal allocation of functions, responsibilities and authority.
  - 15(a), the persons who have the authority to act for them (the applicant/licensee) in their dealings with the Commission.
  - 15(b), the names and position titles of the persons who are responsible for the management and control of the licensed activity and the nuclear substance, nuclear facility, prescribed equipment or prescribed information encompassed by the licence.

#### Human Performance Management

- It is a requirement of the *General Nuclear Safety and Control Regulations* under section 12, that the licensee shall:
  - 12(1)(a), ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the NSCA, the Regulations made under the NSCA [3], and the licence.
  - 12(1)(b), train the workers to carry on the licensed activity in accordance with the NSCA, the Regulations made under the NSCA, and the licence.
  - 12(1)(e), require that every person at the site of the licensed activity to use equipment, devices, clothing, and procedures in accordance with the NSCA, the Regulations made under the NSCA, and the licence.
- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 3(d.1) that a licence application contain the proposed human performance program for the activity to be licensed, including measures to ensure workers' fitness for duty.

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(m) that a licence application contain information on the proposed responsibilities, qualification requirements, and training program for workers including the procedures for the requalification of workers.
- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(n) that a licence application contain information on the results that have been achieved in implementing the program for recruiting, training, and qualifying workers in respect of the operation and maintenance of the nuclear facility.

### Operating Performance

- Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I nuclear facility contains the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.
- Subsection 24(5) of the *Nuclear Safety and Control Act* (NSCA) [3] states that the licence may contain any term or condition that the Commission considers necessary for the purpose of the NSCA.

### Safety Analysis

- 3(1)(i) of the *General Nuclear Safety and Control Regulations* requires that an application for a licence shall contain a description and the results of any test, analysis, or calculation performed to substantiate the information included in the application.
- It is a requirement of the *Class I Nuclear Facilities Regulations* that an application for a licence to operate a Class I nuclear facility shall contain the following information under paragraph:
  - 6(c), a final safety analysis report demonstrating the adequacy of the design of the nuclear facility.
  - 6(h), the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects.

### Physical Design

- Paragraph 3(1)(d) of the *General Nuclear Safety and Control Regulations* requires that an application for a licence shall contain a description of any nuclear facility, prescribed equipment, or prescribed information to be encompassed by the licence.
- Other requirements set out in paragraphs 3(a), 3(b), 6(a) and 6(b) of the *Class I Nuclear Facilities Regulations* require more specific information to be submitted in the licence application related to the site and design of the facility and the final safety analysis report.
- Paragraphs 6(c) and 6(d) of the *Class I Nuclear Facilities Regulations* require that an application for a licence contain a final safety analysis report demonstrating the adequacy of the design of the facility and proposed measures, policies, methods, and procedures for operating and maintaining the facility.

**Fitness for Service**

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(d) that an application for a licence to operate a Class I nuclear facility contain the proposed measures, policies, methods, and procedures for operating and maintaining the nuclear facility.

**Radiation Protection**

- The *General Nuclear Safety and Control Regulations* require, under subsection 3(1) that a licence application contain the following information under paragraph:
  - 3(1)(e), the proposed measures to ensure compliance with the *Radiation Protection Regulations*.
  - 3(1)(f), any proposed action level for the purpose of section 6 of the *Radiation Protection Regulations*.
- The *Radiation Protection Regulations* require, under sections 4 to 6 that the licensee implements a radiation protection program, ascertain and record doses, and take the required actions in the case that an action level has been reached.
- The *Class I Nuclear Facilities Regulations* require that an application for a licence to operate a Class I nuclear facility contain the following information under paragraph:
  - 6(e), the proposed procedures for handling, storing, loading, and transporting nuclear substances and hazardous substances.
  - 6(h), the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measure that will be taken to prevent or mitigate those effects.

**Conventional Health and Safety**

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 3(f) that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the proposed worker health and safety policies and procedures.
- The CRL's activities and operations must comply with the *Canada Labour Code* [28], *Part II: Occupational Health and Safety*.

**Environmental Protection**

- The *General Nuclear Safety and Control Regulations*, under paragraphs 12(1)(c) and (f) require that each licensee take all reasonable precautions to protect the environment and the health and safety of persons, and to control the release of radioactive nuclear substances and hazardous substances within the site of the licensed activity and into the environment.
- The *Radiation Protection Regulations* prescribe the dose limit for the general public, which under subsection 1(3) is 1mSv per calendar year.
- In addition, Sections 3 and 6 of the *Class I Nuclear Facilities Regulations* must be met by the applicant. The application for a licence shall contain under paragraph:

- 3(e), the name, form, characteristics, and quantity of any hazardous substances that may be on the site while the activity to be licensed is carried on.
- 3(g), the proposed environmental protection policies and procedures.
- 3(h), the proposed effluent and environmental monitoring programs.
- 6(e), the proposed procedures for handling, storing, loading, and transporting nuclear substances and hazardous substances.
- 6(h), the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects.
- 6(i), the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical, and radiological characteristics.
- 6(j), the proposed measures to control releases of nuclear substances and hazardous substances into the environment.

### **Emergency Management and Fire Protection**

- 12(1)(c) of the *General Nuclear Safety and Control Regulations* states that every licensee shall “take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities, and of nuclear substances”.
- 12(1)(f) of the *General Nuclear Safety and Control Regulations* states that every licensee shall “take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances within the site of the licensed activity and into the environment of the licensed activity...”.
- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 6(k) that a licence application contain information on the licensee’s proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of national security, including measures to:
  - Assist offsite authorities in planning and preparing to limit the effects of an accidental release.
  - Notify offsite authorities of an accidental release or the imminence of an accidental release.
  - Report information to offsite authorities during and after an accidental release.
  - Assist offsite authorities in dealing with the effects of an accidental release.
  - Test the implementation of the measures to prevent or mitigate the effects of an accidental release.

## Waste Management

- It is a requirement of the *General Nuclear Safety and Control Regulations* under paragraph 3(1)(j) that an application for a licence include the name, origin, quantity, form, and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed, or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste.

## Security

- Paragraph 3(1)(e) of the *General Nuclear Safety and Control Regulations* requires that an application for a licence contains the proposed measures to ensure compliance with the *Radiation Protection Regulations*, the *Nuclear Security Regulations* and the *Packaging and Transport of Nuclear Substances Regulations, 2015*.
- Paragraph 12(1)(c) of the *General Nuclear Safety and Control Regulations* requires the licensee to take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities and of nuclear substances.
- Paragraph 6(k) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I nuclear facility contains the proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances to the environment, the health and safety of persons and the maintenance of national security.
- Paragraph 2(a) of Part 1 of *Nuclear Security Regulations* states that Part 1 applies to Category I, II or III nuclear material.
- Subsection 24(5) of the *Nuclear Safety and Control Act* (NSCA) [3] states that the licence may contain any term or condition that the Commission considers necessary for the purpose of the NSCA.

## Safeguards and Non-Proliferation

- Subsection 24(5) of the *Nuclear Safety and Control Act* (NSCA) states that the licence may contain any term or condition that the Commission considers necessary for the purpose of the NSCA.
- Paragraph 12(1)(i) of the *General Nuclear Safety and Control Regulations* requires the licensee to take all necessary measures to facilitate Canada's compliance with any applicable safeguard agreement.
- Paragraph 6(f) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I nuclear facility contains the proposed measures to facilitate Canada's compliance with any applicable safeguards agreement. The applicable safeguards agreements are:
  - *Agreement Between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/164); and



- *Protocol Additional to the Agreement Between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/164/Add. 1).

### **Packaging and Transport**

- CNL is required to comply with the *Packaging and Transport of Nuclear Substances Regulations, 2015*, and Transport Canada's *Transportation of Dangerous Goods Regulations*.

### **Cost Recovery**

- Paragraph 24(2)(c) of the *Nuclear Safety and Control Act* requires that a licence application is accompanied by the prescribed fee.
- The *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations* (CRFR) set out the specific requirements based on the activities to be licensed.

### **Financial Guarantee**

- The *General Nuclear Safety and Control Regulations* requires under paragraph 3(1)(I) that a licence application contains a description of any proposed financial guarantee relating to the activity to be licensed.

### **Licensee Public Information Program**

- It is a requirement of the *Class I Nuclear Facilities Regulations* under paragraph 3(j) that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain information on the licensee's public information program.

## B.2 Technical Basis

The technical bases for the recommendations presented in this CMD are as follows. The following CNSC regulatory documents and CSA standards are relevant to CRL:

### Management System

- CSA N286, *Management system requirements for nuclear facilities*
- CAN/CSA-ISO 14001, *Environmental management systems – Requirements with guidance for use*
- CSA Z1000, *Occupational health and safety management*
- CSA N286.0.1, *Commentary on N286-12, Management system requirements for nuclear facilities*
- CSA N286.10, *Configuration management for high energy reactor facilities*

### Human Performance Management

- REGDOC-2.2.4, *Fitness for Duty: Managing Workers Fatigue*
- RD-363, *Nuclear Security Officer Medical, Physical, and Psychological Fitness*
- G-323, *Ensuring Presence of Sufficient Qualified Staff at Class I Nuclear Facilities: Minimum Staff Complement*
- REGDOC-2.2.2, *Personnel Training*, version 2

### Operating Performance

- REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs*
- REGDOC-2.3.2, *Accident Management*, version 2

### Safety Analysis

- REGDOC-2.4.1, *Deterministic Safety Analysis*
- REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants*
- RD-327, *Nuclear Criticality Safety*
- GD-327, *Guidance for Nuclear Criticality Safety*

### Physical Design

- RD-367, *Design of Small Reactor Facilities*
- RD/GD-352, *Design, Testing and Performance of Exposure Devices*
- *National Building Code of Canada*
- REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants*
- G-276, *Human Factors Engineering Program Plans*
- G-278, *Human Factors Verification and Validation Plans*
- GD-52, *Design Guide for Nuclear Substances Laboratories and Nuclear Medicine Rooms*

- CSA N285.0/N285.6 Series, *General requirements for pressure-retaining system and components in CANDU nuclear power plants / Material standards for reactor components for CANDU nuclear power plants*
- CSA B51, *Boiler, pressure vessel, and pressure piping code*
- CSA N285.0.1, *Commentary on CSA N285.0-12, General requirements for pressure-retaining systems and components in CANDU nuclear power plants*

**Fitness for Service**

- REGDOC-2.6.3, *Aging Management*
- CSA N291, *Requirements for Safety-Related Structures for CANDU Nuclear Power Plants*
- RD/GD-210, *Maintenance Programs for Nuclear Power Plants*

**Radiation Protection**

- G-129, Revision 1, *Keeping Radiation Exposures and Doses “As Low as Reasonably Achievable (ALARA)”*
- G-228, *Developing and Using Action Levels*

**Conventional Health and Safety**

- CSA Z460, *Control of hazardous energy – Lockout and other methods*
- CSA Z462, *Workplace Electrical Safety*

**Environmental Protection**

- REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures*, version 1.1
- N288.1, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear*
- N288.2, *Guidelines for calculating the radiological consequences to the public of a release of airborne radioactive material for nuclear reactor accidents*
- N288.3.4, *Performance testing of nuclear air-cleaning systems at nuclear facilities*
- N288.4, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*
- N288.5, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills facilities*
- N288.6, *Environmental risk assessment at class I nuclear facilities and uranium mines and mills*
- N288.7, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills*
- N288.8, *Establishing and implementing action levels for releases to the environment from nuclear facilities*

**Emergency Management and Fire Protection**

- REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response, version 2*
- N-1600, *General requirements for nuclear emergency management programs*
- N393, *Fire protection for facilities that process, handle, or store nuclear substances*
- *National Fire Code of Canada*

**Waste Management**

- CSA N292.1, *Wet storage of irradiated fuel and other radioactive materials*
- CSA N292.2, *Interim dry storage of irradiated fuel*
- CSA N292.3, *Management of low- and intermediate-level radioactive waste*
- CSA N292.0, *General principles for the management of radioactive waste and irradiated fuel*
- CSA N292.5, *Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substances*
- CSA N294, *Decommissioning of facilities containing nuclear substances*
- G-219, *Decommissioning Planning for Licensed Activities*
- G-320, *Assessing the Long term Safety of Radioactive Waste Management*

**Security**

- RD-321, *Criteria for Physical Protection Systems and Devices at High-Security Sites* (document contains prescribed information)
- RD-361, *Criteria for Explosive Substance Detection, X-ray Imaging, and Metal Detection Devices at High-Security Sites* (document contains prescribed information)
- REGDOC-2.12.1, *High-Security Sites: Nuclear Response Force* (document contains prescribed information)
- REGDOC-2.12.2, *Site Access Security Clearance*
- REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources*
- G-208, *Transportation Security Plans for Category I, II or III Nuclear Material*
- G-274, *Security Programs for Category I or II Nuclear Material or Certain Nuclear Facilities*
- N290.7, *Cyber-security for nuclear power plants and small reactor facilities*

**Safeguards and Non-Proliferation**

- RD-336, *Accounting and Reporting of Nuclear Material*
- GD-336, *Guidance for Accounting and Reporting of Nuclear Materials*
- REGDOC-2.13.2, *Import and Export*

Canada has entered into a safeguards agreement with the IAEA pursuant to its obligations under the *Treaty on the Non-Proliferation of Nuclear Weapons*. The objective of the Canada/IAEA Safeguards Agreement is for the IAEA to provide assurance on an annual basis to Canada and to the international community that all declared nuclear materials are in peaceful uses and that there is no indication of undeclared nuclear materials or activities. The IAEA safeguards conclusion for 2016 confirms that Canada is in compliance with its obligations under the following Canada/IAEA Safeguards Agreements: *Agreement Between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*; and

*Protocol Additional to the Agreement Between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*.

### **Packaging and Transport**

- RD-364, *Joint Canada-United States Guide for Approval of Type B(U) and Fissile Material Transportation Packages*
- REGDOC-2.14.1, *Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substances Regulations, 2015*

### **Aboriginal Consultation**

- REGDOC-3.2.2, *Aboriginal Engagement*

### **Financial Guarantee**

- G-206, *Financial Guarantee for the Decommissioning of Licensed Activities*

### **Licensee Public Information Program**

- RD/GD-99.3, *Public Information and Disclosure*

## C. SAFETY AND CONTROL AREA FRAMEWORK

### C.1 Safety and Control Areas Defined

The safety and control areas identified in subsection 2.3, and discussed in summary in subsections 3.1 through 3.14 are comprised of specific areas of regulatory interest which vary between facility types.

The following table provides a high-level definition of each SCA. The specific areas within each SCA are defined and presented below in section C.2 of this CMD.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	Safety and Control Area	Definition
<b>Management</b>	Management System	Covers the framework which establishes the processes and programs required to ensure an organization achieves its safety objectives and continuously monitors its performance against these objectives and fostering a healthy safety culture.
	Human Performance Management	Covers activities that enable effective human performance through the development and implementation of processes that ensure that licensee staff are sufficient in number in all relevant job areas and that licensee staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.
	Operating Performance	This includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.
<b>Facility and Equipment</b>	Safety Analysis	Maintenance of the safety analysis that supports that 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.
	Physical Design	Relates to activities that impact on the ability of systems, components and structures to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.
	Fitness for Service	Covers activities that impact on the physical condition of systems, components and structures 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.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	Safety and Control Area	Definition
<b>Core Control Processes</b>	Radiation Protection	Covers the implementation of a radiation protection program in accordance with the Radiation Protection Regulations. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA.
	Conventional Health and Safety	Covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.
	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.
	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.
	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.
	Security	Covers the programs required to implement and support the security requirements stipulated in the regulations, in their licence, in orders, or in expectations for their facility or activity.
	Safeguards and Non-Proliferation	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.
	Packaging and Transport	Programs that cover the safe packaging and transport of nuclear substances and radiation devices to and from the licensed facility.

## C.2 Specific Areas for this Facility Type

The following table identifies and defines the specific areas that comprise each SCA for Chalk River Laboratories:

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
Management System	Management System	This specific area brings together in a planned and integrated manner the processes necessary to satisfy regulatory requirements, and organize, manage, direct and control licensee personnel in the safe operation of the CRL.
	Organization	This specific area consists of measures to ensure that all roles and responsibilities within the organization are defined, established, and understood.
	Performance Assessment, Improvement and Management Review	This specific area consists of measures to ensure the licensee's management reviews and assesses performance and identifies improvements.
	Operating Experience (OPEX)	This specific area consists of measures to assess operating experience (internal, external and benchmarking) to help problems identification and resolution.
	Change Management	This specific area consists of measures to control required changes to management system framework, organization, authorities, accountabilities and responsibilities, and physical or operational changes to the facility.
	Safety Culture	This specific area consists of behavior and attitude towards safety which is the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management.
	Configuration Management	This specific area consists of measures to ensure conformance between design requirements, physical configuration and facility configuration information can be achieved.
	Records Management	This specific area consists of measures to control documented information from its creation until its eventual disposal to ensure adequate availability, format, results achieved, and appropriateness for use.



SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
	Management of Contractors	This specific area consists of the measures to manage suppliers of items and services while retaining the overall responsibility for control and oversight of safety and security of its business, including work carried out on its behalf.
	Business Continuity	This specific area consists of measures to address and minimize the impact of disruptions, caused by both internal and external factors, which affect the safe operation.
Human Performance Management	Human Performance Program	This specific area consists of measures to facilitate work and minimize human error.
	Personnel Training	This specific area consists of measures to train licensee personnel using a SAT-based training management system that identify and analyze training needs, design and plan the training, deliver the training, evaluate training outcomes, and monitor and improve the training processes to achieve objectives. The underlying principles emphasize the provision of the right skills, knowledge and attitudes, to the right people, at the right time, to ensure that they can safely operate and maintain nuclear equipment and facilities.
	Personnel Certification	This specific area consists of measures to support moving certification candidates through selection, training, examination and initial or renewal authorization for positions that require CNSC certification.
	Work Organization and Job Design	This specific area consists of measures for planning, organizing, designing and authorizing work.
	Fitness for Duty	This specific area consists of measures to monitor and ensure that workers are physically and mentally capable of performing the duties of their employment or assigned tasks.
Operating Performance	Conduct of Licensed Activity	This specific area consists of measures to ensure that day-to-day operations are performed safely and kept within the licensing basis.
	Reporting and Trending	This specific area consists of measures to ensure that operational performance and areas for improvement within the organization are shared and communicated.

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
	Outage Management Performance	This specific area consists of planning, scheduling and conducting, outside of normal operational processes, the specialized testing, maintenance and corrective actions conducted during NRU reactor shutdown.
	Accident Management and Recovery	This specific area consists of measures to ensure that the operation of the NRU reactor can be returned to a safe and controlled state by control room personnel should operation deviate from normal during non-routine and emergency conditions (within the design basis accident).
	Severe Accident Management and Recovery	This specific area consists of measures to ensure that NRU reactor accident conditions, more severe than a design basis accidents and involving significant core damage, are addressed in actions to be taken to limit damage, mitigate the consequences and to achieve a safe, stable state of the reactor over the long term and the preparatory measures necessary for implementation of such actions.
Safety Analysis	Deterministic Safety Analysis	This specific area consists of the process of analyzing facility responses to an event performed using predetermined rules and assumptions. Deterministic safety analysis can use either conservative or best-estimate methods.
	Hazard Analysis	This specific area consists of the process of recognizing hazards that may arise from a system or its environment, documenting their unwanted consequences and analyzing their potential causes.
	Probabilistic Safety Analysis	This specific area consists of comprehensive and integrated statistical analysis of the safety of NRU reactor. The probabilistic safety analysis considers the probability, progression and consequences of equipment failures or transient conditions to derive numerical estimates that provide a consistent quantified measure of the safety of the NRU reactor for combinations of events.
	Criticality Safety	This specific area consists of analyzing work practices and processes to prevent nuclear criticality accidents under both normal and credible abnormal conditions involving fissionable materials outside reactors, and recommending criticality safety controls to prevent nuclear criticality accidents.

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
	Severe Accident Analysis	This specific area consists of analytical studies used to demonstrate how safety requirements are met and accident management measures are implemented to mitigate the accident consequences leading to severe core damage in NRU reactor, or large release of radioactive substances.
Physical Design	Design Governance	This specific area consists of the overall conceptual design of the facility and the operation of all its systems, structures and components together.
	Site Characterization	This specific area consists of descriptions of the distinguishing characteristics, qualities, physical features, and environment of the piece of land on which the nuclear facility is located, and topics that have a direct bearing on the design of the nuclear facility.
	Facility Design	This specific area consists of the facility design, including the layout of the facility itself.
	Structure Design	This specific area consists of the design of the materials and building that houses and physically supports the systems, structures and components which comprise the nuclear facility.
	System Design	This specific area consists of design of complete systems which deliver a specified function (usually identified in the safety analysis) within the operation of the nuclear facilities.
	Component Design	This specific area consists of design of individual components that make up the systems and structures of the nuclear facilities.
Fitness for Service	Equipment Fitness for Service / Equipment Performance	This specific area consists of measures to preserve the equipment and ensure that the systems, structures and components (SSCs) are always capable of performing their design functions.
	Maintenance	This specific area consists of measures for planning, monitoring, scheduling and executing work activities that SSCs continue to meet design specifications; prevent future degradation; or correction current failure and impairments.

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
	Aging Management	This specific area consists of measures that ensure reliability and availability of required safety functions of SSCs throughout the service life of the facility. Aging management addresses both physical aging and obsolescence of SSCs.
	Structural Integrity	This specific area consists of measures to ensure that a structure is able to perform its required function by proper design, aging management, inspection and testing of the structure.
	Chemistry Control	This specific area consists of measures to ensure the integrity, reliability and availability of the main SSCs important to safety by minimizing the harmful effects of chemical impurities and corrosion, buildup of radioactive contamination, and releases to the environment.
	Periodic Inspection and Testing	This specific area consists of measures to ensure in-service inspection and testing programs are effective and proactive to ensure on-going monitoring in accordance with the applicable standards.
Radiation Protection	Application of ALARA	This specific area consists of measures to ensure that doses to workers are kept As Low As Reasonably Achievable (the ALARA principle), social and economic factors being taken into account.
	Worker Dose Control	This specific area consists of measures to ensure the control of occupational exposure to radiation and to report on the radiation doses received by workers.
	Radiation Protection Program Performance	This specific area consists of measures to ensure the effectiveness of the RP program in protecting the health and safety of persons, including performance against objectives, goals and targets, and continuous improvement initiatives.
	Radiological Hazard Control	This specific area consists of measures to ensure the control of radiological hazards and radiation exposures.
	Estimated Dose to the Public	This specific area consists of measure to ensure the ascertainment and recording of radiation doses received by the public.
Conventional Health and Safety	Practices	This specific area consists of measures to ensure that managers and workers are actively involved in, support, and enforce safety practices associate with specific task.

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
	Awareness	This specific area consists of measures to ensure that managers and workers have the knowledge to identify workplace hazards and precautions associated with specific tasks.
	Performance	This specific area covers measures to monitor, track, and report the level of occupational safety of workers.
Environmental Protection	Effluent and Emissions Control (Releases)	This specific area covers measures to ensure monitoring of effluent and environmental releases of radioactive and hazardous substances, and maintain them within limits.
	Environmental Management System (EMS)	This specific area is part of CNL's management system used to develop and implement its environmental policy and manage its environmental aspects.
	Assessment and Monitoring	This specific area covers measures to ensure assessment and monitoring of the concentration of nuclear and/or hazardous substances in the environment to assess: exposure or the potential effects on human health and safety; the effects on the environment; the intensity of physical stressors and/or their potential effect on the environment; and the physical and biological parameters of the environment.
	Protection of the Public	This specific area covers measures to assess the predicted human health effects of measured and potential quantities of hazardous substances in the environment (abiotic and biotic) as a result of the operation of the nuclear facility.
	Environmental Risk Assessment	This specific area covers measures to identify potential adverse biological effects and for predicting the magnitude, probability, and significance of the identified effects on both ecological and human components of the environment.
Emergency Management and Fire Protection	Nuclear Emergency Preparedness and Response	In order to respond effectively to nuclear emergencies, licensees must establish and maintain an emergency plan associated with an emergency preparedness program, and must conduct simulated emergencies drills and exercises to ensure that staff are capable of responding.
	Fire Emergency Preparedness and Response	This specific area covers measures to ensure fire prevention and that the licensee has sufficient fire response personnel and resources to respond to any onsite fires.

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
	Conventional Emergency Preparedness and Response	CNL continues to maintain effective conventional emergency response programs. Emergency response personnel are available on site 24 hours a day to respond to any type of emergency. Training and equipment continue to be maintained for medical response, hazardous materials and other conventional hazards that may be present. CNSC staff conclude CNL's conventional emergency response programs meet regulatory requirements.
Waste Management	Waste Characterization	This specific area covers measures to ascertain the physical, chemical, biological, and radiological properties of the waste in order to determine the hazard presented by the waste, its processing and management.
	Waste Minimization	This specific area covers measures to minimize the physical volume of waste material that may require further processing and management. Waste minimization can also be achieved by reducing or eliminating sources of contamination and recycling.
	Waste Management Practices	This specific area covers measures to manage wastes from the point of generation through to the period where wastes are no longer subject to licensee controls. Waste management includes delivery, processing, storage and transfer of all waste streams associated with nuclear substances, hazardous and conventional wastes.
	Decommissioning Plans	This specific area covers plans describing how the CRL facilities and/or the CRL site itself will be retired permanently from service and rendered to a predetermined end-state.
Security	Facilities and Equipment	This specific area consists of measures to ensure that security systems, devices and equipment provide deterrence, detection, assessment and delay functions and the maintenance of operational readiness.
	Security Practices	This specific area consists of measures enabling the implementation of administrative and technical measures, which are maintained and documented in a security program.
	Response Arrangements	This specific area consists of measures to ensure onsite and offsite response arrangements provide effective response to unauthorized removal of nuclear/radioactive material or to the sabotage of nuclear facilities.

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Safety and Control Area	Specific Areas	Definition
	Drills and Exercises	This specific area consists of measures to ensure response personnel are trained and capable. This includes conducting realistic drills and exercises to test the performance of security systems, processes and procedures.
Safeguards and Non-Proliferation	Nuclear Material Accountancy and Control	This specific area consists of measures which ensure the collection, storage and reporting to the CNSC and IAEA on the inventory and transfer of fissionable and fertile substances.
	Access and Assistance to the IAEA	This specific area consists of measures which ensure that the IAEA is able, upon request, to access the licensee's facility for inspections and other verification activities, and which provide for the provision of licensee's personnel and resources to support such activities.
	Operational and Design Information	This specific area consists of measures to collect, store, and report relevant operational information to the CNSC and the IAEA, and ensure that the facility's Design Information Questionnaire is complete and correct, and updates reported to the CNSC.
	Safeguards Equipment, Containment and Surveillance	This specific area consists of measures which ensure that the licensee provides adequate resources (power, lighting) to IAEA equipment, and IAEA equipment and seals are protected.
Packaging and Transport	Packaging and Transport	This specific area consists of measures to ensure that all nuclear substances are properly packaged when shipped offsite.
	Package Design and Maintenance	This specific area consists of measures to ensure that all shipping packages are design and maintained in accordance with the applicable requirements.
	Registration for Use	This specific area consists of measures that are in place to ensure certified packages are registered prior to transport.

## D. SUPPORTING DETAILS

### D.1 CRL Performance Ratings for Past Years

Safety and Control Area	Rating					
	2012	2013	2014	2015	2016	2017 <sup>1</sup>
Management System	BE	SA	SA	SA	SA	SA
Human Performance Management	SA	SA	SA	SA	SA	SA
Operating Performance	SA	SA	SA	SA	SA	SA
Safety Analysis	SA	SA	SA	SA	SA	SA
Physical Design	SA	SA	SA	SA	SA	SA
Fitness for Service	BE	BE	BE	BE	BE	SA
Radiation Protection	SA	SA	SA	SA	SA	SA
Conventional Health and Safety	SA	SA	SA	SA	SA	SA
Environmental Protection	SA	SA	SA	SA	SA	SA
Emergency Management and Fire Protection	SA	SA	SA	SA	SA	SA
Waste Management	SA	SA	SA	SA	SA	SA
Security	SA	SA	SA	SA	SA	SA
Safeguards and Non-Proliferation	SA	SA	SA	SA	SA	SA
Packaging and Transport	SA	SA	SA	SA	SA	SA

<sup>1</sup> For the period of January 1 to June 30, 2017



## **E. ENVIRONMENTAL ASSESSMENT REPORT**

e-Doc 5256244 (Word)

e-Doc 5325993 (PDF)





# **Environmental Assessment Report: Canadian Nuclear Laboratories Chalk River Laboratories Nuclear Research and Test Establishment Licence**

**September 2017**

e-Doc: 5256244 (Word)

e-Doc: 5325993 (PDF)





# REVISION HISTORY

The following table identifies the revision history of this document.

Revision number	Change	Summary of changes	Date
000	Initial release	N/A	
001			



## EXECUTIVE SUMMARY

The Canadian Nuclear Safety Commission (CNSC) conducts environmental assessments (EAs) under the *Nuclear Safety and Control Act* (NSCA) for all projects, in accordance with its mandate, to ensure the protection of the environment and the health of persons. The safety component of the CNSC's mandate is covered in the safety case assessment carried out for all projects.

This EA Report, written by CNSC staff for the Commission and the public, describes the findings of the EA under the NSCA completed for the licence application by Canadian Nuclear Laboratories Ltd. (CNL) to renew the Chalk River Laboratories (CRL) Nuclear Research and Test Establishment Operating Licence, NRTEOL-01.00/2018. This licence covers the operation of the CRL site, which houses various licensed nuclear facilities, including research reactors, a molybdenum processing facility, a nuclear fabrication laboratory, shielded facilities, a waste management area, a waste treatment centre, a recycled fuel fabrication laboratory and tritium-handling facilities. This EA report (and licence application) does not consider CNL's proposed Near Surface Disposal Facility, as the proposed NSDF project is undergoing a separate *Canadian Environmental Assessment Act* (CEAA) 2012 process.

This EA Report includes CNSC staff's assessment of the licence application and the documents submitted in support of the application, the site-wide environmental risk assessment (ERA), annual safety (environmental monitoring) reports and compliance verification activities (e.g., inspections, audits, reviews) conducted at the CRL site, as well as the findings of the CNSC's Independent Environmental Monitoring Program (IEMP).

The EA Report focuses on environmental topics that are of current public and regulatory interest such as, releases to air and water, health of the surrounding populations, and the protection of groundwater, surface water, aquatic and terrestrial environments.

CNSC staff's conclusions are based on, but are not limited to, the following, that:

- CNL's environmental protection programs meet CNSC regulatory requirements
- the findings and methodology of CNL's site-wide ERA are in compliance with Canadian Standards Association (CSA Group) standard N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*
- the results of the CNSC's 2012, 2013 and 2015 IEMP confirm that the public and the environment in the vicinity of the CRL site are protected from the releases from the site

Based on the EA under the NSCA conducted for this licence application, CNSC staff conclude that CNL has made, and will continue to make, adequate provision for the protection of the environment and the health of persons, up until and including the decommissioning and abandonment of the site.

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## 1.0 INTRODUCTION

### 1.1 Purpose

The purpose of this Environmental Assessment (EA) Report is to document the results of the EA conducted under the *Nuclear Safety and Control Act* (NSCA) for the licence application by Canadian Nuclear Laboratories Ltd. (CNL) to renew the Chalk River Laboratories (CRL) Nuclear Research and Test Establishment Operating Licence, NRTEOL-01.00/2018, [1] for a period of 10 years. The EA under the NSCA was conducted to determine whether CNL has made, and will continue to make, adequate provisions for the protection of the environment and the health of persons up until and including the decommissioning and abandonment of the site. The safety component of the Canadian Nuclear Safety Commission's (CNSC) mandate is covered in the safety case assessment carried out for all projects.

This EA Report will be used as a mechanism to communicate to the public, Indigenous communities and the Commission the current status of the site and its activities. This EA Report is based on information submitted by CNL and activities completed by CNSC staff, and includes the following:

- regulatory oversight (section 2)
- CNSC staff review of the site-wide ERA (section 2.1.1)
- CNSC staff review of the recent Preliminary Decommissioning Plan (PDP) (section 2.2)
- update on the status of the environment (section 3)
- Independent Environmental Monitoring Program (IEMP) results (section 4)

An analysis has been conducted for all components related to the proposed licence application, but only a selection of topics are presented in detail in this report. Topics were selected as those of interest to the Commission, members of the public, Indigenous communities, or of regulatory interest. These topics are atmospheric, aquatic, geological, hydrogeological, and terrestrial environments, and human health.

CNSC staff assess the environment at every phase of a project and its activities, and will continue to do so until the decommissioning and abandonment of the site. An EA under the NSCA is carried out at every phase of the lifecycle of a nuclear facility or activity and assesses impacts for the entire lifecycle of a project.

### 1.2 Background

The CRL site is located in the province of Ontario within the town of Chalk River, a small rural village within Renfrew County approximately 10 km east of the Deep River. The current CRL Nuclear Research and Test Establishment Operating Licence, NRTEOL-01.00/2018, [1] expires on March 31, 2018. This licence covers the operation of the CRL site, which houses various licensed nuclear facilities, including research reactors, a molybdenum processing facility, a nuclear fabrication laboratory, shielded facilities, a waste management area, a waste treatment centre, a recycled fuel fabrication laboratory and tritium handling facilities.

On March 30, 2017, CNL submitted an application for the renewal of their operating licence, NRTEOL-01.00/2018 for a 10-year term. [2]

CNL has indicated their intent to use the proposed 10-year licence period to consolidate and modernize the CRL site. In particular, CNL intends to focus the proposed 10-year licence period on several programs and initiatives, including the National Research Universal (NRU) reactor shutdown on March 31, 2018 and the subsequent transition from regular production operation to a state suitable for storage with surveillance, as well as the decommissioning and demolishing of over 120 buildings to reduce liabilities, remove redundant buildings, and reduce the risk of high residual hazards.

CNL's licence application does not include the proposed Near Surface Disposal Facility (NSDF), which is the subject of a separate EA process under CEAA 2012. Details of the CEAA EA will be presented to the Commission in 2018, and will require a Commission Decision. More information on the NSDF, including how the public and Indigenous groups can participate, is available on the [CNSC website](#).

**Figure 1.1: Aerial view showing the Built-up Region of the CRL, which includes the Controlled Area and the Supervised Area**



Source: Image taken from Google Images

## 2.0 REGULATORY OVERSIGHT

The CNSC regulates nuclear facilities and activities in Canada to protect the environment and the health and safety of persons in a manner that is consistent with Canadian environmental policies, acts and regulations and with Canada's international obligations.

To meet the CNSC's regulatory requirements, CNL is responsible for implementing and maintaining environmental protection measures that identify, control and (where necessary) monitor all releases of radioactive and non-radioactive (i.e., hazardous) substances and effects on the environment, including the public, from the CRL site. These environmental protection measures must comply with, or have implementation plans in place to comply with the regulatory requirements and technical requirements and guidelines set out in:

- CNSC Regulatory Document, *REGDOC-2.9.1, Environmental Protection: Environmental Protection Policies, Programs and Procedures* (2013) [3]
- CSA Group Standard N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills* [4]
- CSA Group Standard N288.5-11, *Effluent monitoring program at Class I nuclear facilities and uranium mines and mills* [5]
- CSA Group Standard N288.6-12, *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills* [6]

Compliance activities of verification, enforcement and reporting are in place to ensure that CNSC licensees exhibit a high level of compliance with the CNSC's regulatory framework. CNL is required to submit to the CNSC annual environmental monitoring reports that detail the results of the environmental protection measures related to the operations at the CRL site. These annual reports are reviewed by CNSC staff and are publicly accessible upon request.

CNL also provides summaries of the above noted reports and makes them available to the public via the [CNL website](#).

The following sections provide information on the CNSC's regulatory oversight of environmental protection measures at the CRL site.

### 2.1 Environmental Protection Measures

Environmental protection measures identify, control and monitor releases of radioactive and non-radioactive substances from facilities, activities and their effects on the environment.

Environmental protection measures are an important component of the overall requirement for licensees to make adequate provision for the protection of the environment and the health of persons.

**Note:** Environmental protection measures may also be referred to as environmental protection programs. Applicants and licensees are not required to update their management system or other documents to reflect the term "environmental protection measures", but they must meet the requirements listed below.

The necessary environmental protection measures required for the CRL site are described in this section.

### 2.1.1 Environmental Risk Assessment

An Environmental Risk Assessment (ERA) is a systematic process that evaluates the likelihood that adverse effects may occur or are occurring as a result of physical disturbances (stressors) or releases of radioactive or non-radioactive substances, and the severity or significance of those adverse effects. An ERA is a practice or methodology that provides science-based information to support decision-making and to prioritize the implementation of mitigation measures.

An ERA:

- identifies proposed activity characteristics and site-specific environmental characteristics
- identifies interactions between activities and the environment
- assesses the likelihood and significance of these interactions and the resulting potential effects on the environment and the health of persons
- is used to demonstrate protection of the environment and human health under the NSCA, and should be conducted every five-years, or when major changes have occurred to the facility, or when new scientific information becomes available

CNL submitted an ERA [7] for the CRL site in accordance with CSA Group Standard N288.6-12, *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills* [6] in December 2013. ERAs have been previously conducted for the CRL operations and CNL has used the results effectively to assess environmental performance relative to ERA predictions and inform the updated ERA. In 2014, CNSC staff reviewed the ERA submitted in 2013 and determined it to be aligned with the CSA standard.

The objective of the ERA for the CRL site was to update the Ecological Effects Review (EER) conducted in 2005, [8] using more recent environmental data, including data from EER follow-up studies, and takes into consideration the CSA Group Standard N288.6-12, following its release in 2012. [6] Specific objectives consistent with the CSA Group Standard N288.6-12 were to evaluate the risk to human and non-human biota resulting from exposure to contaminants and stressors related to the CRL site and its activities and to recommend further monitoring or assessment, based on the results, in order to clarify risks or reduce uncertainties in the assessment. The natural environment considered in this ERA included all locations outside operational areas, both on-site and off-site, that may have been subject to adverse impacts arising from CRL site operations. Further, the updated ERA is a method to identify opportunities for continual improvement including the need for additional mitigation measures if required.

CNL's predictions and conclusions of the ERA are summarized in table 2.1. The predicted ecological and human health risks due to releases to air and water from the CRL operations are consistent with the overall conclusions of previous EAs completed for the licensed nuclear facilities on the CRL site (see table 2.3 for list of previously completed EAs).

**Table 2.1: Summary of CNL's 2013 environmental risk assessment conclusions**

Type	Members of the public	Aquatic biota	Terrestrial biota
<b>Radiological</b>	No adverse impacts expected from radiological contaminants of potential concern (COPCs) released from the CRL site.	No adverse impacts expected from radiological COPCs released from the CRL site with the exception of the radio-strontium groundwater plumes. Potential effects to a small number of aquatic species in the Perch Lake watershed are unlikely to affect population levels though. Additionally, active and planned decommissioning activities should further mitigate the effects of contaminant plumes. Please see section 3.4.3: Aquatic Environment – Radiological Contaminants for more information.	No adverse impacts expected from radiological COPCs released from the CRL site with the exception of some terrestrial biota that are predicted to receive exposures above benchmarks, mostly due to cesium-137 from contaminant plumes. However, these doses are unlikely to lead to adverse impacts at the population level. Additionally, active and planned decommissioning activities will further mitigate the effects of contaminant plumes. Please see section 3.4.4: Terrestrial Environment – Radiological Contaminants for more information.
<b>Non-Radiological</b>	No adverse impacts expected from non-radiological COPCs released from the CRL site.	No adverse impacts expected from non-radiological COPCs released from the CRL site with the exception of some aquatic biota that are predicted to receive chemical exposures above benchmarks, principally from copper and iron. However, adverse impacts to aquatic biota are not expected as most benchmark exceedances are predicted to be marginal. Please see section 3.4.3: Aquatic Environment – Non-Radiological Contaminants for more information.	No adverse impacts expected from non-radiological COPCs released from the CRL site with the exception of some terrestrial biota that are predicted to receive chemical exposures above soil benchmarks, principally from cadmium, copper, zinc and iron. However, adverse impacts to terrestrial biota are not expected as most benchmark exceedances are predicted to be marginal. Please see section 3.4.4: Terrestrial Environment – Non-Radiological Contaminants for more information.
<b>Physical*</b>	No adverse impacts to human health expected from noise.	No adverse impacts to aquatic biota expected from thermal releases to the aquatic environment. Furthermore, there are no adverse impacts to aquatic biota, at the population level, expected from impingement and entrainment.	No adverse impacts to terrestrial biota from physical stressors. Mitigation measures were put in place, including turtle crossing signs and silt fences. Road grading during the spring nesting season was curtailed and a nest management program was implemented as a turtle conservation measure.

\* Physical stressors for aquatic receptors include entrainment/impingement of aquatic biota and thermal releases to the aquatic environment. Physical stressors for terrestrial receptors include noise, road kill and habitat alteration.



Following the technical review of the ERA, CNSC staff agreed with the conclusions of the ERA as summarized in table 2.1, and staff are of the opinion that the ERA for the CRL site is in compliance with CSA Group Standard N288.6-12. [6] However, CNSC and CNL staff did work to develop closure criteria concerning 10 recommendations that came out of the ERA. [7] These recommendations were developed to resolve gaps, address uncertainties and increase transparency of inputs and results for future ERAs concerning the CRL site. In December 2014, an ERA Recommendations Work Plan was submitted to CNSC staff in order to provide a breakdown of timelines for completion and expected deliverables. [9]

An outline and status update for each of the ERA recommendations is presented in table 2.2.

**Table 2.2: ERA recommendations and status update**

No.	Recommendations	Current status	Next steps	Closure date
1	Investigate benchmark exceedances from ERA [7]	In progress	Field sampling will span three years (2015-2017) in order to address this recommendation. Year one (2015) and two (2016) of the sampling plan are complete. The next ERA will include results for the full three-year sampling plan and revised upper limits of background, screening limits and risk benchmarks in soil, sediment and water for all parameters monitored.	Next ERA submission – December 2018
2	Demonstrate effectiveness of South Swamp plume capture technology	In progress	Capture efficiency (of strontium-90) was virtually 100% in 2015. Monitoring will continue in 2016 and 2017 and results will be presented in the updated ERA	Next ERA submission – December 2018
3	Implement vegetation control programs in most Waste Management Areas	Complete	Not applicable	Not applicable
4	Conduct ecological risk assessment of sediments in the Ottawa River	Complete	Not applicable	Not applicable
5	Assess dose and potential effects to Chimney Swift population on CRL site	Complete	CNSC staff review	To be determined
6	Impingement and entrainment monitoring	In progress	Lake sturgeon mortality counts are on-going (2016/2017) and targeted impingement and entrainment monitoring has	Next ERA submission – December 2018



No.	Recommendations	Current status	Next steps	Closure date
			continued into 2017. The next ERA will include the updated impingement and entrainment assessment.	
7	Report on soil excavation activities	Complete	Not applicable	Not applicable
8	Define ERA and measurement endpoints for environmental values that CNL has previously determined – valued ecosystem components	In progress	The next ERA will include a defined list of assessment and measurement endpoints, and these endpoints will guide revisions to current CNL environmental monitoring	Next ERA submission – December 2018
9	Investigate chlorine releases from Storm Outfalls 030 and 040	Delayed	Supplementary study concerning chlorine releases complete. Investigation is expected to be closed by the end of 2017	Planned completion is at the end of 2017
10	Communicate risk quotients to CNL risk managers	In progress	Updated risk quotients will be sent to CNL risk managers for inclusion in remediation plans for the CRL site once risk quotients for each area of concern in the ERA [7] are confirmed	Next ERA submission – December 2018

As required, CNL's 2013 ERA will be reviewed and revised in 2018, unless there is a significant change (in either the facility or activity or in the science on which the ERA is based) that requires an earlier update to the ERA. CNL has indicated their intention to submit an updated ERA in December 2018.

CNL's ERA for the CRL site was a significant source of information used to inform the Description of the Environment (section 3.4) detailed later in this EA report. As such, the results of the ERA are discussed in more detail throughout section 3.4. Additionally, Annual Safety Reports containing annual effluent and emissions monitoring results have been submitted annually since the last ERA was conducted on the CRL site, and the information from these reports also contributed significantly to the Description of the Environment sections in this EA report.

### 2.1.2 Environmental Management System

An Environmental Management System (EMS) refers to the management of an organization's environmental policies, programs and procedures in a comprehensive, systematic, planned and documented manner. It includes the organizational structure, planning and resources for developing, implementing and maintaining policies related to environmental protection.

An EMS is the integrated set of documented activities (policies, programs and procedures) that provide a framework for action with respect to environmental protection. An EMS encompasses:

- control measures on releases and wastes to prevent or mitigate environmental effects

- demonstration of the effectiveness of those control measures
- training of personnel
- public disclosure and information

CNL has established and implemented an EMS, integrated into the corporate wide management system, in accordance with REGDOC-2.9.1, *Environmental Protection: Environmental Protection Policies, Programs and Procedures* [3] as referenced in CNL's licensing basis. The EMS assesses environmental risks associated with its nuclear activities to ensure these activities are conducted in a way that prevents or mitigates adverse environmental effects.

While certification to CAN/CSA ISO 14001 by an authorized registrar, or other independent third party, is not solely considered by the CNSC as meeting the requirements of REGDOC-2.9.1, CNL's EMS is registered to the CSA ISO 14001: 2004 Standard, *Environmental Management Systems – Requirements with Guidance for Use* and the results of audits required to maintain CNL's status under this standard are reviewed by CNSC staff as part of the compliance program.

### **2.1.3 Effluent and Emissions Control and Monitoring**

Controls on environmental releases are established to provide protection to the environment and to respect the principles of sustainable development and pollution prevention. The effluent and emissions preventive and control measures are established on the basis of best industry practice, incorporating the application of the best available technology and techniques economically achievable (BATEA) and as low as reasonably achievable (ALARA) principles, process optimization, continuous improvement and the results of an ERA.

Licensee's effluent and emissions monitoring is the primary indicator of performance in terms of releases to air, surface water, groundwater and soil from both activity operations and waste management activities. This type of monitoring addresses both the nature and quantities of releases of radioactive and non-radioactive substances.

CNL has implemented and maintains an Effluent Verification Monitoring Program at the CRL site. [10] [11] CNL's reported radiological and non-radiological releases at CRL during the licensing period have remained below their respective regulatory limits.

CNL completed the implementation of CSA Group Standard N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [5] during the current licence period.

Throughout the licence term, CNSC staff conducted both focused and general compliance inspections which included various aspects of environmental protection. As part of the CNSC's compliance verification program, in 2015, CNSC staff conducted a desktop review inspection of this program and concluded that the control, monitoring and reporting of releases at the CRL site are adequate and in compliance with regulatory requirements. Additionally, CNSC staff conducted a Type II compliance inspection of CNL's Environmental Protection Program Airborne and Liquid Effluent Verification Monitoring in 2016. CNSC staff found no items of non-compliance with the criteria assessed. Therefore, no compliance actions or recommendations were issued.

As per reporting requirements outlined in the licence and licence condition handbook (LCH), [12] CNL provides reports of performance data for the CRL site and its associated operations, which are reviewed by CNSC staff to ensure that CNL's current Effluent Verification Monitoring Program for the CRL site continues to provide adequate protection of the environment. Based on

the review and assessment of the results presented in CNL's reports and CNSC staff compliance verification activities, CNSC staff conclude that the Effluent Verification Monitoring Program currently in place for the CRL site does continue to provide adequate protection to the environment. For further details on CNSC staff's analysis of effluent and emissions released from the CRL site, see sections 3.4.1, Atmospheric Environment and 3.4.3, Aquatic Environment.

### 2.1.4 Environmental Monitoring

CNL's environmental monitoring program (EMP) is designed to sample, measure, analyze, interpret and report the following in the vicinity of the CRL site:

- concentration of radioactive and non-radioactive substances in environmental media
- effect, or lack of effect, on biological organisms or communities if such potential is predicted by the ERA or required by legislation
- intensity of physical stressors and their potential effect on human health and the environment
- physical, chemical and biological parameters of the environment normally considered in the design of the environmental monitoring necessary to support the interpretation of the results

Routine monitoring of environmental impacts from CRL operations is carried out under its integrated EMP [10] using a wide range of effluent, groundwater and environmental monitoring activities. The integrated EMP [10] is designed and managed according to CSA Group Standard N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills* [4] and CSA Group Standard N288.5-11, *Effluent monitoring program at Class I nuclear facilities and uranium mines and mills*. [5]

Based on the integrated EMP, [10] environmental samples from different pathways of the food chain are collected from various offsite locations and analyzed. Data from the program are also used to assess public doses resulting from the routine operation of the CRL site, and to verify predictions made in ERAs.

As per reporting requirements outlined in the licence and LCH, [12] CNL provides reports of performance data for the CRL site and its associated operations which are reviewed by CNSC staff to ensure that CNL's Environmental Protection Program currently in place for the CRL site continues to provide adequate protection to the environment. As a result of these reviews, CNSC staff conclude that CNL's Environmental Protection Program currently in place for CRL is in compliance with CSA Group Standard N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills* [4] and CSA Group Standard N288.5-11, *Effluent monitoring program at Class I nuclear facilities and uranium mines and mills*, [5] and continues to provide adequate protection to the environment.

In its application, CNL has committed to revise the CRL Integrated EMP [10] to be compliant with and implement CSA Group Standard N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills* [13] and CSA Group Standard N288.8-17, *Establishing and implementing action levels for releases to the environment from nuclear facilities* [14] during the proposed licensing period. While the existing groundwater monitoring program under the EMP is satisfactory and adequately monitoring groundwater at the CRL site, implementation of this CSA standard will ensure a more standardized approach that will improve compliance.

### 2.1.5 Public Dose

Radiological releases to the environment are controlled and monitored by the Radiological Effluent Verification Monitoring Program, [11] the EMP and the groundwater monitoring program. Results of these monitoring and control activities are used to determine dose to members of the public.

The *Radiation Protection Regulations* require licensees to implement a radiation protection program (RPP) for protection of workers as well as the public. The focus for radiation protection within the environmental protection framework is on radiological protection of the environment and the public.

The *Radiation Protection Regulations* define prescribed dose limits for workers and members of the public, and require doses to be monitored by direct measurement or by estimation of the quantities and concentrations of any nuclear substance released as a result of a proposed activity.

A human health risk assessment (HHRA) is completed as part of the ERA [7] for both radioactive and non-radioactive substances. Licensees must meet the requirements of the NSCA and the regulations for radiological protection of members of the public. CNL's HHRA concluded that the highest estimated annual dose to a public receptor is 0.092 millisievert (mSv). CNSC staff reviewed CNL's assessment and concluded that public doses are below the annual public dose limit of 1 mSv. Further details on the HHRA are provided in section 3.4.5.

The Commission introduced annual liquid and airborne effluent release limits into the CRL operating licence in 2011. These limits are based on a dose constraint limit to the critical group of 0.3 mSv from the sum of all releases from CRL. During the licence period, reported radiological and non-radiological releases at CRL have remained below their respective regulatory limits. At no time during the licensing period did the emissions from the CRL site exceed the dose constraint.

As a result of the reviews and compliance verification activities described in section 2.1.3, CNSC staff conclude that the public continues to be protected from facility effluent releases and emissions.

## 2.2 Preliminary Decommissioning Plan

The CRL site has a site-wide comprehensive PDP, prepared in accordance with CSA Group Standard N294-09, *Decommissioning of facilities containing nuclear substances* [15] and submitted to the CNSC in accordance with the CNSC's Regulatory Guide G-219, *Decommissioning Planning for Licensed Activities*. [16] Because this EA report considers the full lifecycle of the CRL site, CNSC staff examined the PDP to assess project-environment interactions until the end state of the site.

The objective of the CRL site-wide PDP is that most areas of the site will qualify for a minimum of industrial use, while some other areas may qualify for unrestricted use. Planning for the eventual decommissioning of the CRL site is an ongoing process, taking place throughout each stage of the licensed facility lifecycle. The actual decommissioning will be achieved in a phased approach, with the site reaching an interim state in approximately 2100, and reaching a final end-state approximately 300 years later, around 2400.

Decommissioning of the CRL site will require the removal of buildings, storage tanks and service infrastructure in order for the site to meet the interim state criteria by 2100. Decommissioning activities are organized in groups as follows:

- reactors (e.g., NRU, National Research Experimental Reactor (NRX), MAPLE 1 and 2)
- buildings (other than reactor buildings)
- storage tanks
- other structures and services (e.g., underground services for electricity, active drains, service water)

Decommissioning of reactor facilities including the NRU and the NRX will consist of the removal of all activated and contaminated components, which will be packaged for disposal once permanent storage facilities become available. The reactor buildings will be decontaminated and demolished and the sites will be remediated to meet requirements for future land use. The MAPLE 1 and 2 reactors were never operated (other than some low-level commissioning operations) and therefore have minimal to no radioactivity associated with them. Decommissioning of these reactor facilities will primarily consist of dismantling and some processing for disposal. The cleared site will then be remediated to meet the conditions required for future land use.

Approximately 160 buildings on the CRL site excluding reactors and underground storage tanks are planned to be removed. They range in size and complexity from complex hot cell facilities such as the Universal Cells and Materials Cells to simple office and storage buildings. Construction materials range from heavily reinforced concrete and steel to simple wooden frames.

Various storage tanks are located on the CRL site. The liquids in these storage tanks vary from relatively benign wash liquids to highly radioactive liquid wastes. Decommissioning of these storage tanks includes removal of the liquids which would then be solidified for ongoing storage until a permanent disposal facility is available. The strategy for the emptied storage tanks involves three components: excavation, size reduction and packaging followed by ongoing storage or emplacement in an appropriate disposal facility.

Other structures include all underground services for electricity, active drains, service water, etc. Generally, service infrastructure is underground throughout the site. Therefore, decommissioning of this infrastructure will wait until final site decommissioning begins.

Environmental remediation activities planned for the CRL site will result in the retrieval of waste and contaminated soil in order for the site to meet end-state objectives by 2400. In some cases, removal of contamination will be required and in others, natural decay of radioactivity or natural attenuation of contaminants in the environment will mean that no intervention will be necessary to meet end-state objectives. CNL has also grouped environmental remediation projects into separate remediation initiatives that focus on different areas used for various activities within the site. The six groupings are as follows:

- Waste Management Area A
- Waste Management Area B (asphalt trenches, rectangular bunkers and cylindrical bunkers)
- Waste Management Area B sand trenches

- infiltration Pits (Chemical Pits, Reactor Pits, Laundry Pits, Nitrate Plant Pit and buildings, Thorium Pit, and Acid, Chemical and Solvent Pits)
- groundwater and affected lands (roads, site support areas including: aggregate burrow pits, snow dumps, target ranges, pipelines and landfills, experimental areas, boreholes, plumes from contamination areas, river sediments and groundwater treatment systems)
- other environmental remediation including remediation at Waste Management Areas C, D, E, F, G, H and J, tile holes<sup>1</sup> in Waste Management Area B

In March 2014, CNL submitted an updated PDP [17] to CNSC staff for the CRL site. The updated PDP was submitted in accordance with CSA Group Standard N294-09 [15] and RD/GD G-219 [16] and in support of the facility operating licence requiring CNL to maintain a PDP and financial guarantee for the final decommissioning of the facility. A financial guarantee for the decommissioning of the CRL site was provided to the CNSC in December 2003 by the Minister of Natural Resources Canada. [18] The financial guarantee was reaffirmed in 2009 by the Minister of Natural Resources Canada. [19] CNSC staff reviewed CNL's PDP [17] submission and concluded that it met the criteria identified in CSA Group Standard N294-09 [15] and RD/GD G-219. [16]

Individual buildings and facilities that are transferred to CNL's decommissioning group for decommissioning and demolition prior to CNL's application for a decommissioning licence require a detailed decommissioning plan (DDP). This DDP needs to be approved by CNSC staff prior to CNL undertaking any decommissioning activities. This is in addition to the DDP that will be submitted by CNL in support of their application for a decommissioning licence when the time comes to decommission the site as a whole.

## 2.3 Environmental Assessments and Reviews

The CNSC has conducted EAs for proposed and ongoing nuclear facilities and activities at the CRL site under the NSCA and the *Canadian Environmental Assessment Act*, (CEAA) 2012 (and the former CEAA 1992). The purpose of an EA is to identify the possible environmental effects of a proposed project, and determine whether those effects can be sufficiently mitigated, so that the environment and health of persons will be protected, before a licence decision can be made. Under the CEAA, a decision must be taken that the project, after implementation of mitigation measures, will not cause significant adverse environmental effects. Under the NSCA, no decision is made on the EA itself, as the information is intended to inform and support the regulatory decision being sought.

The CRL site has undergone several CEAA EA reviews related to its licensed nuclear facilities and activities. Table 2.3 provides a complete list of previously completed federal EAs for the CRL site. All EA follow-up monitoring programs associated with past projects at the CRL site for previously completed EAs are now closed.

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<sup>1</sup> Tile holes are sub-surface, mainly concrete (a few are stainless steel) drain pipes set vertically on a poured concrete base that hold waste with higher radiation fields (e.g., used fuel).

**Table 2.3: Previously completed EAs under the federal EA processes for the CRL site**

Project	EA start date	EA decision date	EA Follow-Up Monitoring Program Complete (if applicable)
Decommissioning of the fuel storage and handling bays at CRL	Apr 2000	Oct 25, 2006	Yes
Decommissioning of the heavy water upgrading plant	Sept 13, 2002	May 15, 2008	Yes
Construct and operate liquid waste storage facility	Jun 11, 2003	Mar 30, 2006	Project Cancelled
Decommission a plutonium tower building	Sept, 2004	Dec 16, 2011	No CEAA follow-up program required
Decommission pool test reactor	Sept 13, 2004	May 11, 2007	No CEAA follow-up program required
Continued operation of nuclear research reactor	Dec 13, 2004	Jun 29, 2005	Yes
Construction and operation of fuel packaging and storage facility	Jan 4, 2005	Jul 3, 2008	Yes
Construction and operation of shielded modular above ground storage project	Feb 4, 2005	May 25, 2006	Yes
Construction and operation of a bulk materials landfill	Jun 4, 2007	Jun 18, 2010	Yes
NRU reactor long-term management project	Mar 31, 2009	Mar 18, 2011	Yes
Decommissioning of Building 220 (Plutonium Recovery Laboratory)	Feb 2014	May 21, 2015	No CEAA follow-up program required

## 2.4 EA Follow-Up Program

A CEAA EA follow-up program verifies the effectiveness of mitigation measures and the accuracy of environmental predictions. Where appropriate, the results of a follow-up program may also support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects.

The completed CEAA EA follow-up programs for the above listed projects have demonstrated that mitigation measures and monitoring programs introduced previously have proven effective, and as a result, were consequently incorporated into the on-going CRL monitoring programs and relevant operating policies and procedures. New mitigation measures are not deemed necessary at this time,

for this licence renewal, as the existing mitigation measures were found to be effective, and the predictions of past EAs were verified to be accurate.

As part of the CNSC's environmental protection framework and regulatory oversight, CNSC staff continue to review the detailed sampling plans for the CRL EMP to ensure that the objectives of the plan are being met. The results of the EMP monitoring data are in accordance with regulatory requirements.



### 3.0 STATUS OF THE ENVIRONMENT

The following two sections summarize independent regional monitoring initiatives conducted near the CRL site, and provide details on greenhouse gas emissions from the CRL site. Additionally, a section updating the Commission, the public and the Indigenous communities on the status of a *Fisheries Act* authorization for the CRL site is provided.

#### 3.1 Regional Monitoring Initiatives

CNSC staff are not aware of any regional monitoring initiatives conducted in the area of the CRL site that could provide additional information on potential environmental impacts resulting from operations at the CRL site beyond the detailed information already collected by CNL, and independently by the CNSC. However, the Minister of Ontario Environment and Climate Change (MOECC) [Drinking Water Surveillance Program](#) provides water quality information for selected municipal drinking water systems for scientific and research purposes. The latest data released for this program are from 2012, including data on radiological and non-radiological parameters in water measured at the Pembroke drinking water system, which is located approximately 28 km downstream of the CRL site.

All of the non-radiological parameters that are monitored and tested through the program for the Pembroke drinking water system, and that are relevant to CRL operations, remain below [Government of Canada Guidelines for Canadian Drinking Water Quality](#), [20] and [MOECC Provincial Water Quality Objectives](#). [21] Additionally, as illustrated in table 3.1 below, all of the radiological parameters (gross alpha, gross beta and tritium) monitored and tested through the program are below method detection limits (i.e., radiological concentrations are too small to measure).

**Table 3.1: Drinking Water Surveillance Program results of radionuclide activity in water sampled from stations along the Ottawa River in 2011 and 2012**

Activity of radionuclides in raw water in 2011				Activity of radionuclides in raw water in 2012		
Station	Tritium (Bq/L)	Gross Alpha (Bq/L)	Gross Beta (Bq/L)	Tritium (Bq/L)	Gross Alpha (Bq/L)	Gross Beta (Bq/L)
Pembroke	< 5	< 0.04	< 0.04	< 5	< 0.04	< 0.04
Lemieux Island	< 5 - 5.5	< 0.04	< 0.04 - 0.08	< 5 - 5.2	< 0.04	< 0.04
Britannia	< 5 - 5.2	< 0.04 - 0.04	< 0.04 - 0.04	< 5 - 5.2	< 0.04	< 0.04

The results of the Drinking Water Surveillance Program show that the activity of radionuclides of water from the Ottawa River are either below or slightly above the method detection limits. Also, the values are below the Health Canada Guidelines for Canadian Drinking Water Quality screening level. [20] The results of the Drinking Water Surveillance Program substantiate CNSC staff's conclusion that CNL has made, and will continue to make, adequate provisions for the protection of the environment and the health of persons.

Also, the Radiation Protection Bureau of Health Canada manages [the Canadian Radiological Monitoring Network \(CRMN\)](#). [22] The CRMN routinely collects drinking water, precipitation, atmospheric water vapour, air particulate, external gamma dose, and milk samples for radioactivity analysis at 26 monitoring locations. The closest CRMN monitoring location to the CRL site is in Ottawa. The sampling results at the Ottawa station for 2016 are consistent with data from previous years and are well below the acceptable public dose limit. Also, tritium levels measured at water treatment plants are well below Health Canada's *Guidelines for Canadian Drinking Water Quality*.

In addition, Health Canada has complemented its CRMN network with a [Fixed Point Surveillance](#) system, [23] which consists of 77 remotely operated monitoring stations. At each station, there are detectors that measure the radioactivity of ground deposited and airborne contaminants. The results of the 2016 data collected at the Chalk River station are consistent with data from previous years and are well below the acceptable public dose limit. The results of Health Canada's monitoring substantiate CNSC staff's conclusion that CNL has made, and will continue to make, adequate provisions for the protection of the environment and the health of persons.

## 3.2 Greenhouse Gas Emissions

CNL is required to report releases for the CRL site under the *Canadian Environmental Protection Act* (CEPA), provided the facility meets the reporting requirements of the annual Notice for the Reporting of Greenhouse Gas Emissions. Since the 2013 reporting notice, facilities that emit more than the 50,000 tons of Carbon Dioxide equivalent (CO<sub>2</sub>e) reporting threshold on an annual basis must report their emissions. [24] However, over the licence period, CRL operations did not exceed the reporting threshold (50,000 tons CO<sub>2</sub>e); therefore, CNL did not submit a report under the Greenhouse Gas Emissions Notice. [25]

The main sources of greenhouse emissions at the CRL site include: combustion of fuel oil for onsite heating with small contributions from the burning of propane, the burning of diesel generators, the use of fuel by the on-site transportation fleet and releases from the on-site landfill. Although not required to report under the Greenhouse Gas Emissions notice, CNL has monitored, quantified and reported greenhouse emissions data to the CNSC throughout the current licence period. Greenhouse gas emissions are expected to further decline in the future as CNL is transitioning to a natural gas heating system, which should result in lower greenhouse gas emissions. The greenhouse gas emissions from the CRL site for the period of 2011-2016 are shown in table 3.2.

**Table 3.2: CRL Site Greenhouse Gas Emissions**

Year	2011	2012	2013	2014	2015	2016
Greenhouse Gas (CO <sub>2</sub> e tonnes)*	39,905	35,696	38,985	42,000	38,598	36,127

\* CO<sub>2</sub>e tonnes: A unit of measure used to compare between greenhouse gases with different Global Warming Potentials. For example, the Global Warming Potentials for methane is 25. This means that emissions of one metric ton of methane are equivalent to emissions of 25 metric tons of CO<sub>2</sub>

### 3.3 Status of the Environment

The following sections of the EA Report include summaries of project-environment interactions that were assessed by CNSC staff and were deemed to be of specific public and/or regulatory interest including atmospheric, aquatic, geological and hydrogeological, and the terrestrial environment and human health, for the licence application by CNL to renew the CRL site's operating licence. It should be noted that all environmental components are regularly reviewed through annual reporting requirements and CNSC compliance verification activities. These are reported on, to the Commission, in the environmental protection safety and control area of licensing Commission Member Documents and annual Regulatory Oversight Reports.

#### 3.4.1 Atmospheric Environment

##### *Radiological Airborne Emissions*

The main radionuclides released from the CRL site include argon-41, carbon-14, tritium oxide and iodine-131. [7] The sources of radiological releases include numerous operational facilities and activities at the CRL site, including facilities under decommissioning and listed as being in a state of storage with surveillance. Radiological releases are routinely monitored as part of CRL's Radiological Effluent Verification Monitoring Program. [11] The primary sources of argon-41 and other noble gases are the NRU reactor stack, the Molybdenum-99 Production Facility (MPF) stack, and the tile holes in the Waste Management Area B. The NRU reactor stack is the most significant source of airborne tritium at the site.

All radiological releases during the current licence period were below their respective release limits and there were no release limit exceedances. Total annual radiological releases to the atmospheric environment from the CRL site for the current licence period are provided in table 3.3.

**Table 3.3: Total annual airborne radionuclide emissions from the CRL site for the 2011 – 2016 licence period compared against applicable release limits<sup>1</sup>**

Year	Tritium oxide (Bq/year)	Argon-41 (Bq/year)	Iodine-131 (Bq/year)	Carbon-14 (Bq/year)	Mixed fission product noble gases <sup>2</sup> (BqMeV/year <sup>3</sup> )
2011	9.72x10 <sup>13</sup>	1.09x10 <sup>16</sup>	3.73x10 <sup>09</sup>	5.56x10 <sup>11</sup>	9.36x10 <sup>14</sup>

Year	Tritium oxide (Bq/year)	Argon-41 (Bq/year)	Iodine-131 (Bq/year)	Carbon-14 (Bq/year)	Mixed fission product noble gases <sup>2</sup> (BqMeV/year <sup>3</sup> )
2012	2.45x10 <sup>14</sup>	9.33x10 <sup>15</sup>	3.19x10 <sup>10</sup>	6.41x10 <sup>11</sup>	8.80x10 <sup>14</sup>
2013	2.46x10 <sup>14</sup>	8.46x10 <sup>15</sup>	1.38x10 <sup>11</sup>	5.74x10 <sup>11</sup>	1.32x10 <sup>15</sup>
2014	2.60x10 <sup>14</sup>	9.37x10 <sup>15</sup>	2.06x10 <sup>11</sup>	8.69x10 <sup>11</sup>	2.11x10 <sup>15</sup>
2015	2.77x10 <sup>14</sup>	1.29x10 <sup>16</sup>	1.03x10 <sup>11</sup>	3.77x10 <sup>11</sup>	1.20x10 <sup>15</sup>
2016	2.36x10 <sup>14</sup>	1.07x10 <sup>16</sup>	5.17x10 <sup>10</sup>	4.84x10 <sup>11</sup>	8.50x10 <sup>14</sup>
<b>Release Limits</b>	1.25x10 <sup>16</sup>	6.60x10 <sup>16</sup>	3.96x10 <sup>12</sup>	2.14x10 <sup>15</sup>	4.96x10 <sup>16</sup>

1) Release limits are based on 0.3 mSv dose constraint of the derived release limit (DRL)

2) Mixed Fission Product Noble Gases includes all noble gas emissions

3) BqMeV/year = becquerel (Bq) x mega-electronvolts (MeV) per year and is a unit to quantify ionizing radiation

### *Non-Radiological Airborne Emissions*

Non-radiological airborne emissions from the CRL site include carbon monoxide, nitrogen oxides (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>), particulate matter (PM) and volatile organic compounds. [11] [26] The main stationary source of non-radiological emissions is from the burning of number 6 fuel oil at the powerhouse. Number 6 fuel oil is a common high viscous fuel oil. Emissions from the powerhouse stack are estimated and compared with the compliance verification criteria outlined in table I-7 of CRL's LCH. [12] The compliance verification criteria in table I-7 of the LCH and summarized in table 3.4 are specific to the powerhouse stack (i.e., they are not site-wide requirements).

Table 3.4 provides the estimated annual non-radiological airborne releases from the CRL powerhouse stack for the 2011 – 2016 licence period compared with the compliance verification criteria. There were no exceedances of the airborne non-radiological compliance verification criteria during the licence period.

**Table 3.4: Estimated annual non-radionuclide airborne emissions<sup>1</sup> from the CRL powerhouse stack for the 2011 – 2016 licence period compared with compliance verification criteria**

Year	Carbon monoxide (tonnes)	Nitrogen oxides <sup>2</sup> (tonnes)	Sulphur dioxide <sup>3</sup> (tonnes)	Total particulate matter (tonnes)	PM <sub>10</sub> (tonnes)	PM <sub>2.5</sub> (tonnes)	Volatile organic compounds (tonnes)
2011	6.43	57.40	242	18.32	15.80	10.29	0.36

Year	Carbon monoxide (tonnes)	Nitrogen oxides <sup>2</sup> (tonnes)	Sulphur dioxide <sup>3</sup> (tonnes)	Total particulate matter (tonnes)	PM <sub>10</sub> (tonnes)	PM <sub>2.5</sub> (tonnes)	Volatile organic compounds (tonnes)
2012	5.79	50.57	175	13.99	12.04	7.84	0.33
2013	6.18	56.41	173	14.13	12.15	7.91	0.35
2014	6.38	57.42	224	17.19	12.52	8.17	0.36
2015	5.80	52.45	200	15.43	13.30	8.66	0.33
2016	5.33	48.40	240	17.47	15.10	9.83	0.30
<b>Compliance verification criteria (tonnes)</b>	8.0	75.0	315.0	24.0	21.0	15.0	0.5

1) Emissions are estimated using the U.S. EPA emission factors given in AP-42, [27] unless stated differently

2) Emissions are based on emission factors calculated from stack measurements on each boiler

3) Emissions are estimated based on the measured Sulphur content in the Number 6 fuel oil

For airborne releases of non-radiological substances from sources other than the powerhouse stack, CNL is required to maintain non-radiological (i.e., hazardous) emissions below release limits, and keep records that fully and accurately describe the amount and type of non-radiological contaminant substances released from the CRL site. There are no set requirements for atmospheric non-radiological releases to the environment outside of those in place for the powerhouse stack. During the licence period, CNL has reported non-radiological releases to Environment and Climate Change Canada's National Pollutant Release Inventory as required under the CEPA. The releases that are reported are a result of burning fuel, road dust emissions, solvent dust and the storage of petroleum fuel. The information reported to Environment and Climate Change Canada is publically available online at <https://www.ec.gc.ca/inrp-npri/>.

### *Radiological Ambient Air Monitoring*

Tritium and carbon-14 are measured in ambient air at monitoring stations on and offsite. Airborne tritium concentrations are highest closest to the NRU stack and decrease with increasing distance from the site. Tritium concentrations in ambient air at offsite monitoring stations are low and have remained similar throughout the current licence period and since the restart of the NRU in 2010. Ambient carbon-14 concentrations (on and offsite) have been measured close to the level of detection throughout the current licence period.

### **Conclusion**

CNSC staff have concluded that CNL's reported releases of radionuclides and non-radiological contaminant substances from CRL operations have remained below their respective regulatory limits during the current licensing period, based on compliance monitoring data. [11] [26] CNL's Effluent Verification Monitoring Program confirms that radionuclide and non-radiological

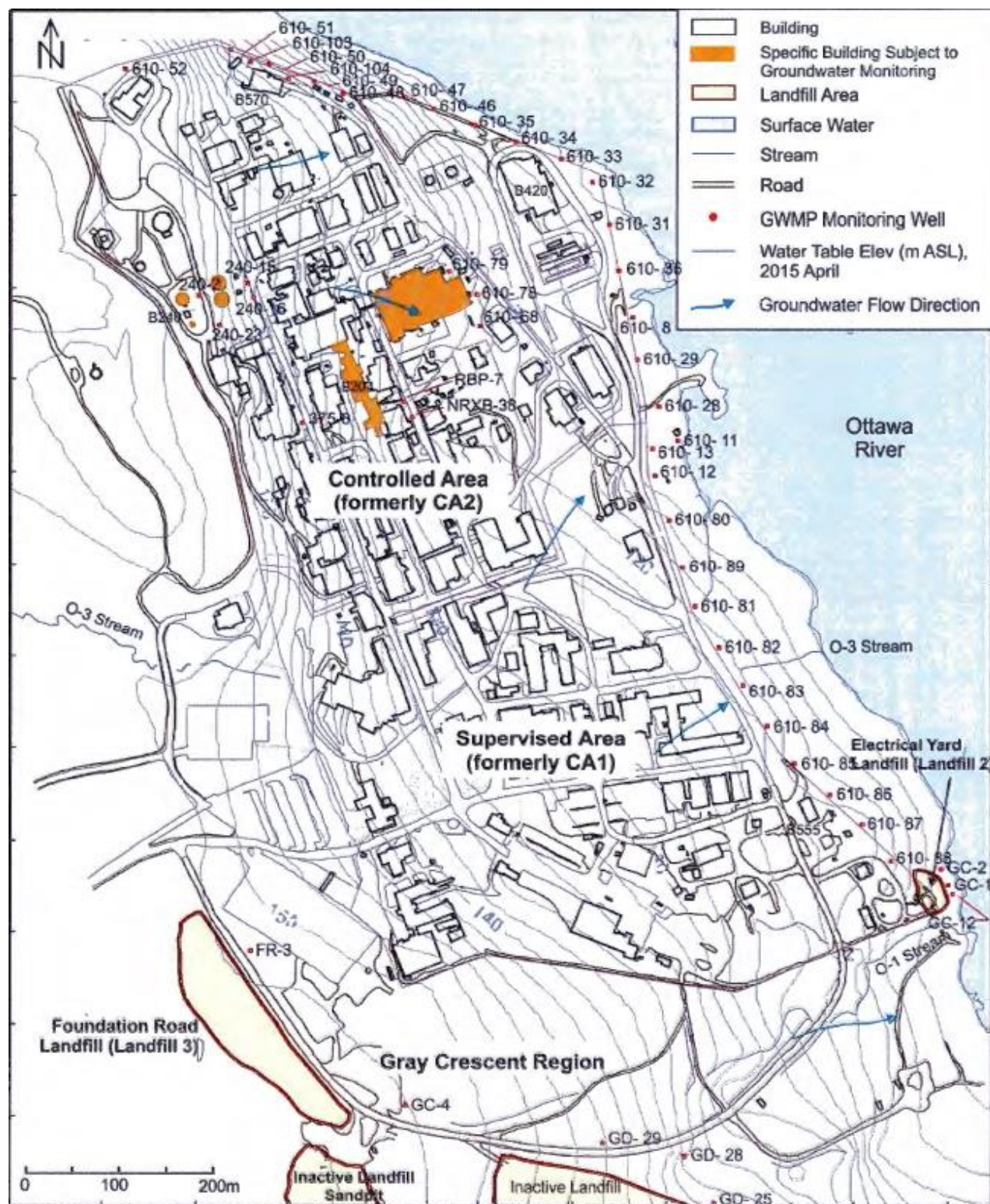
contaminant concentrations in air surrounding the CRL site are low and that ecological and human receptors are protected.

### **3.4.2 Geological and Hydrogeological Environment**

The eastern boundary of the CRL Built-up Region (see figure 3.1) is adjacent to the Ottawa River. A large proportion of the groundwater that becomes contaminated, as it passes below the Built-up Region of the CRL site, discharges directly to the Ottawa River. [11] [26]



**Figure 3.1: Built-up Region of CRL site and the line of monitoring wells established along the downgradient perimeter of the Built-up Region**



Note 1: Use figure 3.2 to view the Built-up Region in relation to CRL site as a whole

Note 2: GWMP in the legend denotes Ground Water Monitoring Program

Source: CNL, *Environmental Monitoring in 2016 at Chalk River Laboratories*, June 2017 [28]

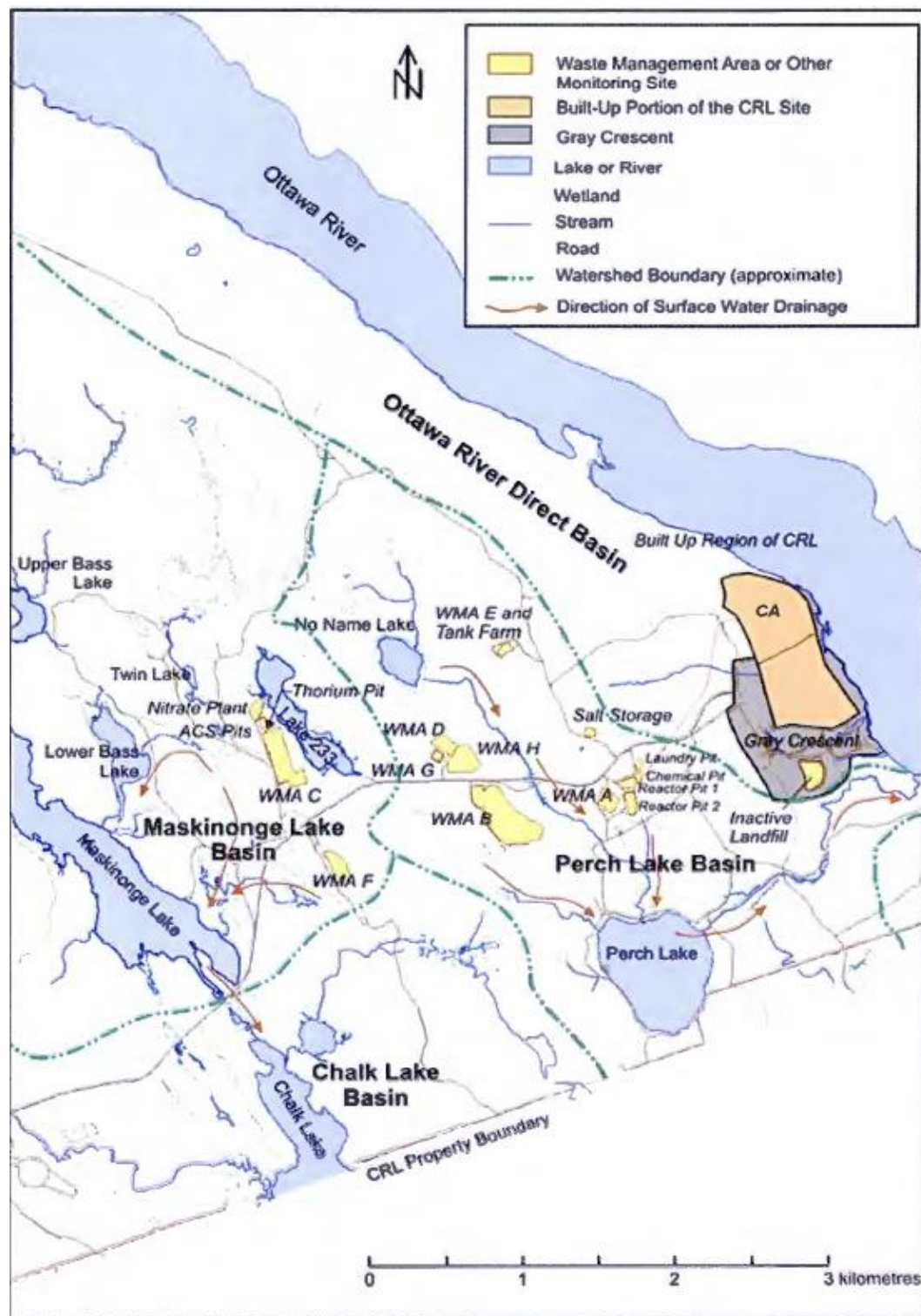
The dominant drainage feature is a large bedrock ridge that runs parallel to the Ottawa River near the CRL site. This ridge, which generally runs parallel to the former Pembroke to Mattawa Road, separates surface drainage between the Ottawa River and inland lakes. There are three main drainage basins that are directly affected by CRL operations: the Ottawa River Direct, Perch Lake and Maskinonge Lake basins. These basins - and the CRL facilities located within them - are illustrated in figure 3.2. Figure 3.3 is a schematic diagram that identifies the flow-path of groundwater (and surface water) from specific CRL facilities to their corresponding drainage basin.

### *Radiological Contaminants*

Groundwater is the principal initial pathway for the migration of dissolved radiological and non-radiological compounds that may be released from past and present operating areas to the subsurface at the CRL site. [7] The most significant radiological releases to subsurface at the CRL site are from the Liquid Dispersal Area (see figure 3.4); Waste Management Area C, where low level solid wastes were buried in unlined trenches between 1963 and 2000 (see figure 3.5); and the NRU and NRX rod bay leaks (rod bays are located near the Built-up Region of the CRL site in figures 3.1 and 3.2). The NRX and NRU rod bay leaks have formed well-defined plumes of groundwater contamination that terminate in the Ottawa River. The rod bay leaks are discussed in more detail after discussions on the Liquid Dispersal Area and Waste Management Area C.



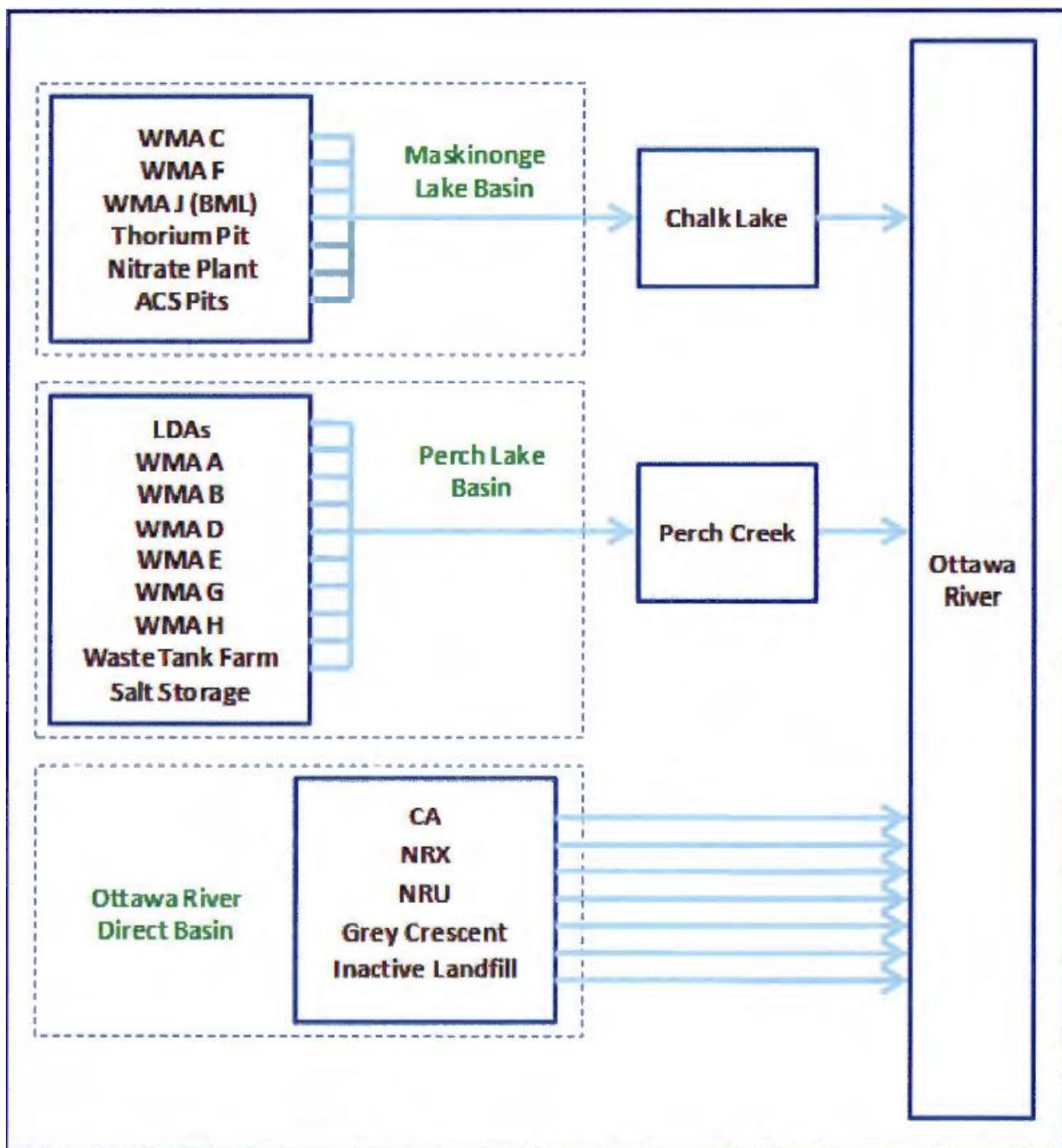
**Figure 3.2: CRL facilities in relation to three primary drainage basins that are directly affected by CRL operations**



Note: On the above map, WMA denotes Waste Management Area and CA denotes Controlled Area

Source: CNL, *Environmental Monitoring in 2016 at CRL*, June 2017 [28]

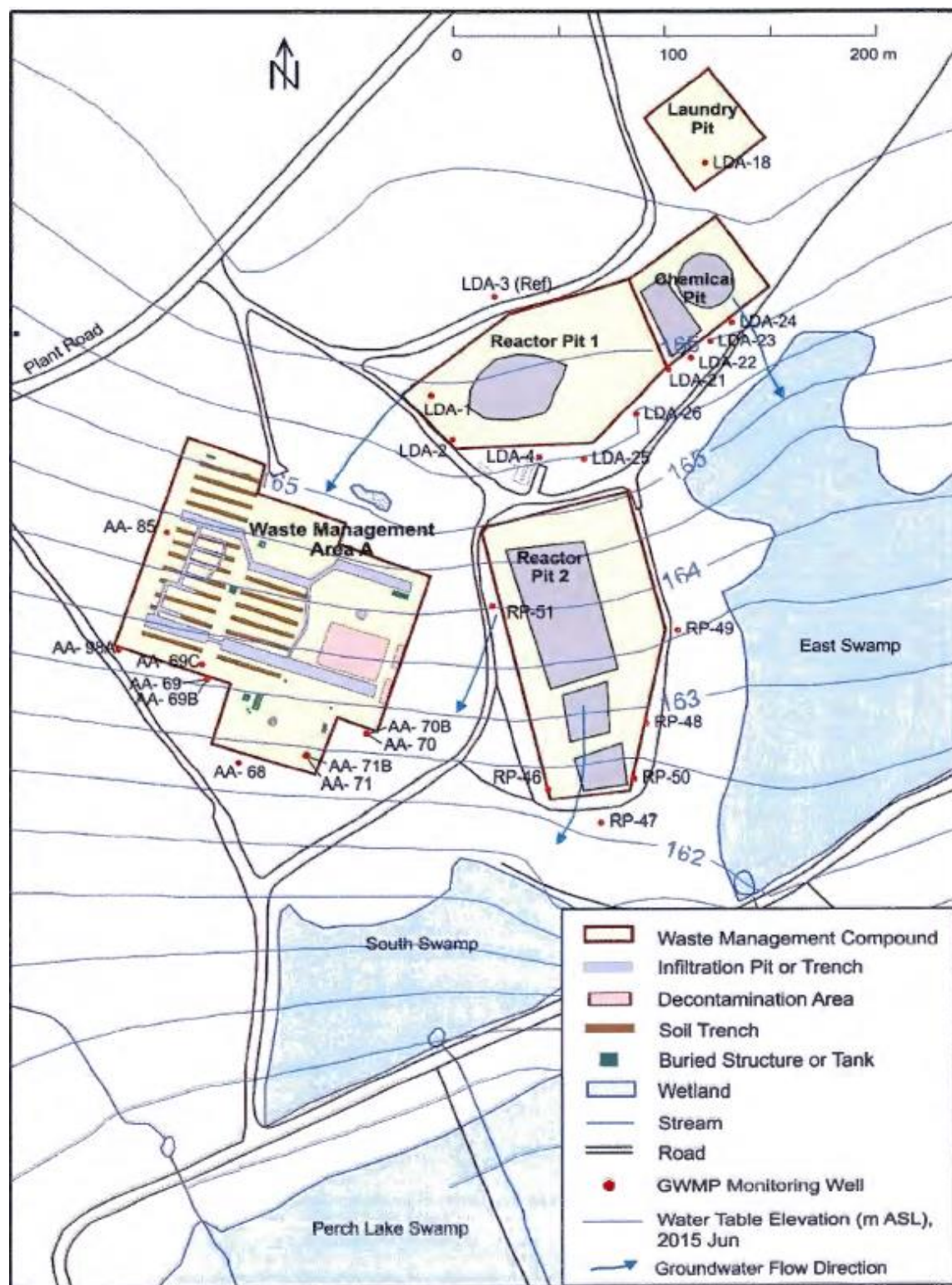
**Figure 3.3: Schematic diagram displaying flow path of groundwater and surface water from CRL facilities to drainage basins and the Ottawa River**



Note: On the above schematic, WMA denotes Waste Management Area, ACS denotes Active, Chemical, Solvent Pits, LDA denotes Liquid Dispersal Area, and CA denotes Controlled Area

Source: CNL, Environmental Risk Assessment [7]



**Figure 3.4: Close-up view of Liquid Dispersal Area**

Note 1: LDA denotes Liquid Dispersal Area, which is subdivided into Reactor Pits 1 and 2, the Laundry Pit and the Chemical Pit

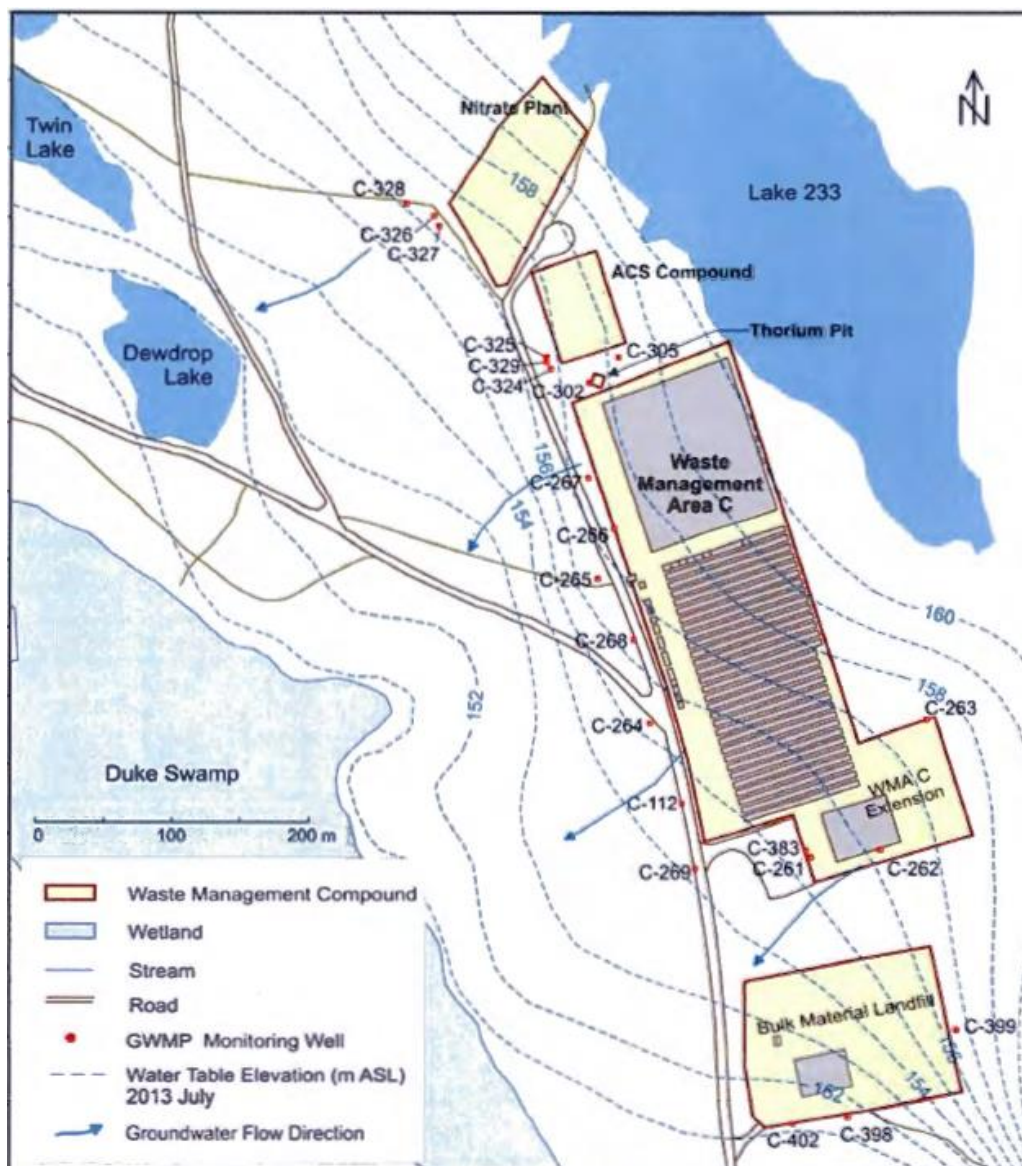
Note 2: GWMP in the legend denotes Ground Water Monitoring Program

Note 3: Use figure 3.2 to view Liquid Dispersal Area in relation to CRL site as a whole

Source: CNL, *Environmental Monitoring in 2016 at CRL*, June 2017 [28]

The ERA identified the main contaminant of concern associated with the Liquid Dispersal Area (which includes Reactor Pits 1 and 2, the Laundry Pit and the Chemical Pit) as gross beta activity (primarily strontium-90) in the form of a groundwater plume. Historically, within the Liquid Dispersal Area, the Chemical Pit (1956-1994) and Reactor Pit 2 (1956-2000) were used to discharge low-radioactivity wastewaters and promote wastewater infiltration to groundwater. To mitigate the effects of contaminant migration, a portion of the groundwater plume from the Chemical Pit is pumped and treated by the Chemical Pit treatment system, before being discharged to East Swamp stream. In 2016, when the treatment system operated at full capacity, average influent concentrations of strontium-90 (662 Bq/l) were reduced to approximately 5 Bq/l. The treatment system does not capture the entire plume; however, it does mitigate potential effects to the environment from ongoing contaminant migration from the Liquid Dispersal Area. Potential effects resulting from the Liquid Dispersal Area are further discussed in section 3.4.3: Aquatic Environment.

**Figure 3.5: Close-up view of Waste Management Area C**





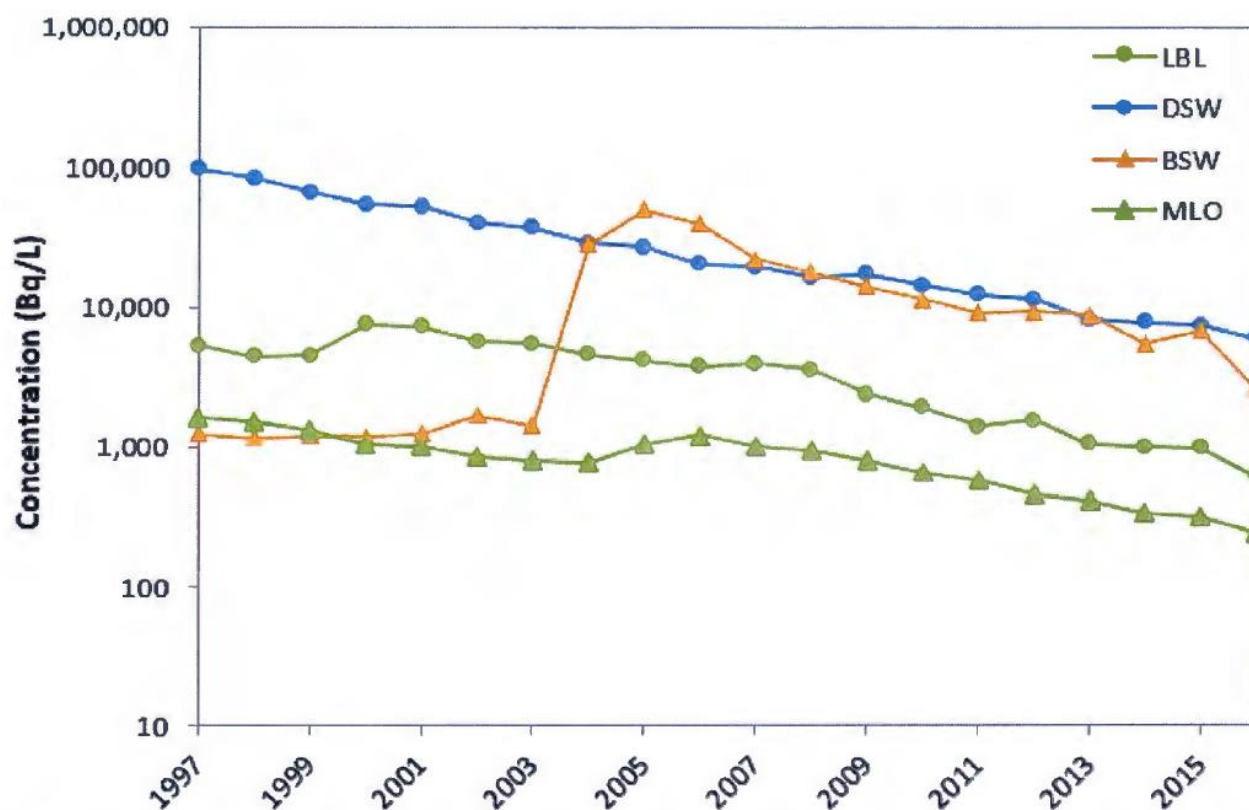
Note 1: Use figure 3.2 to view Waste Management Area C in relation to CRL site as a whole

Note 2: GWMP in the legend denotes Ground Water Monitoring Program

Source: CNL, *Environmental Monitoring in 2016 at CRL*, June 2017 [28]

The groundwater tritium plume arising from Waste Management Area C primarily affects nearby wetlands and streams (Duke Stream, Bulk Storage Stream and Lower Bass Creek), which eventually discharge into Maskinonge Lake. [29] The tritium concentrations in surface waters along the drainage routes near Waste Management Area C have continued to show a decreasing trend throughout the licence period (see figure 3.6). An impermeable cover was installed over Waste Management Area C in 2013, and further reductions in downgradient tritium concentrations became evident in 2015 data. [28] In time, Waste Management Area C (and the remaining Waste Management Areas on the CRL site) will be remediated, which will ultimately remove the source of the tritium plume completely.

**Figure 3.6: Tritium concentrations in Duke Stream (DSW), Bulk Storage Stream (BSW), Lower Bass Creek (LBL) and Maskinonge Lake (MLO)**



Source: CNL, *Environmental Monitoring in 2016 at CRL*, June 2017 [28]

For the purposes of the environmental and effluent monitoring programs, groundwater discharge is not an effluent stream; however, CNL applies site DRLs to the groundwater releases to the Ottawa River for the purposes of comparing the release to a release limit. [11] A line of monitoring wells was established along the downgradient perimeter of the Built-up Region in 2000 in order to gain information and to evaluate the groundwater contaminant releases to the Ottawa River. The downgradient perimeter wells (like the other groundwater monitoring wells throughout the CRL

site) are sampled twice-yearly and analyzed for tritiated water, gross alpha and gross beta. See figure 3.1 for the monitoring well locations.

Most of the tritiated water discharged to the Ottawa River by groundwater is the result of NRU fuel rod bay leaks, which are located near the Built-up Region of the CRL site. In response to the rod bay leaks, CNL completed the NRU Rod Bay Water Replacement Project in 2012. The replacement of the water in the NRU bays in December 2012 reduced the tritium oxide concentration in the source by up to 75%. [30] The decrease in tritium oxide discharged to the river in 2013 represents the start of the decrease attributable to the NRU bay-water replacement, and the further decreases in 2014 and 2015 reflect tritium oxide taking slower flow paths between NRU and the river. CNL will continue to monitor and report to the CNSC on tritium oxide discharge to the Ottawa River, and subsequently measure the effectiveness of the NRU Rod Bay Water Replacement Project.

As identified in the ERA, [7] radiological contamination is still present downgradient of the NRX fuel rod bays. Almost all of the estimated gross beta reported in table 3.5 is strontium-90 and yttrium-90, and is the result of the groundwater plume that originated from the NRX rod bay leaks. The current releases to the Ottawa River represent the slow transport of strontium-90. Tritiated water was removed from the NRX bays in 2000, and the portion of the NRX bays that leaked to the subsurface were drained in 2006. [30]

Annual groundwater monitoring results do not tend to show significant variability from one year to the next, which is to be expected of the subsurface (hydrogeological) environment, where contaminant migration in groundwater flow systems is very slow compared to transport in effluents and surface waters. Table 3.5 provides average estimated yearly radionuclide releases in groundwater from below the Built-up Region of the CRL site to the Ottawa River for the 2011 – 2016 licence period compared with applicable release limits.

**Table 3.5: Average estimated yearly radionuclide releases in groundwater from below the Built-up Region of the CRL site to the Ottawa River for the 2011 – 2016 licence period compared with release limits**

Emissions (estimate)	Tritium oxide (Bq/year)	Gross beta (Bq/year)	Gross alpha (Bq/year)
2011	$5.44 \times 10^{12}$	$3.32 \times 10^9$	$2.54 \times 10^7$
2012	$5.87 \times 10^{12}$	$3.50 \times 10^9$	$2.53 \times 10^7$
2013	$3.79 \times 10^{12}$	$2.98 \times 10^9$	$4.08 \times 10^7$
2014	$2.44 \times 10^{12}$	$2.98 \times 10^9$	$3.90 \times 10^7$
2015	$1.90 \times 10^{12}$	$2.64 \times 10^9$	$3.77 \times 10^7$
2016	$1.91 \times 10^{12}$	$3.16 \times 10^9$	$3.13 \times 10^7$

<b>Release limits (Bq/year)</b>	$1.03 \times 10^{17}$	$2.70 \times 10^{13}$	$1.32 \times 10^{12}$
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### *Non-Radiological Contaminants*

The non-radiological constituents that appear in groundwater downgradient of CRL facilities, and that are subject to groundwater monitoring are largely the result of historic operations and early waste storage practices. [7] Contaminants include mercury and chlorinated solvents (volatile organic compounds), which are present only in small, localized areas (Perch Lake basin from the historical use of the Chemical Pit and in a groundwater plume situated at the northeast corner of Waste Management Area B respectively), as illustrated in figures 3.4 and 3.9.

Mercury concentrations downgradient of the Chemical Pit have shown a declining trend from 1998 to 2016. [26] With respect to the groundwater solvent plume located in the northeast corner of Waste Management Area B, the most abundant volatile organic compound in 2016 was 1,1,1-trichloroethane (average concentration in most affected well was 865 µg/L – no recommended guideline or reference level in place for this substance in Canada). Other organic compounds present in the Waste Management Area B solvent plume include: Chloroform, trichloroethylene, 1,1-dichloroethane, 1,1-dichloroethylene, 1,1,2,2-tetrachloroethane, and tetrachloroethylene. These contaminants originate from waste emplaced in the eastern block of unlined trenches within Waste Management Area B.

A detailed update on the Waste Management Area B solvent plume conducted in 2013 concluded that there have been no notable changes in the plume over the past five years. [31] The key finding was that the more abundant chlorinated organics were present in seepage samples (where the plume comes to surface and enters a stream that discharges to Perch Lake), but all of the compounds were below detection limits in the samples taken approximately 50 m downstream from the (seepage) entry points to the stream. The absence of compounds in the stream itself has been attributed to their loss by volatilization (note that chlorinated solvents rapidly volatilize, dispersing into the atmosphere and limiting the potential for ecological effects in groundwater discharge areas). [28]

Low concentrations of polychlorinated dibenzodioxins and polychlorinated dibenzofurans are detected at the Electrical Storage Yard Landfill in the Supervised Area, which is within the Built-up Region of the CRL site (see figure 3.1). These contaminants are believed to be the result of the past practice of burning landfill wastes. Among the inorganic parameters included in groundwater monitoring, iron and manganese are the metals that are most frequently present at elevated (above background) concentrations in groundwater downgradient of some of the waste management facilities. Both of these metals are naturally present at high concentrations in local soils and both exhibit significant solubility under reducing conditions when dissolved oxygen is absent. Such reducing conditions are a common natural occurrence in local groundwater flow systems, but the creation of reducing conditions is enhanced when groundwater or infiltration passes through materials with appreciable amounts of readily degradable organic materials. For this reason,

elevated iron and manganese concentrations are observed in groundwater downgradient of the waste management facilities that feature biodegradable waste buried in unlined pits and trenches.

## Conclusion

The results of groundwater monitoring at the CRL site demonstrate that groundwater has been contaminated by activities conducted on the CRL site. However, much of the contamination is a result of historic operations and early waste management practices. Current (and future) operations at the CRL site are continuously monitored and controlled to ensure that historical groundwater contamination is not exacerbated, and that CNL continues to improve environmental performance. Additionally, when decommissioning activities commence, and source-terms are removed, additional environmental remediation will take place on site as per the PDP discussed in section 2.2 of this report. [17]

CNSC staff have concluded that CNL's reported radiological and non-radiological contaminant concentrations in groundwater wells surrounding the CRL site have remained below their respective regulatory limits during the current licensing period, based on review of the most recent ERA and annual groundwater monitoring data. CNL's groundwater monitoring program confirms that radiological and non-radiological contaminant concentrations in groundwater surrounding the CRL site are generally low and if elevated, the contamination is localized. Thus, ecological and human receptors are protected.

### 3.4.3 Aquatic Environment

The area surrounding the CRL site lies within the Ottawa River watershed. [7] The three main drainage basins – the Ottawa River Direct, Perch Lake and Maskinonge Lake basins – are illustrated in figure 3.2 (as shown in section 3.4.2).

Direct drainage to the Ottawa River occurs from the portion of the CRL site that is located in the Ottawa River Direct basin. This portion of the CRL site contains the Built-up Region of the site, which includes the Controlled Area and the Supervised Area, where most operational nuclear facilities are located (see figure 3.1 in section 3.4.2), the Inactive Landfill, and a number of smaller historic landfill areas. The Ottawa River Direct basin is also unique in that most of the air and liquid effluents resulting from CRL operations are discharged from this zone, with liquid effluent discharges occurring directly to the Ottawa River.

The Perch Lake basin also drains some of the CRL site and is significant because it contains many of CRL's operating waste management areas including those from the earliest days in waste storage practices (e.g., the Liquid Dispersal Area). This basin is the most affected by historical operations.

Finally, Maskinonge Lake is the largest surface water body entirely within the CRL site boundary, and much of its drainage basin is within the CRL site boundary accounting for almost 40% of the site's area. Waste Management Areas C and F, the Bulk Material Landfill (Waste Management Area J), and the Nitrate Plant and Thorium Pit compounds are located in this basin. Drainage from this basin is into Chalk (Sturgeon) Lake, and then into the Ottawa River via the Chalk River. Figure 3.3 (shown in section 3.4.2) is a schematic diagram that relates the CRL facilities discussed



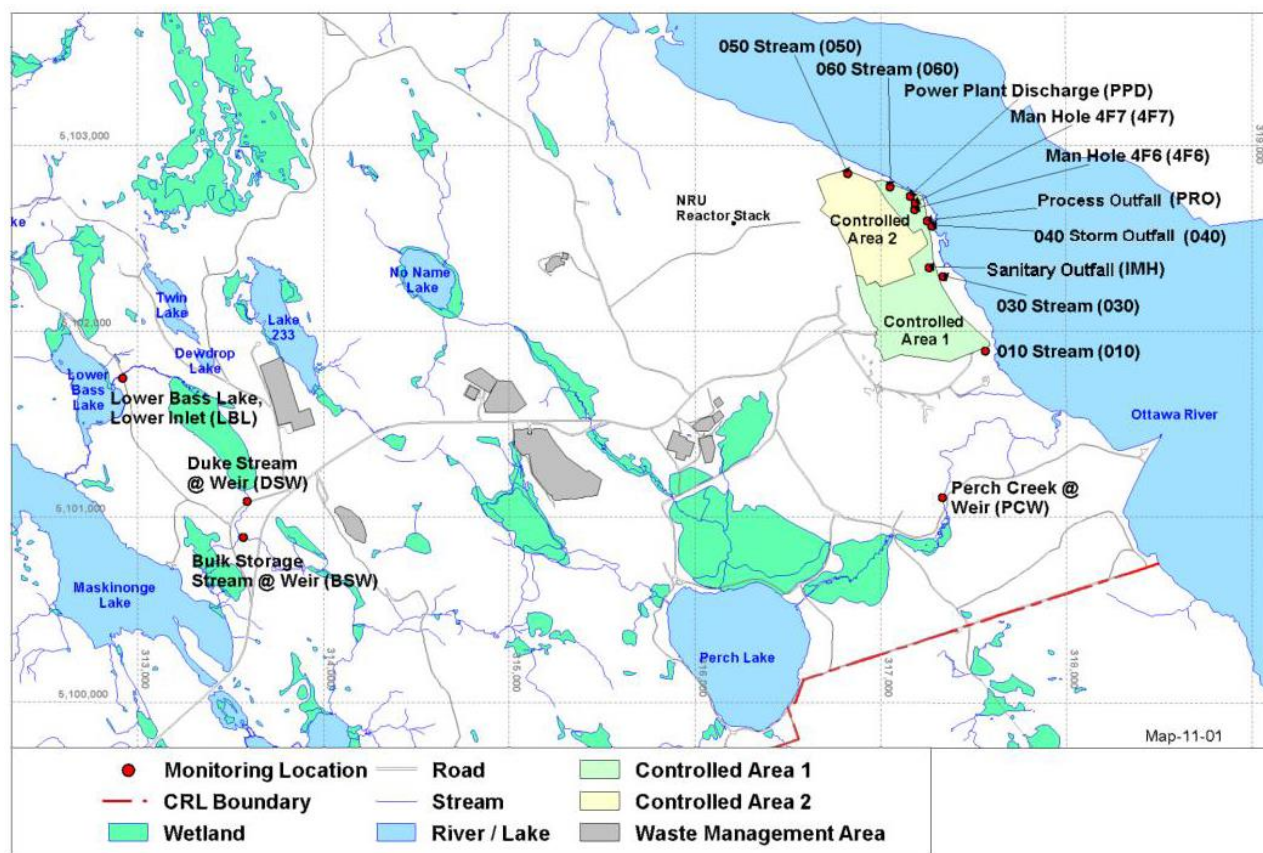
in this report with the drainage basins and flow-paths along which groundwater or surface water contaminants travel on their way to the Ottawa River.

### *Radiological Contaminants*

The CRL Radiological Liquid Effluent Verification Monitoring Program [11] comprises 13 monitoring points. General descriptions of these liquid radiological effluent monitoring points as well as potential contaminant sources are provided in the CRL Radiological Effluent Verification Monitoring Plan. [32]

CRL's Radiological Liquid Effluent Verification Monitoring Program [11] covers routine monitoring of gross alpha and gross beta particulates as well as tritium oxide. Gamma spectroscopy analysis is applied to streams of higher interest where specific gamma emitters require monitoring. In two locations, Process Outfall and Perch Creek Weir, total strontium is also reported. The monitoring locations are shown in figure 3.7.

**Figure 3.7: CRL site-wide radiological liquid effluent monitoring locations**



Note: Controlled Area 1 on the above figure is now called the Supervised Area, and Controlled Area 2 is now called the Controlled Area, as per figure 3.1 shown earlier in this report. Both of these areas are sub-parts of the Built-up Region of the CRL site.

Source: CRL Annual Safety Review for 2016 [26]

The liquid effluent streams discharging either directly to the Ottawa River via drainage systems, or indirectly to the Ottawa River by way of Maskinonge Lake, Perch Lake and Chalk Lake are

monitored under the Radiological Liquid Effluent Verification Monitoring Program. [11] The following are the major sources of liquid radiological effluents from CRL:

- NRU reactor and Waste Treatment Center (monitored at the Process Outfall)
- active laundry facility (monitored at the Sanitary Outfall)
- surface water runoff and groundwater from the Waste Management Areas (monitored at the Perch Creek Weir, the Duke Stream, the Bulk Storage Stream and the Lower Bass Lake Inlet Weir)
- groundwater discharges to the Ottawa River from sources within the Built-up Region of the CRL site (already discussed in section 3.4.2)

The Process Outfall monitoring point is located at the final discharge point of the Process Water Collection System. This system carries once-through cooling water from the reactor as well as water from sumps, floor, and roof drains in the NRU, treated distillate water from the Waste Treatment Center and effluent process water from other facilities. Water from the Active Drain System (which collects low-level radiological wastewater from various nuclear facilities and laboratories within the Controlled Area and Supervised Area) is transferred to the Waste Treatment Center for treatment prior to monitored discharge to the Ottawa River via the Process Outfall.

All releases of radiological material in CRL liquid effluents during the current licensing period were below their respective release limits and there were no release limit exceedances.

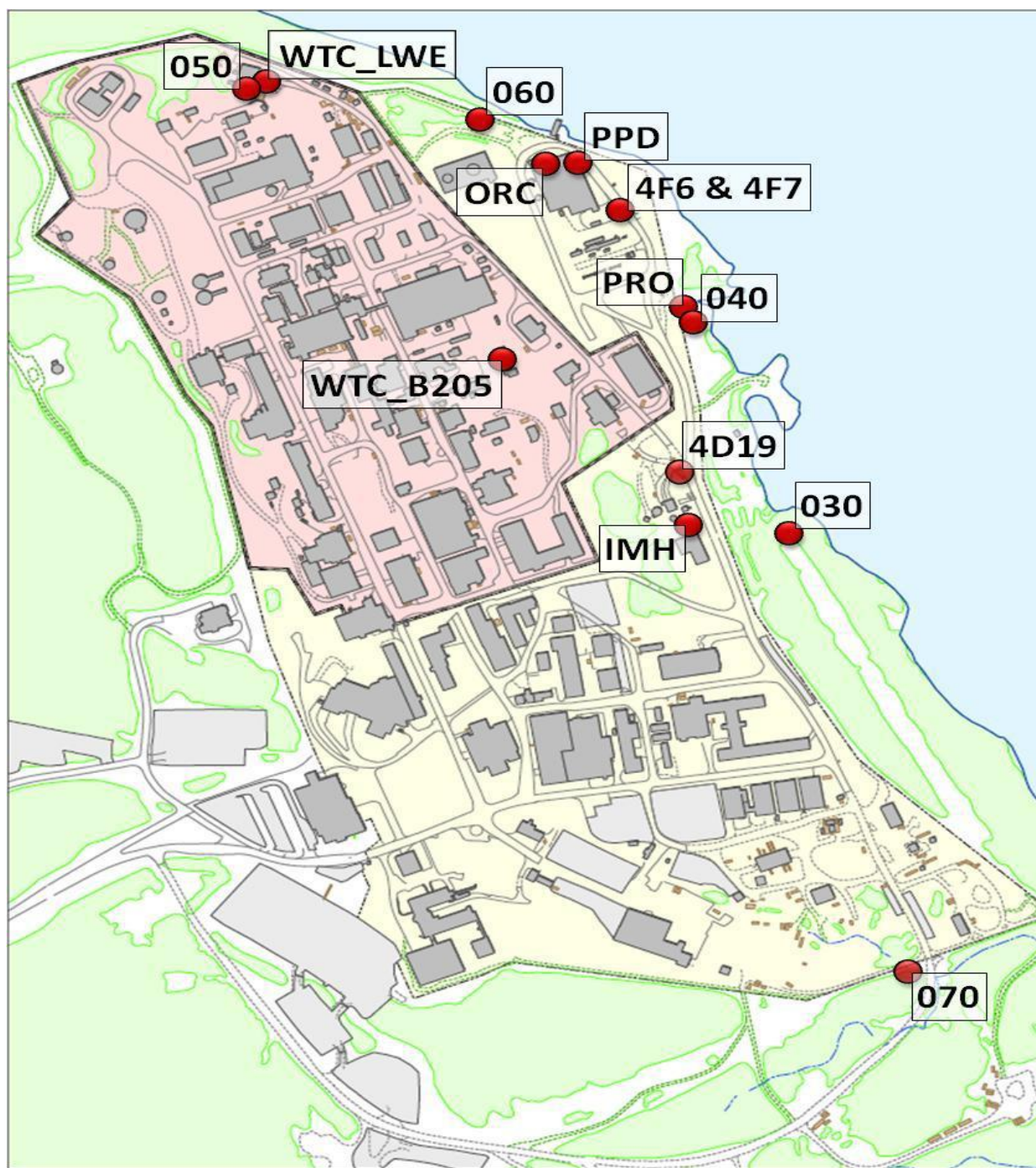
Additionally, the dose constraint of 0.30 mSv to critical groups was not exceeded during the current licensing period. Total annual radiological releases to the aquatic environment from the CRL site for the current licence period are provided in table 3.6.

**Table 3.6: Total annual radionuclide releases to the aquatic environment from the CRL site for the 2011 – 2016 licence period compared with applicable release limits**

Emission	Tritium Oxide (Bq/yr)	Gross beta (Bq/yr)	Gross alpha (Bq/yr)
2011	$3.16 \times 10^{12}$	$2.67 \times 10^9$	$6.04 \times 10^7$
2012	$2.68 \times 10^{12}$	$2.32 \times 10^9$	$4.23 \times 10^7$
2013	$2.43 \times 10^{12}$	$3.02 \times 10^9$	$4.68 \times 10^7$
2014	$2.56 \times 10^{12}$	$2.18 \times 10^{10}$	$7.56 \times 10^7$
2015	$3.29 \times 10^{12}$	$3.31 \times 10^9$	$5.79 \times 10^7$
2016	$2.92 \times 10^{12}$	$2.69 \times 10^9$	$5.50 \times 10^7$
<b>Release limits</b>	$1.03 \times 10^{17}$	$2.70 \times 10^{13}$	$1.32 \times 10^{12}$

*Non-Radiological Contaminants*

There are 12 effluent monitoring points in the Non-radiological Effluent Verification Monitoring Program as shown in figure 3.8. All of the monitoring points belong to the Ottawa River direct watershed. In addition to the effluent monitoring points, the program also includes one influent monitoring point (Ottawa River Intake Well). General descriptions of each of the liquid effluent monitoring points, as well as potential contaminant sources, are detailed in CRL's Non-Radiological Effluent Verification Monitoring Plan. [33] In total, there are 220 parameter/location combinations reported on.

**Figure 3.8: CRL non-radiological liquid effluent monitoring locations**

Source: CRL Annual Safety Review for 2016 [24]

Eighty-nine percent (89%) of the parameter/location combinations in the CRL liquid effluents monitoring during 2016 were below their five-year averages, showing an improvement in environmental performance across the CRL site. The remaining 11% of the parameter/location combinations in the CRL liquid effluents monitoring during 2016 were not below their five-year averages; however, this does not necessarily indicate impacts to the environment. Nonetheless, potential effects will be discussed further in the subsection below (Aquatic Biota).



### *Aquatic Species At Risk*

Aquatic species that are present or potentially present in and around the CRL site, and that are either listed under the Ontario *Endangered Species Act* (ESA) or the federal *Species at Risk Act* (SARA), are outlined in table 3.7.

**Table 3.7: Aquatic species at risk present or potentially present in and around the CRL site**

Common Name	Provincial ESA	SARA (Schedule 1)
Lake Sturgeon (present)	Threatened	No status
American Eel (potentially present)	Endangered	No status

Since 2012, an average of two juvenile Lake Sturgeon have been impinged annually at the CRL site. Currently, mortality counts are ongoing for Lake Sturgeon. Lake Sturgeon is also the subject of targeted impingement and entrainment monitoring as per recommendation #6 of the ERA (see table 2.2). However, although threatened under the Ontario ESA, the Lake sturgeon population upstream of the CRL site is stable, and the population downstream in Allumette Lake is increasing according to the Ontario Ministry of Natural Resources. [34]

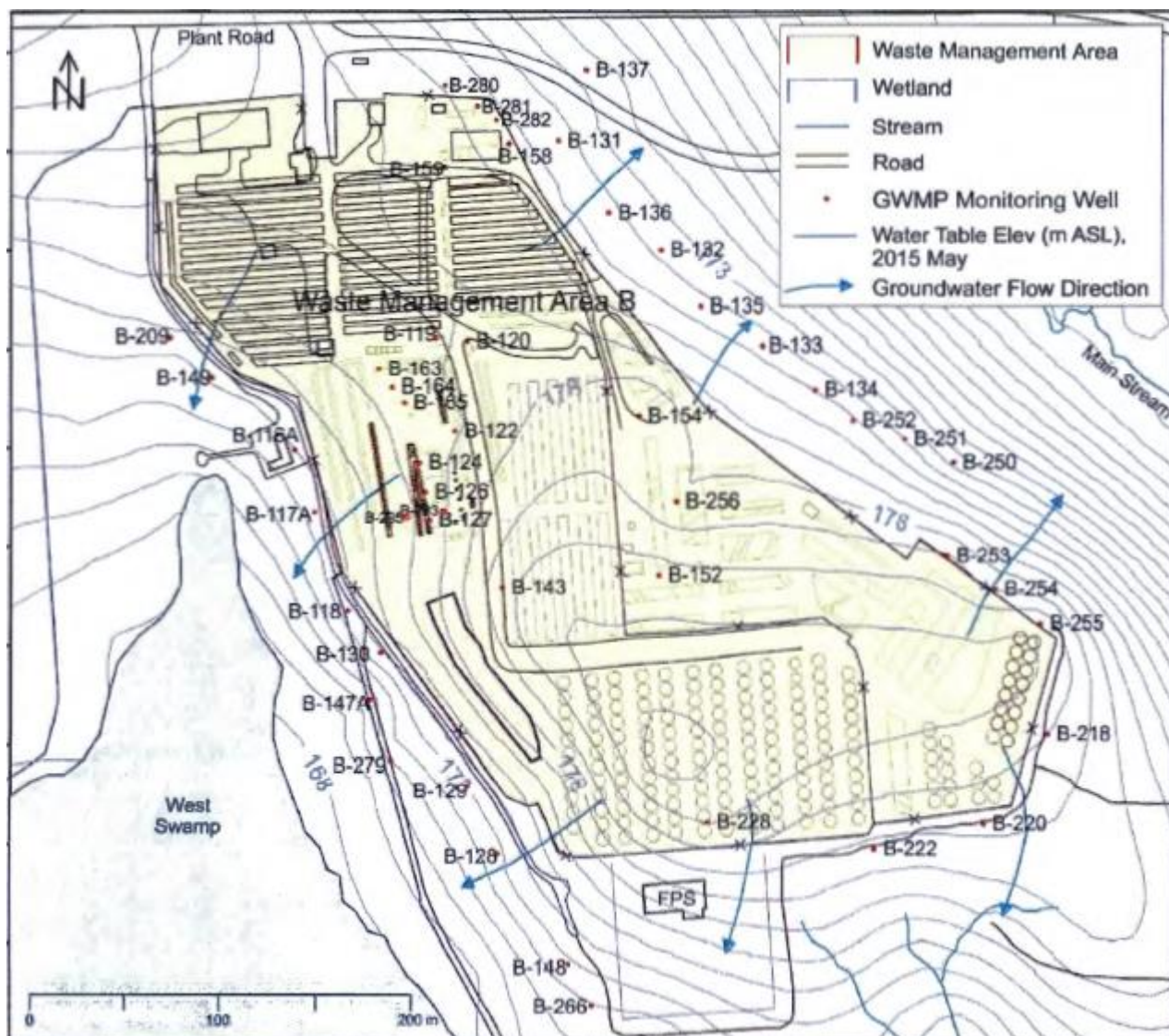
With respect to the American Eel, dramatic decline, and in many instances extirpation of eels has occurred throughout tributaries of the middle and upper reaches of the Ottawa River, coinciding with the construction of hydro-electric dams. [35] However, CNL has not reported any impingement of American eels at the CRL site to date. [36]

Given that the American Eel has not been impinged at the CRL site, and considering that Lake sturgeon populations upstream and downstream of the CRL site are stable and increasing respectively, CNSC staff consider the potential impact from impingement and entrainment at the CRL site on these two species at risk as low.

### *Aquatic Biota*

As recommended in CSA Group Standard N288.6-12, the radiation dose benchmark for the assessment of effects for aquatic biota is 400 µGy/h (9600 µGy/d). Combined total radiological dose (from all radionuclides) to aquatic receptor organisms at inland, nearshore and offshore locations within and around the CRL site were estimated from available measured concentrations. Based on these measurements, the ERA predicted radiation doses would exceed 400 µGy/h in the South Swamp, East Swamp and Spring B Forest for the most exposed member (snail). South Swamp and East Swamp are shown in figure 3.4 (section 3.4.2). Spring B Forest is an area on the northeast corner of West Swamp, shown in figure 3.9.

**Figure 3.9: Map showing location of West Swamp (Spring B Forest sits near northeast corner) in relation to Waste Management Area B**



Source: CNL, *Environmental Monitoring in 2016 at CRL*, June 2017 [28]

The highest average level of exposure is predicted to occur in Spring B Forest and result in average doses of 52,600  $\mu\text{Gy/d}$  to the snail. This dose arises from strontium-90, which originates from Waste Management Area B. The next highest average doses estimated are for South Swamp and are 16,900  $\mu\text{Gy/d}$  to the snail, and this dose arises from strontium-90 originating from Waste Management Area A and the Reactor Pit 2 within the Liquid Dispersal Area. East Swamp produced average estimated doses of 10,200  $\mu\text{Gy/d}$  to the snail, which is only marginally higher than the radiation dose benchmark (9600  $\mu\text{Gy/d}$ ).

With respect to South Swamp, it is important to note the plume capture technology (permeable reactive barrier) currently in use and previously discussed in section 2.1.1. The permeable reactive barrier is specifically targeting strontium-90 and early monitoring results are positive. Once the

monitoring campaign (2015 – 2017) is complete, dose values will be re-evaluated as per recommendation #2 of the ERA (see table 2.2).

Doses well above benchmarks indicate a potential for adverse effects and identify appropriate locations for effects monitoring and/or risk management. In this instance though, doses received above benchmarks are limited to the plume area of the Perch Lake basin, and are therefore unlikely to have an effect at the population level in the remaining area of Perch Lake and further downstream. Additionally, doses were calculated to fall below benchmark values for aquatic biota for all other inland aquatic locations and for the Ottawa River nearshore mixing zone areas for all liquid effluent discharges.

With respect to non-radiological contaminants, risk quotients (RQ) are calculated by dividing exposure values by benchmark values for each relevant receptor at each assessment location. When a parameter (contaminant) in a given area or media is above effluent limits, benchmarks or guidelines, the resulting RQ greater than 1 indicates a potential for adverse effects, particularly if based on average exposure at the assessment location. RQs based on maximum concentrations may overestimate risk for birds and mammals that may average their exposure through their movements.

At inland aquatic receptor locations, some aquatic biota was predicted to receive chemical exposures above benchmarks, principally for copper and iron. In most cases, the exceedance is marginal (e.g.,  $RQ = 1-2$ ). However, some locations were predicted to have RQs well above benchmark. These locations include: Spring B Forest (iron), Perch Creek (iron, tetrachlorodibenzofuran and benzo(a)pyrene), Duke Stream (iron, lead and cadmium), Perch Lake Inlet 2 (iron and tetrachlorodibenzofuran), East Swamp (selenium, polychlorinated biphenyl and tetrachlorodibenzofuran), West Swamp (iron and selenium) and South Swamp (selenium and iron). These RQs are limited to small areas and are therefore not a concern to ecological populations downstream of these areas.

Riparian birds and mammals at the inland aquatic sites have RQs below 1 for most contaminants of potential concern. An exception is selenium (RQs range from 1 – 2) for water shrews based on West and South Swamp soil concentrations. However, data on selenium background levels are limited, and it is possible that elevated selenium levels are a background condition. Additionally, it is important to note that RQs marginally above 1 do not necessarily produce adverse effects to the species and even so, the effect will be localized and will not affect the population at the site.

## Conclusion

Radio-strontium groundwater plumes originating from Waste Management Areas and the Liquid Dispersal Area have contaminated and perhaps affected a few wetland locations including the South Swamp, East Swamp and Spring B Forest. Snails received the highest radiological doses and could be the most affected aquatic species. However, this is limited to the plume area of the Perch Lake basin. As indicated in section 3.4.2, much of the contamination is a result of historic operations and early waste management practices. Current (and future) operations at the CRL site are continuously monitored and controlled to ensure that historical groundwater contamination is not exacerbated, and that CNL continues to improve environmental performance.

Likewise, some aquatic biota in aquatic receptor locations are predicted to receive chemical exposures above benchmarks. However, adverse impacts to aquatic biota are expected to remain low, as most benchmark exceedances are marginal and the spatial extent of exposure is small. Regardless, in instances where chemical exposures were predicted to exceed benchmarks, CNSC staff have requested CNL to confirm exposure conditions and the presence of ecological receptors similar to those assessed, and conduct ongoing monitoring for effects relevant to benchmark exceedances as per recommendation #1 of the ERA (see table 2.2).

CNL's EMP confirms that radiological and non-radiological contaminant concentrations in the aquatic environment surrounding the CRL site are generally low and if elevated, the contamination is localized. CNSC staff have concluded, based on the review of the most recent ERA and annual environmental monitoring data, that CNL will continue to make adequate provision for the protection of the environment, and radiological and non-radiological impacts to aquatic biota will be low, as a result of the proposed CRL licence renewal.

### 3.4.4 Terrestrial Environment

The terrestrial sites identified and assessed in the ERA [7] include operating and non-operating waste management areas, designated landfills and other contaminated lands. Some of the terrestrial sites are source areas for contaminated groundwater, which migrates in the downgradient direction toward aquatic sites including the Ottawa River.

#### *Radiological Contaminants*

Surface and near surface soils at the terrestrial sites mentioned above are contaminated. The contaminants of potential concern identified in soils include radiological contaminants (strontium-90 or gross beta, cesium-137, cobalt-60 and gross alpha) and associated gamma fields. A localized site of natural uranium contamination is also present within the Liquid Dispersal Area as a result of historical leaks in the Liquid Dispersal Area/NRX pipeline<sup>2</sup>. However, when home range and average uranium concentrations are considered, resulting RQs remain below 1 for mobile receptors.

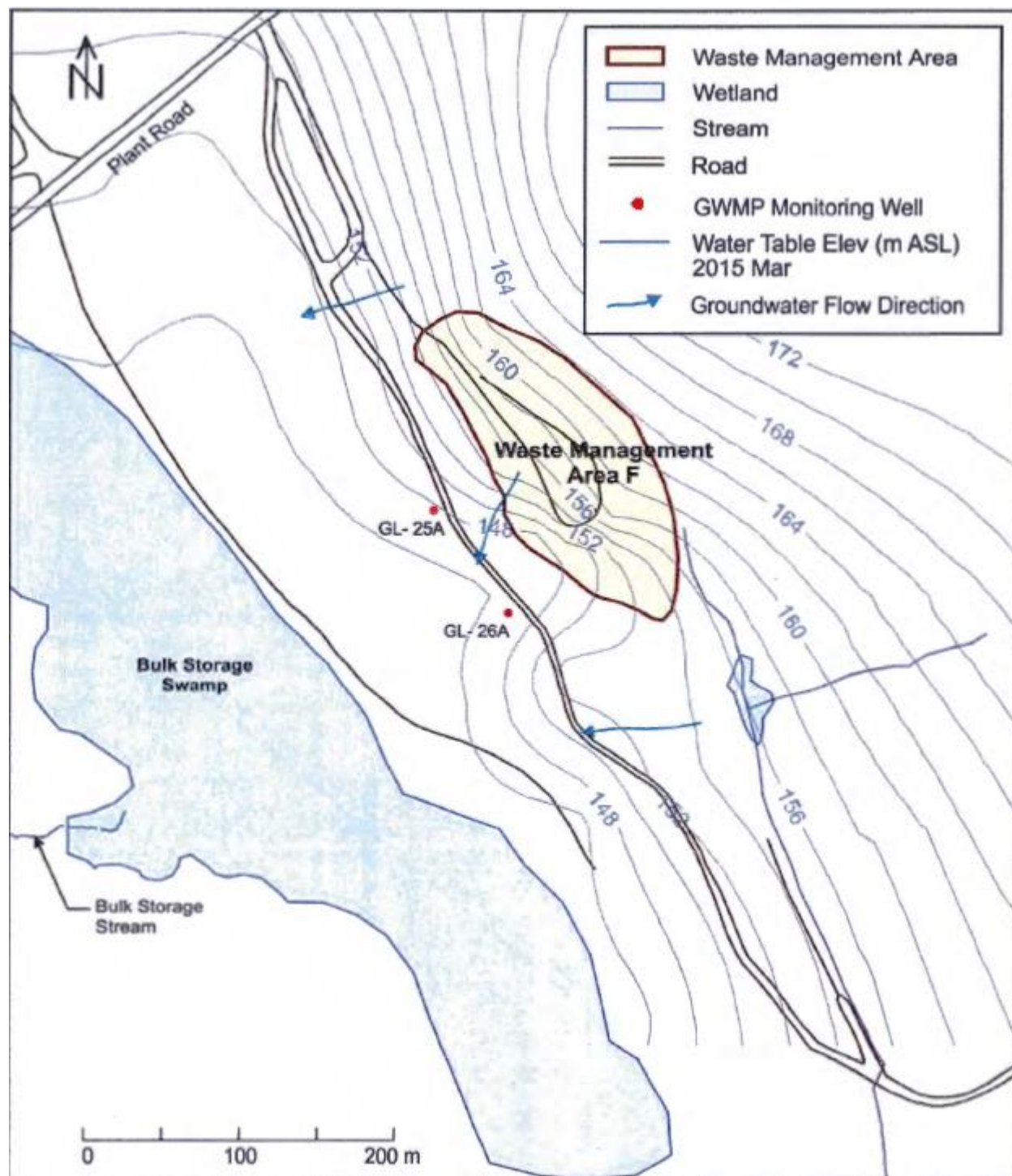
As recommended in CSA Group Standard N288.6-12, the radiation dose benchmark for the assessment of effects for terrestrial biota is 100 µGy/h (2400 µGy/d). Combined total radiological dose (from all radionuclides) to terrestrial receptor organisms at inland, nearshore and offshore locations within and around the CRL site were estimated from available measured concentrations and/or doses. According to the ERA, predicted radiation doses may exceed 100 µGy/h (under average exposure conditions) within or near Waste Management Areas A (see figure 3.4 – section 3.4.2) and F (see figure 3.10), and within or near the Chemical Pit, Laundry Pit and Reactor Pit 2 (see figure 3.4 – section 3.4.2). Additionally, radiation doses are predicted to exceed the radiation benchmark in areas affected by historical leaks in the Liquid Dispersal Area/NRX pipeline system.

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<sup>2</sup> The Liquid Dispersal Area/NRX pipeline consists of two pipes that run very close to each other. One pipe transferred low-level radioactive wastewater from the NRU AND NRX reactors to Reactor Pit 2 (1956 – 2000, within the Liquid Dispersal Area). The other pipe transferred low-level radioactive wastewater from various CRL operations to the Chemical Pit (1956 – 1996, also within the Liquid Dispersal Area).



**Figure 3.10: Map showing location of Waste Management Area F in relation to Plant Road and Bulk Storage Swamp**



Source: CNL, *Environmental Monitoring in 2016 at CRL*, June 2017 [28]

The Waste Management Areas do not generally provide suitable habitat for wildlife, and they are not large enough to accommodate any resident mammals or birds. Larger mammals and birds may forage in the Waste Management Areas though, and one-way animal fences have been installed to allow animals to easily exit a Waste Management Area if one becomes trapped. Vegetation growth

is controlled in Waste Management Areas (as per recommendation #3 of the ERA – see table 2.2), and little vegetation cover is available. However, some plants and invertebrates are, or can be, present.

In Waste Management Area A, the highest estimated dose (mainly due to cesium-137) was for the masked shrew (67100 µGy/d). However, actual doses to birds and mammals are probably much lower based on home range and habitat considerations. Vegetation growth is controlled within Waste Management Areas, thereby eliminating suitable habitat. Soil invertebrate dose (49000 µGy/d) was also estimated to be above benchmark.

In Waste Management Area F, a historical site containing Port Hope waste soil, the woodchuck is predicted to receive a dose (6200 µGy/d) above benchmark, due to radon inhalation in the burrow.

In the Chemical Pit (23900 µGy/d) and Reactor Pit 2 (43900 µGy/d), the highest average estimated dose was for the masked shrew. However, actual doses to birds and mammals are probably much lower based on home range and habitat considerations. Soil invertebrate doses were above benchmark in the Chemical Pit (19400 µGy/d), in the Laundry Pit (9400 µGy/d) and in Reactor Pit 2 (34100 µGy/d). Plant dose estimates were lower, but vegetation growth is controlled, thereby eliminating suitable habitat. Doses in these areas are mainly due to cesium-137.

Along the Liquid Dispersal Area/NRX pipeline, the highest average estimated dose was for soil invertebrates (106,000 µGy/d), mainly due to cesium-137. The masked shrew had the highest average vertebrate dose (87000 µGy/d), also mainly due to cesium-137. Again, actual bird and mammal doses would be much lower if home range and habitat were considered.

In all other cases, doses to terrestrial biota within or adjacent to Waste Management Areas were predicted to be below benchmark. Doses marginally above this level, due to tritium in groundwater and vegetation, were estimated for alder growing on the Ottawa River shoreline near groundwater discharge areas for the NRU plume. The terrestrial biota receiving doses above benchmark represent a few individuals within the confines of small waste management facilities. These doses are unlikely to lead to significant effects at the population level.

For other species of interest, radiation doses in white-tail deer (based on measured radionuclides in deer tissue) and in Eastern Wolf (based on calculation of radionuclides in wolf tissue) remain well below benchmark.

### *Non-Radiological Contaminants*

With respect to non-radiological contaminants, benchmark values for non-radiological contaminants of potential concern were taken from various literature sources. An RQ above 1 indicates a potential for adverse effects, particularly if based on average exposure at the assessment location. RQs based on maximum concentrations may overestimate risk for birds and mammals that may average their exposure through their movements.

Based on CNL's reports, chemical concentrations in surface soils within the non-operating waste management areas are not high enough to result in adverse chemical effects on terrestrial biota. A small localized area of soil (contaminated by natural uranium) in the Electrical Storage Yard Landfill produced RQs above benchmark for soil invertebrates in the area. As mentioned above,

risks to mammals and birds are considered much smaller because they have large foraging areas. Nonetheless, resulting RQs were still slightly above benchmarks for some birds (American robin) and mammals (snowshoe hare and masked shrew). Again, contamination in the Electrical Storage Yard Landfill is a result of past operational practices and procedures at the CRL site, and contamination associated with historical operations is only expected to improve over time.

Soil invertebrates and alder trees that reside on river front lands near groundwater discharge locations may be exposed to contamination as a result of occasional rises in the water table, which will result in contamination of root zone soils. The ERA identified cadmium, copper and zinc as marginally exceeding soil benchmarks during times when the water table is elevated. Iron produced a higher RQ, but this was based on the maximum concentration of iron measured on river front lands, which may be overly conservative (average concentrations of a contaminant are typically used to calculate RQs, but maximum measured concentration can be used when an average is not available).

### *Terrestrial Species At Risk*

Terrestrial species that are present or potentially present in and around the CRL site, and that are either listed under the Ontario provincial ESA or the federal SARA, are outlined in table 3.8.

**Table 3.8: Terrestrial species at risk present or potentially present in and around the CRL site**

Common Name	Provincial ESA	SARA (Schedule 1)
<b>Mammals</b>		
Eastern Small-footed Myotis	Endangered	No status
Eastern Wolf	Threatened	Special concern
Little Brown Myotis	Endangered	Endangered
Tri-colored Bat	Endangered	Endangered
<b>Birds</b>		
Bald Eagle	Species of concern	No status
Bank Swallow	Threatened	No status
Barn Swallow	Threatened	No status
Canada Warbler	Species of concern	Threatened
Chimney Swift	Threatened	Threatened
Common Nighthawk	Species of concern	Threatened
Eastern Meadowlark	Threatened	No status

Common Name	Provincial ESA	SARA (Schedule 1)
Eastern Whip-Poor-Will	Threatened	Threatened
Eastern Wood-Pewee	Species of concern	No status
Golden-Winged Warbler	Species of concern	Threatened
Least Bittern	Threatened	Threatened
Olive-Sided Flycatcher	Species of concern	Threatened
Red-Headed Woodpecker	Species of concern	Threatened
Rusty Blackbird	No status	Special concern
Wood Thrush	Species of concern	No status
<b>Amphibians and Reptiles</b>		
Blanding's Turtle (Great Lakes - St. Lawrence River population)	Threatened	Threatened
Eastern Milksnake	No status	Special concern
Eastern Musk Turtle	Species of concern	Threatened
Northern Map Turtle	Species of concern	Special concern
Snapping Turtle	Species of concern	Special concern
Western Chorus Frog (Great Lakes – St. Lawrence – Canadian Shield population)	No status	Threatened
<b>Insects</b>		
Monarch	Endangered	Special concern
<b>Plants</b>		
Butternut	Endangered	Endangered

As identified in table 3.8, there are several SARA species present or potentially present at the CRL site, based on routine surveys conducted by CRL. Assessment of SARA species at the CRL site was carried out using surrogate reference organisms, which were selected to represent these species with respect to body size and likely route(s) of exposure to COPCs. CNSC staff agreed with the conclusion in the ERA that there would be no adverse radiological or non-radiological impacts on terrestrial SARA species. However, as per recommendation #5 of the ERA (see table 2.2), a refined dose assessment for Chimney Swifts was to be conducted in order to better assess

dose and evaluate potential effects on the Chimney Swift individuals roosting in the MPF stack on the CRL site.

On September 22, 2017, CNL submitted a synopsis of the revised dose assessment for Chimney Swifts which showed that potential dose to this species would be well below the radiological dose screening benchmark for terrestrial organisms, and therefore pose a negligible risk to this species. Following this, CNSC staff have requested that CNL submit the full report on this revised dose assessment, for technical review and model verification purposes.

## Conclusion

Radiation doses are generally below benchmark values for terrestrial biota. However, invertebrates in soil, small terrestrial animals and birds residing in or near the Liquid Dispersal Area (Chemical Pit and Laundry Pit) and Waste Management Areas are subject to estimated doses well above benchmark dose values, mostly due to cesium-137. Actual bird and mammal doses would likely be much lower if home range and habitat were considered. Additionally, active and planned decommissioning activities will further mitigate the effects of contaminant plumes.

In instances where chemical exposures were predicted to exceed benchmarks, CNSC staff have requested CNL to confirm exposure conditions and the presence of ecological receptors similar to those assessed, and conduct ongoing monitoring for effects relevant to benchmark exceedances as per recommendation #1 of the ERA (see table 2.2). Where benchmarks were exceeded, these results must be sent to CNL risk managers for inclusion in the remediation plans for the CRL site, as per recommendation #10 of the ERA (see table 2.2). CNSC staff will provide regulatory oversight under the NSCA for results related to ongoing monitoring and for any subsequent changes to remediation plans. In addition, CNL is expected to provide an update on this work in the next ERA submission which is anticipated in December 2018.

Therefore, taking all of the above information into consideration, CNSC staff conclude that CNL will continue to make adequate provision for the protection of the environment, and that radiological and non-radiological impacts to terrestrial biota will remain low, as a result of the proposed CRL licence renewal.

### 3.4.5 Human Health

The ERA [7] for the CRL site included a HHRA, which begins with an identification of the human receptors of interest, the radiological and non-radiological contaminants of potential concern, locations of exposure to contaminants of potential concern and relevant exposure pathways. Workers on the CRL site are potentially exposed to environmental contaminants, both chemical and radiological, but these exposures are considered and controlled through the Occupational Health and Safety Program (OHSP) and the RPP. Because worker and visitor exposures on the site are kept within safe levels through the OHSP and RPP, on-site receptors are not addressed in the HHRA.

#### *Radiological Contaminants*

The CNSC's *Radiation Protection Regulations* prescribes radiation dose limits to protect the public from exposure to radiation as a result of licensed activities. The annual effective dose limit for a member of the public is 1 mSv per year.

Off-site members of the public are potentially exposed to low levels of airborne or waterborne contaminants. As such, CNL assessed doses to these individuals (also known as public receptors) in the HHRA. The HHRA focuses on the radiological and non-radiological contaminants that have the potential to be present in CRL site's airborne and liquid effluents in significant quantities. The receptors selected for the HHRA are those off-site groups that were identified as potentially receiving the highest radionuclide exposures.

The following human receptors were included in the HHRA:

- Balmer Bay residents that consume local produce, consume milk supplied from a nearby dairy farm, consume meat from local farms, and hunt deer.
- Sheenboro Farm residents that obtain water from wells, consume local produce, consume meat from local farms, and hunt deer.
- Harrington Bay residents that obtain water from wells, swim in the Ottawa River, walk along the shoreline of the Ottawa River, consume local produce and consume fish from the Ottawa River.
- Petawawa and Pembroke residents that obtain water from the municipal water supply which draws water from the Ottawa River, swim in the Ottawa River, walk along the shoreline of the Ottawa River, consume local produce and consume fish from the Ottawa River.

The receptors that receive the highest total dose from airborne contaminants from the CRL site are residents located at Balmer Bay; 6.8 km northwest and upstream of the site. The most exposed farm residents are at the Sheenboro farm, located approximately 10.5 km southeast of the CRL site and downriver on the Quebec side of the Ottawa River.

The receptors that receive the highest total dose from waterborne contaminants from the CRL site are riverside residents at Harrington Bay, 8.6 km downriver on the Quebec side, and residents at Petawawa and Pembroke, 17.9 and 30.1 km downriver, respectively.

The following exposure pathways were considered to assess doses to human receptors:

- inhalation of air
- immersion in air
- ingestion of water
- immersion in water
- ingestion of local produce
- ingestion of local meat
- ingestion of local milk

- ingestion of fish

Therefore, factors such as inhalation rates, food and water ingestion rates, fraction of local food consumed, etc. affect doses to human receptors. As such, the highest estimated annual dose was 0.092 mSv per year to the infant resident of Balmer Bay. The majority of this dose was through the air immersion pathway.

There are no locations off-site that exceed the annual dose limit (1mSv) or the dose constraint limit (0.3 mSv) for humans that live in neighboring communities. The public dose estimates for the Balmer Bay (infant) and Sheenboro (adult) receptors, the receptors with the highest estimated doses, were more than an order of magnitude below the public dose limit of 1 mSv/yr. Therefore, public health is protected at these low levels of exposure to radioactivity from the CRL site. Additionally, the dose estimates represent a fraction of natural background dose (Canadian average is 1.8 mSv/yr). [37]

#### *Non-Radiological Contaminants*

Releases of non-radionuclide contaminants to air (specifically NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub>) from various on-site sources were considered from the perspective of human health protection. For the most exposed off-site location, Balmer Bay, estimated concentrations of these contaminants were well below the Ontario Ambient Air Quality Criteria, [38] pose a negligible risk, and were therefore not considered further in the HHRA.

#### **Conclusion**

Estimated annual doses to all human receptor groups considered in the HHRA were below the annual public dose limit of 1 mSv/year and the dose constraint limit of 0.3 mSv, and no health effects are expected at these low doses. Therefore, taking into consideration the information above and the available Health Canada monitoring data discussed in section 3.1 of this report, CNSC staff conclude that there will be no adverse radiological or non-radiological impacts to the public as a result of the proposed CRL licence renewal, and that human health is adequately protected.

## 4.0 CNSC Independent Environmental Monitoring Program

The CNSC has implemented its IEMP to verify that the public and the environment around licensed nuclear facilities are protected. It is separate from, but complementary to, the CNSC's ongoing compliance verification program. The IEMP involves taking samples from public areas around the facilities, and measuring and analyzing the amount of radiological and non-radiological contaminant substances in those samples. CNSC staff collect the samples and sends them to the CNSC's state-of-the-art laboratory for testing and analysis.

### 4.1 IEMP at Chalk River Laboratories

The 2012, 2013 and 2015 IEMP sampling campaigns for the CRL site focused on both radiological and non-radiological contaminants. Site-specific sampling plans were developed based on CNL's approved EMP and the CNSC's regulatory experience with the site. In 2012, 2013 and 2015, samples were collected in publicly accessible areas outside the CRL site perimeter and included river and lake water, soil and river sediment, and food such as milk, meat, and produce from local farms outside of the CRL perimeter fence. The site-specific sample plans are reviewed by CNSC staff on an ongoing basis to continuously improve and refine the for future IEMP sampling campaigns.

CNSC staff sampled the following in the vicinity of the CRL:

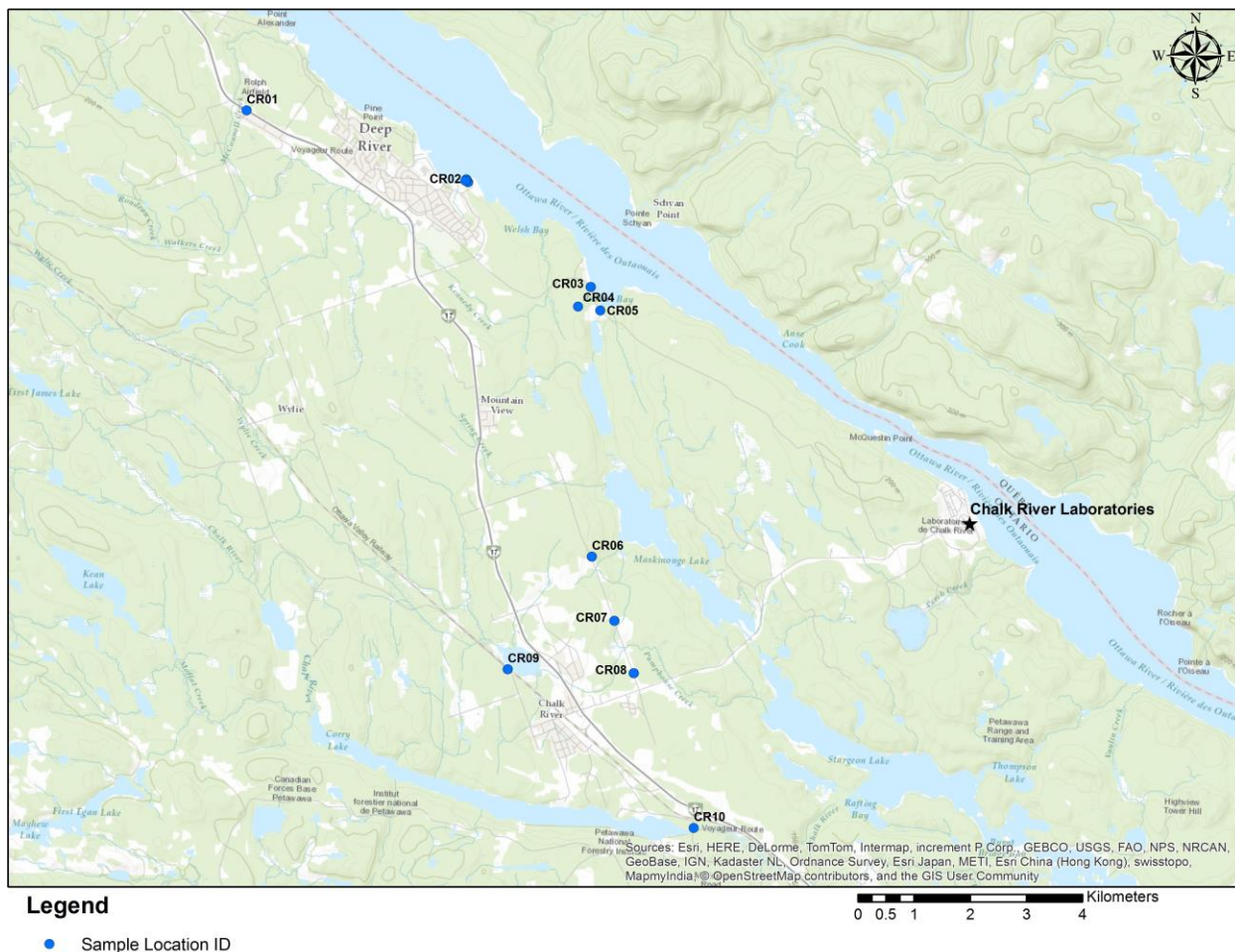
- air (1 location in 2013 and 3 locations in 2015)
- water (8 locations in 2012, 9 locations in 2013 and 8 locations in 2015)
- soil (13 locations in 2012, 11 locations in 2013 and 2 locations in 2015)
- sediment (4 locations in 2012, 3 locations in 2013 and 4 locations in 2015)
- vegetation (2 locations in 2012, 2 locations in 2013 and 3 locations in 2015)
- local food (3 locations in 2012, 13 locations in 2013 and 7 locations in 2015)

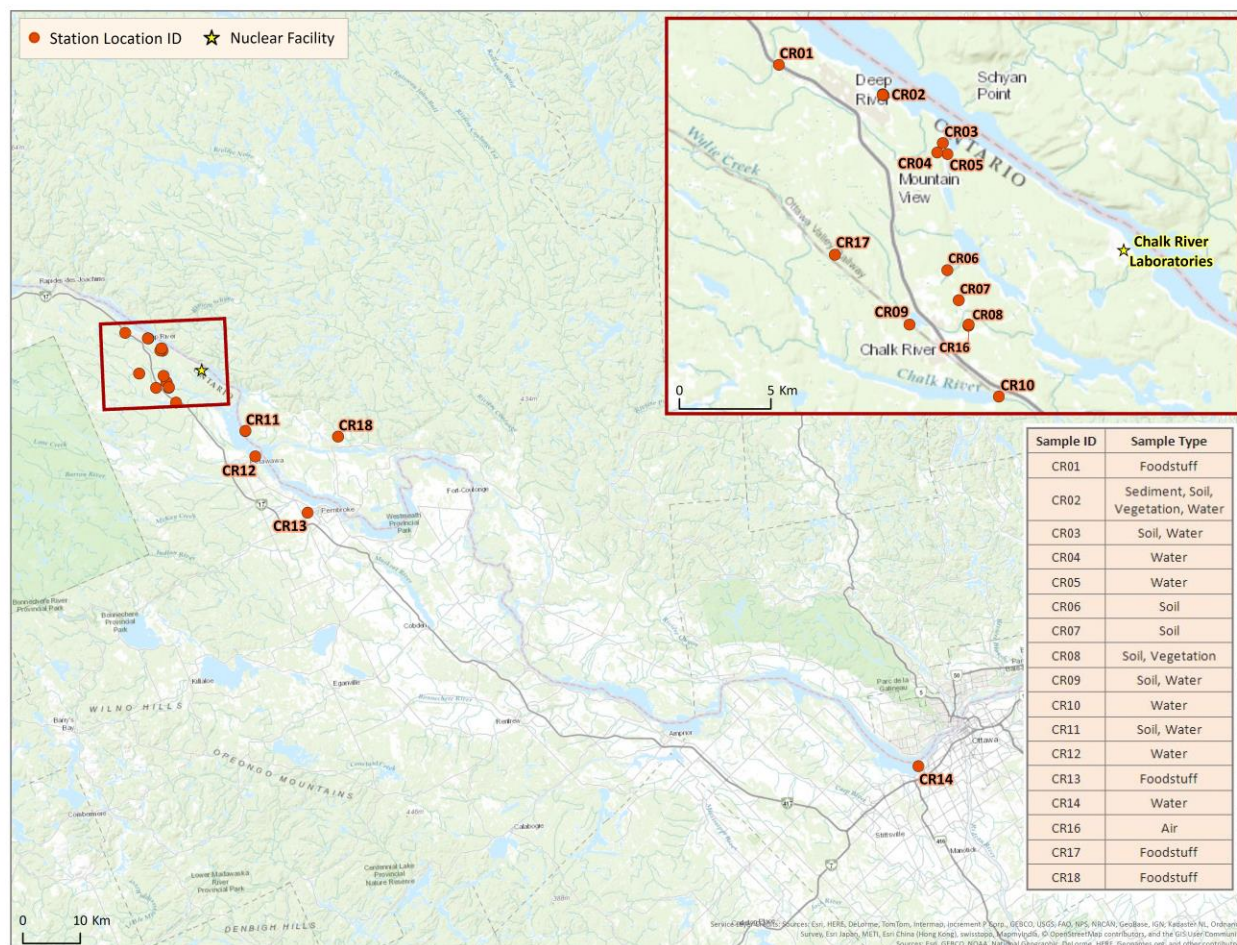
Samples collected were analyzed by qualified laboratory specialists in the CNSC's state-of-the-art laboratory in Ottawa, using appropriate protocols. CNSC staff measured the following:

- contaminants of potential concern – such as arsenic, aluminum, iron and lead
- nuclear substances – such as cesium-137, tritiated water, gross alpha and gross beta

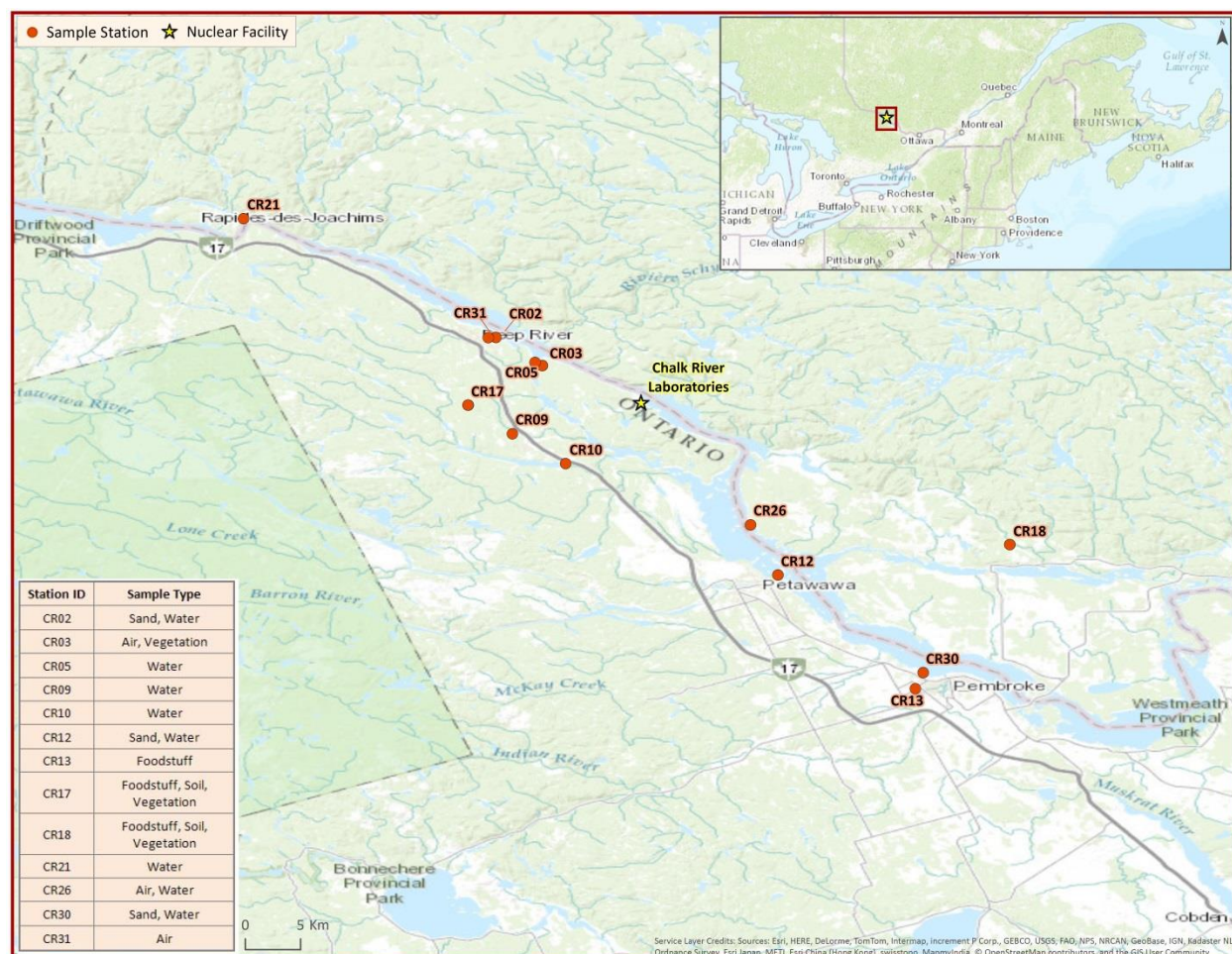
Figures 4.1 to 4.3 provide an overview of the CRL site and sample locations for the 2012, 2013 and 2015 IEMP sampling campaigns.



**Figure 4.1: Location overview of the CRL site and 2012 sample locations**

**Figure 4.2: Location overview of the CRL site and 2013 sample locations**



**Figure 4.3: Location overview of the CRL site and 2015 sample locations**

## 4.2 Results

The measured radioactivity in all samples were below available guidelines and CNSC reference levels and are within natural background levels. CNSC reference levels are based on conservative assumptions about the exposure that would result in a dose of 0.1 mSv/year.

Table 4.1 provides the range of results from the 2012, 2013 and 2015 IEMP sampling campaigns. The full IEMP results are available through a public-friendly [dashboard](#) on the [CNSC website](#).

The IEMP results confirm that the public and the environment around the CRL site are protected, and that there are no expected health impacts. These results are consistent with the results submitted by CNL confirming that the licensee's environmental protection program protects the health of persons and the environment.

**Table 4.1: Summary of CRL site IEMP 2012, 2013 and 2015 results**

Radionuclide	Range of measured radioactivity			Guideline or CNSC reference level <sup>(1)</sup>
Water (Bq/L)				
	2012	2013	2015	
Tritiated water (HTO)	3.1 – 18.6	<3.0 <sup>(2)</sup> – 15.7	3.5-46.0	7,000 <sup>(3)</sup>
Gross Beta	<0.025 <sup>(2)</sup> – 0.06	0.06 - 0.22	<0.05 <sup>(2)</sup> - 0.11	1 <sup>(4)</sup>
Gross Alpha	<0.015 <sup>(2)</sup> – 0.04	<0.02 <sup>(2)</sup> – 0.13	<0.05 <sup>(2)</sup>	0.5 <sup>(4)</sup>
Cesium-137	<0.15 <sup>(2)</sup>	<0.25 <sup>(2)</sup>	<0.25 <sup>(2)</sup>	10.0 <sup>(3)</sup>
Americium-241	<0.15 <sup>(2)</sup>	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	0.2 <sup>(3)</sup>
Cobalt-60	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<0.29 <sup>(2)</sup>	12.1 <sup>(3)</sup>
Air (Bq/m <sup>3</sup> )				
	2012	2013	2015	
Tritiated water (HTO)	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<2 <sup>(2)</sup>	340 <sup>(1)</sup>
Tritiated hydrogen (HT)	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<2 <sup>(2)</sup>	5,100,000 <sup>(1)</sup>
Air particulate (cesium-137)	N/A <sup>(5)</sup>	<0.001 <sup>(2)</sup>	<4.9e-5 <sup>(2)</sup>	2.56 <sup>(1)</sup>
Air particulate (cobalt-60)	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	0.228 <sup>(1)</sup>
Iodine cartridge (iodine-131)	N/A <sup>(5)</sup>	<0.005 <sup>(2)</sup>	<2.6e-3 <sup>(2)</sup>	0.228 <sup>(1)</sup>
Soil (Bq/kg dry weight)				
	2012	2013	2015	
Tritiated water (HTO)	<1.5 <sup>(2)</sup> – 6.0 <sup>(6)</sup>	<1.5 <sup>(2)</sup> – 16 <sup>(6)</sup>	N/A <sup>(5)</sup>	68,500,000 <sup>(1)(6)</sup>
Cesium-137	<0.9 <sup>(2)</sup> – 50.4	<1.0 <sup>(2)</sup> – 18.3	5.81 – 6.54	58.6 <sup>(1)</sup>
Cobalt-60	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<0.93 <sup>(2)</sup>	14 <sup>(1)</sup>

Radionuclide	Range of measured radioactivity			Guideline or CNSC reference level <sup>(1)</sup>
Americium-241	<1.3 <sup>(2)</sup> – 3.1	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	505 <sup>(1)</sup>
<b>Sediment (Bq/kg dry weight)</b>				
	<b>2012</b>	<b>2013</b>	<b>2015</b>	
Cesium-137	20	6.2	<0.66 <sup>(3)</sup>	37,300 <sup>(1)</sup>
Cobalt-60	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<0.93 <sup>(2)</sup>	14 <sup>(1)</sup>
Americium-241	<1.3 <sup>(2)</sup>	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	28,800 <sup>(1)</sup>
<b>Milk (Bq/kg fresh weight)</b>				
	<b>2012</b>	<b>2013</b>	<b>2015</b>	
Tritiated water (HTO)	5.7 – 8.9	2.5 – 3.0	1.9	5,560 <sup>(1)</sup>
Organically bound tritium (OBT)	<5.0 <sup>(2)</sup>	1.8 – 2.3	<1.5 <sup>(2)</sup>	2,260 <sup>(1)</sup>
<b>Meat - pork (Bq/kg fresh weight)</b>				
	<b>2012</b>	<b>2013</b>	<b>2015</b>	
Tritiated water (HTO)	3.0	2.0	<1.5 <sup>(2)</sup>	392,000 <sup>(1)</sup>
Organically bound tritium (OBT)	8.1	<1.5 <sup>(2)</sup>	<1.5 <sup>(2)</sup>	171,000 <sup>(1)</sup>
<b>Radish (Bq/kg fresh weight)</b>				
	<b>2012</b>	<b>2013</b>	<b>2015</b>	
Tritiated water (HTO)	N/A <sup>(5)</sup>	3.2	<1.5 <sup>(2)</sup> – 3.0	104,000 <sup>(1)</sup>
Organically bound tritium (OBT)	N/A <sup>(5)</sup>	<1.5 <sup>(2)</sup>	<1.5 <sup>(2)</sup>	45,200 <sup>(1)</sup>
Cesium-137	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.10 <sup>(2)</sup>	160 <sup>(1)</sup>
Cobalt-60	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.29 <sup>(2)</sup>	373 <sup>(1)</sup>

Radionuclide	Range of measured radioactivity			Guideline or CNSC reference level <sup>(1)</sup>
Kale (Bq/kg fresh weight)				
	2012	2013	2015	
Tritiated water (HTO)	N/A <sup>(5)</sup>	<1.5 <sup>(2)</sup>	2.0	104,000 <sup>(1)</sup>
Organically bound tritium (OBT)	N/A <sup>(5)</sup>	<1.5 <sup>(2)</sup>	<1.5 <sup>(2)</sup>	45,200 <sup>(1)</sup>
Tomatoes (Bq/kg fresh weight)				
	2012	2013	2015	
Tritiated water (HTO)	N/A <sup>(5)</sup>	4.9 – 5.4	3.2	104,000 <sup>(1)</sup>
Organically bound tritium (OBT)	N/A <sup>(5)</sup>	<1.5 <sup>(2)</sup>	<1.5 <sup>(2)</sup>	45,200 <sup>(1)</sup>
Cesium-137	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.10 <sup>(2)</sup>	258 <sup>(1)</sup>
Cobalt-60	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.29 <sup>(2)</sup>	242 <sup>(1)</sup>
Cucumber (Bq/kg fresh weight)				
	2012	2013	2015	
Tritiated water (HTO)	N/A <sup>(5)</sup>	3.1 – 5.2	N/A <sup>(5)</sup>	104,000 <sup>(1)</sup>
Organically bound tritium (OBT)	N/A <sup>(5)</sup>	<1.5 <sup>(2)</sup>	N/A <sup>(5)</sup>	45,200 <sup>(1)</sup>
Beet (Bq/kg fresh weight)				
	2012	2013	2015	
Tritiated water (HTO)	N/A <sup>(5)</sup>	2.6	N/A <sup>(5)</sup>	104,000 <sup>(1)</sup>
Organically bound tritium (OBT)	N/A <sup>(5)</sup>	1.9	N/A <sup>(5)</sup>	45,200 <sup>(1)</sup>

Radionuclide	Range of measured radioactivity			Guideline or CNSC reference level <sup>(1)</sup>
Arugula (Bq/kg fresh weight)				
	2012	2013	2015	
Tritiated water (HTO)	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	3.8	104,000 <sup>(1)</sup>
Organically bound tritium (OBT)	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.5 <sup>(2)</sup>	45,200 <sup>(1)</sup>
Cesium-137	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.10 <sup>(2)</sup>	160 <sup>(1)</sup>
Cobalt-60	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.29 <sup>(2)</sup>	373 <sup>(1)</sup>
Vegetation (Bg/kg fresh weight)				
	2012	2013	2015	
Tritiated water (HTO)	6.0 – 19.0	3.4 – 36.1	N/A <sup>(5)</sup>	10,900 <sup>1</sup>
Organically bound tritium (OBT)	<5.0 <sup>2</sup>	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	73,000 <sup>1</sup>
Cesium-137	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.4 <sup>(2)</sup>	52 <sup>1</sup>
Cobalt-60	N/A <sup>(5)</sup>	N/A <sup>(5)</sup>	<1.7 <sup>(2)</sup>	605 <sup>1</sup>

(1) The concentration required for a hypothetical person (most exposed member of a critical group) to receive an effective whole body dose of 0.1 mSv/year due to exposure to the given radionuclide. Reference levels calculated based on conservative assumptions using CSA Standard N288.1-14. [39]

(2) The < symbol indicates that a result is below the detection limit for laboratory analysis

(3) *Health Canada Guidelines for Canadian Drinking Water Quality*. [20]

(4) *Health Canada Guidelines for Canadian Drinking Water Quality screening level*. [20]

(5) Samples for this contaminant, radionuclide particulate or iodine not taken this year.

(6) Tritiated water concentrations in soil are presented on a fresh-weight basis. This indicates the concentration in bulk soil, for which tritiated water is contained in the soil pore water.

## 5.0 CONCLUSION

CNSC staff reviewed and assessed CNL's environmental protection measures against regulatory requirements. Furthermore, CNSC staff completed regular compliance verification activities (e.g., inspections, audits, reviews) to ensure CNL's environmental protection measures continue to meet CNSC regulatory requirements.

CNSC staff also reviewed CNL's site-wide ERA and most recent PDP, submitted as part of licensing and regulatory requirements. CNSC staff have concluded that the ERA is satisfactory and meets both the CNSC's regulatory requirements and CSA Group standard N288.6-12, *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills*. CNSC staff determined that the Annual Safety Reports submitted since the last ERA support the conclusions of the ERA with respect to characterizing the existing and potential effects of emissions and effluent released into the environment as a result of operations at the CRL site. Additionally, CNSC staff concluded that CNL's PDP, which was included to ensure that the full life-cycle of the CRL was taken into consideration, meets regulatory criteria and CSA Group standards.

The CNSC's 2012, 2013 and 2015 IEMP results also confirm that the public and the environment around the CRL site are protected and that there are no health impacts as a result of facility operations. These results are consistent with the results submitted by CNL, demonstrating the licensee's environmental protection program protects the health of persons and the environment. The results from regional radiological and non-radiological monitoring in proximity to the CRL site also substantiate CNSC staff's conclusion that CNL has made, and will continue to make, adequate provisions for the protection of the environment and the health of persons.

This EA under the NSCA conducted for the proposed CRL licence renewal concludes that CNL has made, and will continue to make, adequate provision for the protection of the environment and the health of persons. Through ongoing licensing and compliance activities and reviews, CNSC staff will continue to verify and ensure that the environment and the health of persons are protected, and will continue to be protected, until the safe state and abandonment of the CRL.

The information provided in this EA Report supports the recommendation by CNSC staff to the Commission to renew the CRL Nuclear Research and Test Establishment Operating Licence, NRTEOL-01.00/2018 for a period of ten years.



## ACRONYMS

<b>Acronym</b>	<b>Term</b>
ALARA	As Low As Reasonably Achievable
BATEA	Best Available Technology and Techniques Economically Achievable
BSW	Bulk Storage Stream
Bq/kg	Becquerel per kilogram
Bq/l	Becquerel per litre
BqMeV/year	Becquerel x mega-electron volts per year
Bq/m <sup>3</sup>	Becquerel per cubic meter
Bq/yr	Becquerel per year
CEAA	<i>Canadian Environmental Assessment Act,</i>
CEPA	<i>Canadian Environmental Protection Act</i>
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CRL	Chalk River Laboratories
CRMN	Canadian Radiological Monitoring Network
COPC	Contaminant of Potential Concern
CO <sub>2</sub> e	Carbon Dioxide equivalent
CSA Group	(Formerly called ) Canadian Standards Association
DDP	Detailed Decommissioning Plan
DRL	Derived Release Limit
DSW	Duke Stream
EA	Environmental Assessment
EER	Ecological Effects Review
EMP	Environmental Monitoring Program
EMS	Environmental Management System
U.S. EPA	United States Environmental Protection Agency
ERA	Environmental Risk Assessment
ESA	<i>Endangered Species Act (Ontario)</i>

HHRA	Human Health Risk Assessment
HTO	Tritiated Water
IEMP	Independent Environmental Monitoring Program
ISO	International Organization for Standardization
LBL	Lower Bass Creek
LCH	Licence Condition Handbook
mASL	Meters Above Sea Level
MeV	Megaelectronvolts
MOECC	Minister of Ontario Environment and Climate Change
MLO	Maskinonge Lake
MPF	Molybdenum-99 Production Facility
mSv	millisievert
mSv/yr	millisievert per year
NO <sub>x</sub>	Nitrogen Oxides
NRU	National Research Universal Reactor
NRX	National Research Experimental Reactor
NSCA	<i>Nuclear Safety and Control Act</i>
OBT	Organically Bound Tritium
OHSP	Occupational Health and Safety Program
PDP	Preliminary Decommissioning Plan
PM	Particulate Matter
RQ	Risk Quotient
RPP	Radiation Protection Program
SARA	<i>Species At Risk Act</i>
SO <sub>2</sub>	Sulphur Dioxide
μGy/d	Microgray per day
μGy/h	Microgray per hour

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## PART TWO

Part Two provides all relevant information pertaining directly to the licence, including:

1. Any proposed changes to the conditions, licensing period, or formatting of an existing licence;
2. The proposed licence;
3. The proposed licence conditions handbook; and
4. The current licence.





## PROPOSED LICENCE CHANGES

### Overview

CNL currently operates under a nuclear research and test establishment operating licence, NRTEOL-01.00/2018. This licence was renewed on November 1, 2011 for a five year term. The licence was renewed for an additional 17 months following a public hearing of the Commission held on April 6, 2016. NRTEOL-01.00/2018 licence expires on March 31, 2018.

The licence issued in 2011 was accompanied by a licence conditions handbook (LCH) for the first time. Since the first issuance, the LCH has been subject to continuous improvements to enhance regulatory oversight as a result of operational experience gained. Since 2011, further improvements have been made to the licence and LCH through:

- development of standard licence conditions and standard format for Class I nuclear facilities licences
- refinement of the SCA framework
- experience gained in the use of the LCH
- development of a standard format and content for LCH

CNL has requested a renewal of the CRL licence for a period of 10 years until March 31, 2028. Based on CNSC staff review of the CNL application, performance history, and supporting information, CNSC staff support CNL's request for a licence period of 10 years. Over the proposed 10 year period, CNSC staff would provide annual reporting on regulatory oversight conducted at CRL in public Commission proceedings.

CNSC staff note that a permanent waste disposal facility (i.e., the NSDF) is not included within the licensing basis of the proposed renewed licence.

The proposed licence uses the standard format and incorporates the standard licence conditions applicable to CRL.

### Licence Conditions Handbook

The LCH associated with the licence provides compliance verification criteria used by CNSC staff to determine whether the conditions of the licence have been met. Additionally, it includes information such as relevant delegations of authority, applicable standards and/or regulatory documents, regulatory interpretation, references to relevant licensee documents and guidance. This structure allows more freedom for the operation to improve and update its documentation within the licensing basis.

The proposed LCH uses the standard format and content.



## **PROPOSED LICENCE**

The proposed Licence is provided on the following pages of the document.

e-Doc 4948674 (WORD)

e-Doc 5390671 (PDF)





## NUCLEAR RESEARCH AND TEST ESTABLISHMENT OPERATING LICENCE CHALK RIVER LABORATORIES

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- I) LICENCE NUMBER:** **NRTEOL-01.00/2028**
- II) LICENSEE:** Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:  
  
**Canadian Nuclear Laboratories Ltd.  
Laboratoires Nucléaires Canadiens Ltée  
286 Plant Road  
Chalk River, Ontario  
K0J 1J0**
- III) LICENCE PERIOD:** This licence is valid from **April 1, 2018**, to **March 31, 2028** unless suspended in whole or in part, amended, revoked or replaced.
- IV) LICENSED ACTIVITIES:**  
  
This licence authorizes the licensee to operate the Chalk River Laboratories located in the Town of Deep River, County of Renfrew, Province of Ontario, as further detailed in paragraphs (a) to (d) below:
- (a) prepare a site for, construct, operate, modify, decommission or abandon a nuclear facility;
  - (b) possess, transfer, use or abandon a nuclear substance, prescribed equipment or prescribed information;
  - (c) produce, refine, convert, process, package, manage, store or dispose of a nuclear substance; and
  - (d) produce or service prescribed equipment.
- V) EXPLANATORY NOTES:**
- (a) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.
  - (b) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated regulations.

- (c) The Chalk River Laboratories Licence Conditions Handbook provides compliance verification criteria used to verify compliance with the conditions set out in this licence, including information regarding delegation of authority and applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria.

## **VI) CONDITIONS:**

### **G. General**

- G.1 The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:
- (i) the regulatory requirements set out in the applicable laws and regulations;
  - (ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence; and
  - (iii) the safety and control measures described in the licence application and the documents needed to support that licence application;
- unless otherwise approved in writing by the Canadian Nuclear Safety Commission (hereinafter "the Commission").
- G.2 The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.
- G.3 The licensee shall control the use and occupation of any land within the exclusion zone.
- G.4 The licensee shall provide, at the nuclear facility and at no expense to the Commission, suitable office space for employees of the Commission who customarily carry out their functions on the premises of that nuclear facility (onsite Commission staff).
- G.5 The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission or a person authorized by the Commission.
- G.6 The licensee shall implement and maintain a public information and disclosure program.

### **1. Management System**

- 1.1 The licensee shall implement and maintain a management system.

### **2. Human Performance Management**

- 2.1 The licensee shall implement and maintain a human performance program.
- 2.2 The licensee shall implement and maintain a training program.
- 2.3 Persons appointed to the following positions shall be certified:
- (a) Senior Reactor Shift Engineer; and
  - (b) NRU Health Physicist.

**3. Operating Performance**

- 3.1 The licensee shall implement and maintain an operating program, which includes a set of operating limits.
- 3.2 The licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission.

**4. Safety Analysis**

- 4.1 The licensee shall implement and maintain a safety analysis program.
- 4.2 The licensee shall implement and maintain a nuclear criticality safety program.

**5. Physical Design**

- 5.1 The licensee shall implement and maintain a design program.
- 5.2 The licensee shall implement and maintain a pressure boundary program and shall have in place a formal agreement with an authorized inspection agency.

**6. Fitness for Service**

- 6.1 The licensee shall implement and maintain a fitness for service program.

**7. Radiation Protection**

- 7.1 The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

**8. Conventional Health and Safety**

- 8.1 The licensee shall implement and maintain a conventional health and safety program.

**9. Environmental Protection**

- 9.1 The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

**10. Emergency Management and Fire Protection**

- 10.1 The licensee shall implement and maintain an emergency preparedness program.
- 10.2 The licensee shall implement and maintain a fire protection program.

**11. Waste Management**

- 11.1 The licensee shall implement and maintain a waste management program.
- 11.2 The licensee shall maintain a decommissioning plan.

**12. Security**

- 12.1 The licensee shall implement and maintain a security program.

**13. Safeguards and Non-Proliferation**

13.1 The licensee shall implement and maintain a safeguards program.

**14. Packaging and Transport**

14.1 The licensee shall implement and maintain a packaging and transport program.

SIGNED at OTTAWA, this       day of       , 2018.

---

Michael Binder, President  
on behalf of the Canadian Nuclear Safety Commission



## **PROPOSED LICENCE CONDITIONS HANDBOOK**

The proposed Licence Conditions Handbook is provided on the following pages of the document.

e-Doc 4978828 (WORD)

e-Doc 5390872 (PDF)





e-Doc 4978828 (WORD)  
2.14

## **LICENCE CONDITIONS HANDBOOK**

**NRTEOL-LCH-01.00/2028**

# **CHALK RIVER LABORATORIES NUCLEAR RESEARCH AND TEST ESTABLISHMENT OPERATING LICENCE**

**NRTEOL-01.00/2028**

Revision 0

# DRAFT





**Licence Conditions Handbook**

**Effective: xxxxxxxx xx, 2018**

**(NRTEOL-LCH-01.00/2028,  
Revision 0)**

**Chalk River Laboratories Nuclear Research and Test  
Establishment Operating Licence**

**NRTEOL-01.00/2028 (Effective: xxxxxxxx xx, 2018)**

SIGNED at OTTAWA this \_\_\_\_\_ day of Xxxxxx, 2018

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**Jean LeClair, Director**

**Nuclear Laboratories and Research Reactors Division  
Directorate of Nuclear Cycle and Facilities Regulations  
CANADIAN NUCLEAR SAFETY COMMISSION**

**REVISION HISTORY:**

<b>Effective Date</b>	<b>Rev. #</b>	<b>e-Doc #</b>	<b>Description</b>	<b>CAF e-Doc #</b>
xxx xx, 2018	0	4978828	New document	

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## INTRODUCTION

The general purpose of the Licence Conditions Handbook (LCH) is to identify and clarify the relevant parts of the licensing basis for each licence condition. This will help ensure that the licensee performs the licensed activities at the Chalk River Laboratories (CRL) in accordance with the licensing basis for CRL and the intent of the CRL licence. The LCH should be read in conjunction with the licence.

The LCH typically has three parts under each licence condition: the Preamble, Compliance Verification Criteria (CVC), and Guidance. The Preamble explains, as needed, the regulatory context, background, and/or history related to the licence condition. CVC are criteria used by CNSC staff to verify and oversee compliance with the licence condition. Guidance is non-mandatory information, including direction, on how to comply with the licence condition.

Current versions of the licensing basis publications, licensee documents that require notification of change, and guidance documents referenced in the LCH are tracked in the document *Licensing Documents for Chalk River Laboratories* (e-Doc [5238065](#)), which is controlled by the Nuclear Laboratories and Research Division and is available to the licensee upon request.

This LCH has the following appendices.

- Appendix A, which lists the nuclear and support facilities at CRL that are subject to CNSC regulatory oversight, and legacy facilities that were placed under care and maintenance (similar to permanent safe shutdown state) or undergoing decommissioning under building removal plans (similar to detailed decommissioning plans).
- Appendix B, which provides definitions of terms and a list of acronyms used throughout the LCH.

Although the LCH will be updated regularly, due to high-rate of changes expected for CRL in the near future, the information included in Appendix A might become outdated. Up to date information is maintained in the document titled *Facilities, Buildings, Structures and Services on the CRL Site* (e-Doc [4974954](#)).

More information on the LCH is available in the CNSC document titled *How to Write a Licence Conditions Handbook* (LCH) (e-Doc [4967591](#)).

## G. GENERAL

### Licence Condition G.1: Licensing Basis

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

- (i) the regulatory requirements set out in the applicable laws and regulations;
- (ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence; and
- (iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (hereinafter "the Commission").

#### Preamble:

The licensing basis sets the boundary conditions for acceptable performance at a regulated facility or activity, and thus establishes the basis for the CNSC's compliance program in respect of that regulated facility or activity. The degree to which the regulatory requirements are applied to CRL facilities and activities should reflect their importance to health and safety of persons, environment, national security, international obligations to which Canada has agreed, licensee's quality and economic expectations, the complexity of facility or activity, and the possible consequences if accidents occur or the activity is carried out incorrectly.

Where the licence condition requires the licensee to implement and maintain a particular program, the licensee documents that describe and implement the program are part of the licensing basis. Several programs required by licence conditions or referred to in the LCH may not be health, safety, security, environment, and quality programs as defined in the Canadian Nuclear Laboratories Ltd. (CNL)'s management system.

#### Compliance Verification Criteria:

##### *Part (i) of the Licensing Basis*

Part (i) of the licensing basis refers to applicable laws and regulations. There are many federal and provincial acts and regulations, and international laws, agreements, guidelines, etc., applicable to activities performed at CRL.

The laws, regulations and international agreements for which CNSC has a regulatory role are:

- *Nuclear Safety and Control Act (NSCA)* and its regulations;
- *Canadian Environmental Assessment Act, 2012 (CEAA, 2012)* and its regulations;
- *Transportation of Dangerous Goods Act* and its regulations;
- *Canada Labour Code* and *Canada Occupational Health and Safety Regulations*;
- *Nuclear Liability and Compensation Act* and its regulations;
- *Fisheries Act* (CNSC responsibilities are defined in the *Memorandum of Understanding between the CNSC and Fisheries and Oceans Canada*); and
- Canada/IAEA safeguards agreements.

Through its decision of October 22, 2014, the Commission, pursuant to section 7 of the NSCA, exempted CNL from the requirements of sections 15.01 and 15.02 of the CNSC *Class II Nuclear Facilities and Prescribed Equipment Regulations* in relation to the requirement for a certified radiation safety officer (e-Doc 4543516).

### ***Part (ii) of the Licensing Basis***

Part (ii) of the licensing basis refers to the conditions and the safety and control measures included in the CRL licence and in the documents directly referenced in the licence.

Under the standardized format and content, the CRL licence requires the licensee to implement and maintain certain programs. There are no documents directly referenced in the standardized CRL licence. For the purpose of licence requirement, a program may be a series of documented, coordinated activities, not necessarily a single document.

### ***Part (iii) of the Licensing Basis***

Part (iii) of the licensing basis refers to the safety and control measures described in the licence application and the documents needed to support that licence application. The safety and control measures include important aspects of that documentation such as, but not limited to:

- the facility-specific design basis and operational information documented in the most recent safety analysis and operational limits and conditions documents;
- the licensee's written commitments, including all modifications and additions to such commitments over the duration of the licence that were made in formal correspondence, and in effect for ensuring compliance with, and conduct of licensed activities within applicable CNSC requirements, including: licensee responses to CNSC enforcement actions; licensee responses to CNSC inspections; licensee responses to CNSC requests; and licensee event reports.

Part (iii) of the licensing basis also includes safety and control measures outlined in CNSC regulatory documents, CSA standards, and other standards, codes and references that are cited in the application or in the licensee's supporting documentation.

Applicable licensee documents are listed in the LCH under the heading "Licensee Documents that Require Notification of Change". Applicable CNSC regulatory documents, CSA standards and other documents are listed in the LCH under the heading "Licensing Basis Publications". The documents listed in the LCH could cite other documents that also contain safety and control measures (i.e., there may be safety and control measures in "nested" references in the application). The documents listed in the LCH and their "nested" references define the licensing basis for the programs required by the CRL licence.

### ***Regulatory Role of the Licensing Basis***

The licensing basis is established when the Commission renders its decision regarding the licence application.

Licence condition G.1 requires the licensee to conduct the licensed activities in accordance with the licensing basis. For activities that are not in accordance with the licensing basis, the licensee shall take action as soon as practicable to return to a state consistent with the licensing basis, taking into account the risk significance of the situation.

### ***CNSC Staff's Approach to Assessing the Licensing Basis for CRL***

For any proposed activity/facility to be carried out on the CRL site, CNSC staff will review the information submitted by CNL to determine if the proposed activity/facility remains within the licensing basis. CNL may proceed with the proposed initiatives if they are found to be within the licensing basis.

CNSC staff assess a proposed facility/activity as being within the licensing basis based on changes or impact on the overall safety of the CRL site.

CNSC staff will submit to the Commission for consideration any proposed activity or facility which CNSC staff consider to be outside the licensing basis. If the Commission grants approval to such an activity/facility, this activity/facility will become part of the licensing basis for CRL and reflected in updates to LCH as appropriate.

***Activities Included in the CRL Licensing Basis***

Conduct of licensed activities at CRL includes:

- (a) Operate, wholly or in part, any facility/building at CRL.
- (b) Carry out site preparation, construction, or construction modification, or undertakings that are required for, associated with, or arise from the conduct of licensed activities at CRL.
- (c) Construct, modify or abandon any facility/building at CRL.
- (d) Transition from operation to an extended or permanent safe shutdown state any facility/building at CRL, or any parts thereof.
- (e) Maintain in safe shutdown state (extended or permanent) any facility/building at CRL, or any parts thereof.
- (f) Transition from operation or from safe shutdown state to decommissioning any facility/building at CRL, or any parts thereof.
- (g) Decommission/demolish any facility/building at CRL, or any parts thereof.
- (h) Release any decommissioned/demolished facility/building from CNSC regulatory control.
- (i) Produce, possess, process, refine, transfer, use, package, manage, store, dispose or abandon nuclear substances.
- (j) Produce, possess, use, service, transfer or abandon prescribed equipment.
- (k) Produce, possess, use, transfer or abandon prescribed information.
- (l) Process, store or dispose of waste received from offsite clients.
- (m) Receive, repair, modify, store and return contaminated equipment from offsite clients.

***Facilities Included in the CRL Licensing Basis***

The following facilities are included in the licensing basis for CRL.

- 1. Research reactor: up to 135MWth power; LEU fuel; negative reactivity coefficient; high pressure high temperature experimental loops; other associated experimental/production facilities; one shutdown system, vented/liquid confinement
- 2. Isotope production reactors: up to 10MWth power
- 3. Waste processing facility
- 4. Mo-99 production facility: total inventory less than 0.2kg of U-235; 6.0g/L maximum concentration of the fresh liquid freed from the Mo-99 process
- 5. FISST: 25000 L content of High Enriched Uranyl Nitrate Liquid (HEUNL); maximum concentration of U-235 in HEUNL is 7.4g/L
- 6. Fuel fabrication facilities: various LEU and HEU fissionable materials in quantities below the upper subcritical limits (USL) processed in several locations; no HEU metal
- 7. Recycle fuel fabrication facility: processing of MOX fuels (Pu, U-235, U-233, U, DU and EU) in quantities below USL processed in several locations
- 8. Hot cells facilities: hot cells, associated equipment and systems, and the ventilation systems connected to the building ventilation system; inventory of radioactive materials in each cell less than 3.7PBq (100 Ci) of Co-60 equivalent; total inventory of radioactive materials less than 56PBq of Co-60 equivalent; inventory of fissionable materials below the USL
- 9. Tritium facilities: total tritium inventory less than 130PBq

10. Nuclear materials/substances storage facilities
11. Waste treatment and decontamination facilities
12. Waste processing and storage facilities
13. Waste storage facilities
14. Waste management areas
15. Class II irradiator facilities: 3.7x10<sup>14</sup>Bq (10kCi) equivalent of Co-60 maximum activity
16. Class II neutron generation facilities: up to 14.5 MeV energy of neutron generated
17. Class II accelerators: 2.5 MeV electron accelerators
18. Radioisotope laboratories

### **Licence Application Documents and Supporting Documents**

<b>Document Number</b>	<b>Document Title</b>	<b>e-Doc</b>
CRL CNNO-17-0005-L	Application for Renewal of the Nuclear Research and Test Establishment Operating Licence for the Chalk River Laboratories – 2018	<a href="#">5220249</a>
CRL-CNNO-17-0010-L	Application for Renewal of the Nuclear Research and Test Establishment Operating Licence for the Chalk River Laboratories – 2018 (Supporting Information for CNSC Staff)	<a href="#">5253216</a>
CRL-CNNO-17-0017-L	Implementation of REGDOCs and CSA Standards in Support of Relicensing	<a href="#">5297028</a>

### **Guidance:**

#### **Guidance Documents**

<b>Document Number</b>	<b>Document Title</b>	<b>Version</b>
INFO-0795	Licensing Basis Objectives and Definition	2010

When the licensee becomes aware that a proposed change or activity might be outside the licensing basis, it should first seek direction from CNSC staff regarding the potential acceptability of this change or activity. The licensee should take into account that certain types of proposed changes might require significant lead times before CNSC staff can make recommendations and/or the Commission can properly consider them.

## Licence Condition G.2: Notification of Changes

The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

### **Preamble:**

Some changes (but not all) to CRL site and its facilities/buildings are captured as changes to corresponding licensee's documents. The LCH identifies licensee documents that require written notification of changes to the CNSC.

### **Compliance Verification Criteria:**

The licensee shall, as a minimum, notify CNSC staff of changes to licensee's documents identified in the LCH. The written notification of change shall include a copy of the revised document.

Licensee documents listed in the LCH are subdivided into groups having different requirements for notification of change.

- PN prior notification - the licensee shall submit the notice to the CNSC prior to implementing the change; typically, the requirement is to submit the proposed changes 30 days prior to planned implementation; however the licensee shall allow sufficient time for the CNSC to review the change proportionate to its complexity and the importance of the safety and control measures being affected
- NT notification at time of making the change
- ACC CNSC staff acceptance of changes is required before proceeding with change

Changes that may affect the licensing basis, including any change that is not captured as a change to a document listed in the LCH (e.g., construction of new facilities/buildings, or transitioning any facility/building from one phase of its life cycle to another), requires written notification to the CNSC to verify they are in accordance with the licensing basis.

For any change that is outside the licensing basis defined in subsection G.1 of the LCH, the licensee shall obtain Commission approval before proceeding with the change.

### **Guidance:**

For proposed changes that would not be in accordance with the licensing basis, the guidance for licence condition G.1 applies.

## Licence Condition G.3: Land Use and Occupation

The licensee shall control the use and occupation of any land within the exclusion zone.

### **Preamble:**

The initial description of CRL property was included in the Schedule to the Atomic Energy Control Board (AECB) Order 1/14/74, dated June 4, 1974, and published in Part I of the Canada Gazette for June 8, 1974, which designated CRL as a protected site. As the concept of exclusion zone for CRL was not defined in AECB Order 1/14/74, for the purpose of this licence condition the exclusion zone is interpreted as the entire CRL site comprising the controlled area and the supervised area.

The current legal description of the CRL property is included in the Ontario Land Registry under the PINs 57075-0003(LT), 57074-021(LT) and 57076-0049(LT).

### **Compliance Verification Criteria:**

The licensee shall not change the ownership, possession or use of lands described in the Ontario Land Registry under the PINs 57075-0003(LT), 57074-021(LT) and 57076-0049(LT) without the prior approval of the Commission.

The licensee shall update the property plan after any change in the ownership, possession or use of lands on the CRL site.

The licensee shall control land use and occupation such that no permanent dwelling (house, residence) is permitted within the supervised or controlled areas at the CRL site.

Permanent dwelling refers to housing that is meant to be fixed. The licensee may erect, for a short time without prior notification, temporary structures required for operational purposes (e.g., a trailer).

### **Licencee Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
E-4500-1101	CRL Outer Area Plant Boundary Monuments Property Plan	3778660	NT

### **Guidance:**

None provided.

## Licence Condition G.4: Office Space for Onsite CNSC Staff

The licensee shall provide, at the nuclear facility and at no expense to the Commission, suitable office space for employees of the Commission who customarily carry out their functions on the premises of that nuclear facility.

### **Preamble:**

CNSC staff require suitable office space and equipment at the CRL site in order to satisfactorily carry out their regulatory activities.

### **Compliance Verification Criteria:**

The licensee shall keep the office space of onsite CNSC staff secured and separated from the remainder of the building in which it is located by walls, partitions or other suitable structures.

### **Guidance:**

Any changes to accommodation or equipment provided to onsite CNSC staff should be made based on discussion, and subsequent agreement, between the CNSC and the licensee. The licensee should provide access to its intranet through licensee-owned computers installed in the CNSC site office at CRL.



## Licence Condition G.5: Financial Guarantee

The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

### **Preamble:**

The financial guarantee for the decommissioning of CRL site consists of one or more financial guarantee instruments which are based on the decommissioning strategy described in the comprehensive preliminary decommissioning plan and the associated cost estimate.

Atomic Energy of Canada Limited (AECL) is a Schedule III, Part 1 Crown Corporation under the *Financial Administration Act* and an agent of Her Majesty in Right of Canada. As an agent of Her Majesty in Right of Canada, AECL's liabilities are ultimately liabilities of Her Majesty in Right of Canada. While the restructuring of AECL has seen the ownership of Canadian Nuclear Laboratories Limited (CNL) transferred to a private-sector contractor, the Canadian National Energy Alliance (CNEA), AECL retains ownership of the lands, assets and liabilities associated with CNL's licences. These liabilities have been officially recognized by the Minister of Natural Resources in a letter dated July 31, 2015 (e-Doc [4803454](#), [4815508](#)).

### **Compliance Verification Criteria:**

#### **Licence Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
146-508810-REPT-036	General Report – 2013 Basis of Cost Estimate: Chalk River Laboratories Decommissioning Liability	<a href="#">4453991</a>	NT

### **Guidance:**

#### **Guidance Documents**

Document Number	Document Title	Version
G-206	Financial Guarantee for the Decommissioning of Licensed Activities	2000

## Licence Condition G.6: Public Information and Disclosure Program

The licensee shall implement and maintain a public information and disclosure program.

### Preamble:

*Class I Nuclear Facilities Regulations* require that an application for a licence shall contain the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed.

*Class II Nuclear Facilities and Prescribed Equipment Regulations* require that an application for a licence shall contain the program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the nuclear facility.

This licence condition requires the licensee to implement and maintain a public information and disclosure program to improve the public's level of understanding about CRL's facilities and activities.

### Compliance Verification Criteria:

#### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
RD/GD-99.3	Public Information and Disclosure	2012	April 1, 2018

#### Licensee Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
CW-513430-REPT-001	Public Information Program for Canadian Nuclear Laboratories (CNL)	5252468	NT

### Guidance:

None provided.

## SCA – MANAGEMENT SYSTEM

### Licence Condition 1.1: Management System

The licensee shall implement and maintain a management system.

#### **Preamble:**

Safe and reliable operation of nuclear facilities requires a commitment and adherence to a set of management system principles and, consistent with those principles, the implementation of planned and systematic processes that achieve expected results. The management system focuses on safety in all business activities.

The *Class I Nuclear Facilities Regulations* that an application for a licence shall contain the proposed management system for the activity to be licensed, including measures to promote and support safety culture.

#### **Compliance Verification Criteria:**

##### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
CSA N286	Management system requirements for nuclear facilities	2012	April 1, 2018

##### Licensor Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-514100-MAN-001	Management System	<a href="#">5185520</a>	NT
900-514200-MAN-001	Quality Assurance	<a href="#">5185528</a>	NT
900-514100-LST-001	Functional Authorities	<a href="#">5185515</a>	NT
900-514300-LST-001	Site Licences, Certificates, Permits and Representatives	<a href="#">5185538</a>	NT
900-502000-LST-001	Program Management Authorities	<a href="#">5185389</a>	NT
900-508200-LST-001	Nuclear Facilities Listing	<a href="#">5198718</a>	NT
900-513000-LST-001	Codes, Regulations, Standards, and other Documents	<a href="#">5185489</a>	NT

#### **Guidance:**

##### Guidance Documents

Document Number	Document Title	Version
CSA N286.0.1	Commentary on N286-12, Management system requirements for nuclear facilities	2014
CSA N286.10	Configuration management for high energy reactor facilities	2016

## SCA – HUMAN PERFORMANCE MANAGEMENT

### Licence Condition 2.1: Human Performance Program

The licensee shall implement and maintain a human performance program.

#### **Preamble:**

Human performance is the outcome of human behaviours, functions and actions in a specified environment, reflecting the ability of workers and management to meet the management system's defined performance under the conditions in which the management system will be employed.

Human factors are factors that influence human performance as it relates to the safety of a nuclear facility or activity over all the phases, including design, operation, maintenance, and decommissioning. These factors may include the characteristics of the person, task, equipment, organization, environment, and training. The application of human factors to issues such as interface design, training, procedures, organization and job design may affect the reliability of humans performing tasks under various conditions.

The *General Nuclear Safety and Control Regulations* require the licensee to: ensure the presence of sufficient number of qualified staff; train the workers; and ensure the workers follow procedures and safe work practices.

The *Class I Nuclear Facilities Regulations* that an application for a licence shall contain the proposed human performance program for the activity to be licensed, including measures ensure workers fitness for duty.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
REGDOC-2.2.4	Fitness for Duty: Managing Worker Fatigue	2017	April 1, 2019
RD-363	Nuclear Security Officer Medical, Physical, and Psychological Fitness	2008	April 1, 2018

##### **Licence Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-514000-PDD-001	Performance Assurance	<a href="#">5185502</a>	NT
900-514000-PRD-001	Performance Assurance	<a href="#">5185508</a>	PN
900-514000-GDI-001	Performance Assurance	<a href="#">5185497</a>	NT

#### **Guidance:**

##### **Guidance Documents**

Document Number	Document Title	Version
G-323	Ensuring Presence of Sufficient Qualified Staff at Class I Nuclear Facilities: Minimum Staff Complement	2007

## Licence Condition 2.2: Training Program

The licensee shall implement and maintain a training program.

### Preamble:

This licence condition requires the licensee to develop and implement training programs for workers.

It also provides the requirements regarding the program and processes necessary to support responsibilities of, qualifications and requalification training of persons at the nuclear facility.

As defined by the *General Nuclear Safety and Control Regulations*, a worker is a person who performs work that is referred to in a licence. This includes contractors and temporary employees. Training requirements apply equally to these types of workers as to the licensee's own employees.

The *General Nuclear Safety and Control Regulations* require that licensees ensure that there are a sufficient number of properly trained and qualified workers to safely conduct the licensed activities.

The *Class I Nuclear Facilities Regulations* require that applicants for a Class I facility licence describe the training programs which have been implemented, and that licence applications include the proposed responsibilities, qualification requirements, training program and requalification program for workers; along with the results that have been achieved in implementing the program for recruiting, training and qualifying workers.

### Compliance Verification Criteria:

#### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
REGDOC-2.2.2	Personnel Training, version 2	2016	April 1, 2018

#### Licensee Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-510200-PDD-001	Training and Development	<a href="#">5185461</a>	NT
900-510200-PRD-001	Training and Development	<a href="#">5185465</a>	PN
900-510200-GDI-001	Training and Development	<a href="#">5262060</a>	NT

The licensee shall ensure that all workers are qualified to perform the duties and tasks required of their position.

All training programs related to workers in positions where the consequence of human error poses a risk to the environment, the health and safety of persons, or to the security of the nuclear facilities and licensed activities, are evaluated against the criteria for a systematic approach to training (SAT).

### Guidance:

None provided.

## Licence Condition 2.3: Staffing and Certification

Persons appointed to the following positions shall be certified

- (a) Senior Reactor Shift Engineer; and
- (b) NRU Health Physicist.

### **Preamble:**

This condition requires that any person that the licensee appoints to the positions of Senior Reactor Shift Engineer or NRU Health Physicist must hold a certification issued pursuant to the NSCA. In addition, the certified persons must maintain their competency through continuing training and experience carrying out the duties of the position for which they have been certified.

### **Compliance Verification Criteria:**

#### **Licence Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
NRU-510000-REQ-001	SRSE Roles and Responsibilities	<a href="#">3199350</a>	PN
NRU-510000-REQ-002	NRU HP Roles and Responsibilities	<a href="#">1325829</a>	PN

The licensee shall ensure persons appointed to the position of Senior Reactor Shift Engineer (SRSE) at NRU or NRU Health Physicist (NRU HP) hold a certification for the position to which they have been appointed, in accordance with the requirements of the *Class I Nuclear Facilities Regulations*.

The licensee shall ensure that each certified SRSE and NRU HP perform the duties of their certified position in accordance with the approved Roles and Responsibilities documents for these positions.

Any person appointed to the position of SRSE or NRU HP shall only delegate the authorities or responsibilities of their position to another person who holds a certification issued pursuant to the NSCA for the same position.

When applying for certification or renewal of certification of a person as SRSE or NRU HP, the licensee shall meet the requirements specified by CNSC staff (e-doc 5390788).

The licensee shall ensure that certified SRSEs and NRU HPs complete the continuing training requirements, complete the requalification tests and perform the duties of the position for the minimum time as specified by CNSC staff (e-doc 5390788).

The licensee shall immediately remove a person from the duties of SRSE or NRU HP under any of the conditions specified by CNSC staff (e-doc 5390788).

### **Guidance:**

None provided.

## SCA – OPERATING PERFORMANCE

### Licence Condition 3.1: Operating Program

The licensee shall implement and maintain an operating program, which includes a set of operating limits.

#### Preamble:

The *Class I Nuclear Facilities Regulations* require that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

The operational limits and conditions for CRL facilities are currently documented in

- facility authorizations documents (for Class I and Class II nuclear facilities);
- MAPLE Reactors operational limits and conditions;
- NPF operational limits and conditions; and
- laboratory protocols, criticality safety documents and procedural documents (for radioisotope laboratories and other workplaces where operations with fissionable materials are performed involving handling, use, processing, movement and storage).

#### Compliance Verification Criteria:

##### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
REGDOC-2.3.1	Conduct of Licensing Activities: Construction and Commissioning Programs	2016	April 1, 2018
REGDOC-2.3.2	Accident Management, Version 2	2015	April 1, 2018

##### Licence Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-508200-PDD-001	Conduct of Operations	<a href="#">5262060</a>	NT
900-508200-PRD-001	Conduct of Operations	<a href="#">5262060</a>	PN
900-508200-GDI-001	Conduct of Operations	<a href="#">5262060</a>	NT
900-505240-PDD-001	Construction	<a href="#">5222352</a>	NT
900-505240-PRD-001	Construction	<a href="#">5222379</a>	PN
900-505240-GDI-001	Construction	<a href="#">5262060</a>	NT
900-505250-PDD-001	Commissioning	<a href="#">5262060</a>	NT
900-505250-PRD-001	Commissioning	<a href="#">5262060</a>	PN
900-505250-GDI-001	Commissioning	<a href="#">5262060</a>	NT
See e-Doc <a href="#">5238065</a>	Facility Authorizations		PN <sup>(1)</sup>
See e-Doc <a href="#">5238065</a>	Storage with Surveillance Plans		NT <sup>(1)</sup>

<sup>(1)</sup> Notification is required only for non-administrative changes. Otherwise, the licensee shall provide lists of updated facility authorizations and storage with surveillance plans to CNSC staff quarterly.

##### *CRL Facilities Operations*

The operational limits and conditions shall define the conditions that must be met to prevent situations or events that might lead to accidents, or to mitigate the consequences of accidents should they occur.

Limits and conditions for normal operation shall include limits on operating parameters, stipulation for minimum amount of operable equipment, actions to be taken by the operating staff in the event of deviations from the operational limits and conditions, and the time allowed for completing these actions.

The licensee shall review, revise and reissue as appropriate the operational limits and conditions when required due to changes in technologies, regulations, operational information or physical configuration. The updated operational limits and conditions shall be based on safety analyses.

### ***Construction and operation of New Nuclear Facilities***

The licensee may construct or install facilities, buildings, structures, components or equipment only if that construction or installation is compliant with the licensing basis.

The Commission has delegated to the DG-DNCFR the authority to approve the documents necessary to allow the construction and operation of Shielded Modular Above-Ground Storage Buildings (SMAGS) (e-Doc [3052093](#), [3530785](#), [3284667](#) and [3316267](#)).

The licensee shall submit the design requirements documents for DG-DNCFR acceptance prior to the construction of the Shielded Modular Above-Ground Storage Buildings (SMAGS) No. 4 to 6.

The licensee shall submit the commissioning report for DG-DNCFR acceptance prior to the operation of the SMAGS Buildings No. 4 to 6.

### ***Facilities in Safe Shutdown State***

The licensee shall develop and maintain storage-with-surveillance plans (SWS plans) for Class I and Class II nuclear facilities in permanent safe shutdown state. The licensee shall maintain those facilities in permanent safe shutdown state according to the SWS plan for the facility.

### ***Facilities under Decommissioning***

See subsection 11.2 for details regarding the decommissioning of individual facilities at CRL.

### ***Release from Regulatory Control***

See Subsection 11.2 for details regarding the release from regulatory control of individual facilities at CRL.

### ***Modifications to Facilities and Processes***

The licensee shall ensure that modifications to CRL facilities do not negatively impact safe operation of the facility. The licensee shall define the process for making permanent or temporary modifications to operational limits and conditions. Such modifications shall be justified by analyses and safety reviews.

The licensee may only modify facilities, buildings, structures, components or equipment in compliance with the licensing basis.

The licensee shall ensure that:

- (a) all temporary modifications are identified at the point of application and at any relevant control positions;
- (b) (b)operating personnel are informed of any modifications and their consequences for facility operations;
- (c) the temporary modifications are reviewed and approved before installation; the review shall be documented to demonstrate the scope and conclusion of the review;
- (d) the number of simultaneous temporary modifications is kept to a minimum;



- (e) the duration of temporary modifications is limited and specified prior to implementation;
- (f) testing is performed after installation and removal of the temporary modification;
- (g) temporary modifications are shown on affected documents; and
- (h) the facility is returned to the original state when the temporary modification is no longer needed.

### ***EOP and SAMG***

The licensee shall ensure that emergency operating procedures (EOPs):

- (a) cover design basis accidents and provide instructions for recovering the facility to a safe condition;
- (b) (cover beyond design basis accidents up to, but not including, the onset of core damage (where applicable) with the aim to re-establish or compensate for any lost safety functions and to set out actions to prevent core damage;
- (c) are developed systematically way and are supported by realistic facility specific analyses performed for this purpose;
- (d) are consistent with other operational procedures, such as alarm response procedures and severe accident management guidelines (SAMG);
- (e) enable the operator to recognize quickly the accident condition to which they apply; and
- (f) define entry and exit conditions to enable operators to select the appropriate EOP, to navigate among EOPs, and to proceed from EOPs to SAMG.

The licensee shall train the operating personnel and onsite technical support staff in the use of EOPs and, where practicable, of SAMG. As a minimum, there shall be sufficient operating personnel, available at any given time, trained and familiar with SAMG.

The licensee shall ensure that SAMG provide measures to mitigate the consequences of severe accidents for cases where the measures provided by the EOPs have not been successful in the prevention of severe accidents.

The licensee shall

- (a) exercise the transition from EOPs to SAMG; and
- (b) plan and exercise regularly the interventions called for in SAMG and needed to restore the necessary safety functions.

### ***Sealed Sources***

The licensee shall ensure the sealed sources are controlled (by maintaining an inventory of sealed sources, and tracking and reporting their transfer) in order to achieve the objectives of IAEA's *Code of Conduct on the Safety and Security of Radioactive Sources*.

The inventory of sealed sources shall contain all sealed sources, both in use and in storage, of any category of sources as defined by IAEA safety guide RS-G-1.9 *Categorization of Radioactive Sources*. The licensee shall provide details of their inventory at the CNSC staff's request.

Unless otherwise permitted by the prior approval of the CNSC, the licensee shall, in respect of a radioactive nuclear substance set out in column 1 of the table 3-1, report in writing to the CNSC staff any transfer or receipt of a sealed source whose corresponding activity is equal to or greater than the value set out in column 2 of the table:

- (a) at least seven business days before any transfer, and
- (b) within two business days of any receipt of a transfer.

**Table 3-1: Activity Limits for Reporting the Transfer of Sealed Sources**

Column 1	Column 2
Nuclear Substance	(TBq)
Americium 241	0.6
Americium 241/Beryllium	0.6
Californium 252	0.2
Curium 244	0.5
Cobalt 60	0.3
Cesium 137	1
Gadolinium 153	10
Iridium 192	0.8
Promethium 147	400
Plutonium 238	0.6
Plutonium 239/Beryllium	0.6
Radium 226	0.4
Selenium 75	2
Strontium 90 (Yttrium 90)	10
Thulium 170	200
Ytterbium 169	3

The written report shall be in a form acceptable to the CNSC staff and shall include:

1. on transfer of a sealed source(s),
  - (a) the date of transfer,
  - (b) the name of the recipient and licence number,
  - (c) the address of the recipient's authorized location,
  - (d) the nuclear substance (radionuclide),
  - (e) activity (radioactivity) (Bq) per sealed source on the reference date,
  - (f) the reference date,
  - (g) the number of sealed source(s),
  - (h) the aggregate activity (Bq),
  - (i) the sealed source unique identifiers (if available), and
  - (j) where the sealed source is incorporated in prescribed equipment,
    - (i) the name and model number of the equipment, and
    - (ii) the equipment serial number (if available);
2. on receipt of a sealed source(s),
  - (a) the date of receipt of a transfer,
  - (b) the name of the shipper and licence number,
  - (c) the address of the shipper's authorized location,
  - (d) the nuclear substance (radionuclide),
  - (e) activity (radioactivity) (Bq) per sealed source on the reference date,

- (f) the reference date,
- (g) the number of sealed source(s),
- (h) the aggregate activity (Bq),
- (i) the sealed source unique identifiers (if available), and
- (j) where the sealed source is incorporated in prescribed equipment,
  - (i) the name and model number of the equipment, and
  - (ii) the equipment serial number (if available).

In this subsection, “transfer” means movement of sealed sources from CRL to locations outside CRL site, or from locations outside CRL site to CRL. It does not include the movement of sealed sources between various CRL facilities/locations.

### **Guidance:**

Typical steps taken to transition the facility from operation to a permanent safe shutdown state are:

#### *During the Operational Phase*

1. The licensee defines and documents the activities needed to transition the facility from operation to a permanent safe shutdown state.
2. The licensee prepares the SWS plans.
3. The licensee submits the documentation prepared during steps 1 and 2 to CNSC staff.

#### *During the Transition Phase*

4. The licensee performs the activities needed to put the facility in a long-term safe shutdown state, updates the SWS plans, and resubmit to CNSC staff if needed.

#### *During the Permanent Safe Shutdown State*

5. The licensee carries out actions as documented in the SWS plans.

The licensee should review outstanding temporary modifications to determine whether they are still needed.

## Licence Condition 3.2: Reporting Requirements

The licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission.

### Preamble:

This licence condition sets the requirements for reporting information to CNSC, including compliance monitoring and operational performance, event reporting, and various types of notifications.

### Compliance Verification Criteria:

#### Licensee Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
CRL-508760-PRO-343	Reporting to the CNSC	4955475	
CW-508760-PRO-001	Canadian Nuclear Laboratories Reporting of Unplanned Events and Situations to the Canadian Nuclear Safety Commission	5037780	

The licensee shall prepare and submit to the CNSC staff, at the intervals specified below, written reports that cover

- the operation and maintenance of the facilities listed in tables A-1 to A-5 and table A-8 of Appendix A to the LCH, summarizing facility and equipment performance and changes, changes to operating policies, changes in organization, personnel radiation exposures, releases of nuclear substances from the facilities, and releases of hazardous substances from the facilities;
- the status of the facilities listed in tables A-6, A-7 and A-9 of Appendix A to the LCH, summarizing facility and equipment performance and changes, changes to operating policies, changes in organization, personnel radiation exposures, releases of nuclear substances from the facilities, and releases of hazardous substances from the facilities;
- changes to the emergency authorities and organization, updates or changes to the radiation emergency procedures, status of and changes in other program documentation, training activities, drill and exercise activities, status of emergency resources and facilities, interactions with outside agencies, and unplanned events that tested the emergency response organization;
- the results of the effluent monitoring for radioactive nuclear substances, the effluent monitoring for hazardous substances, and personnel radiation exposures for CRL;
- the results of environmental monitoring for nuclear substances and hazardous substances;
- the evaluation of the adequacy of the existing or proposed physical protection system;
- changes to security provisions;

The licensee shall, by April 30 of each calendar year, submit to the CNSC staff the reports described in criteria (a), (b), (c), (d), (f), (g), (h), (i), and (j) covering the preceding calendar year.

The licensee shall, by June 30 of each calendar year, submit to the CNSC staff the reports described in criterion (e) of the LCH covering the preceding calendar year.

The licensee shall, by December 1 of each calendar year, submit to the CNSC staff the annual status report on environmental assessment follow-up actions covering the 12-month period up to and including the previous July 31.

**Compliance Monitoring: Reports on Inventory and Transfer of Fissionable and Fertile Substances**

The licensee shall make and submit reports to the CNSC staff on the inventory and transfer of fissionable and fertile substances in accordance with the requirements of the document RD-336 *Accounting and Reporting of Nuclear Material*.

According to Sections 6.4.1 and 6.5.1 of RD-336, the licensee is required to submit to the CNSC staff both a List of Inventory Items (LII) and a Physical Key Measurement Point Inventory Summary (PKMPIS) within seven business days of a Physical Inventory Taking. However, based on initial experience, it has been determined that while the PKMPIS will continue to be a mandatory document as per RD-336, LII will only be required upon request.

Both RD-336 and the associated guidance document GD-336 *Guide for Accounting and Reporting of Nuclear Material* will be revised to reflect this change in reporting requirements. In the interim, this information is being provided to notify the licensee of the change, which is effective immediately.

**Compliance Monitoring: Reporting the Results of the Third Party Reviews**

The licensee shall submit to CNSC staff the result of third party review of modifications required by clauses 4.6.2 and 10.3.3 of CSA standard N393 *Fire protection for facilities that process, handle, or store nuclear substances* prior to implementing the modifications.

The licensee shall submit to CNSC staff the results of the third party review of compliance with CSA standard N393 *Fire protection for facilities that process, handle, or store nuclear substances* no later than six months after the review together with a corrective action plan with compensatory measures for all identified noncompliances.

The licensee shall submit to CNSC staff the audit report (of fire response capability) required by clause 11.5.9 of CSA standard N393 *Fire protection for facilities that process, handle, or store nuclear substances* no later than six months after the audit.

**Guidance:**

None provided.

## SCA – SAFETY ANALYSIS

### Licence Condition 4.1: Safety Analysis Program

The licensee shall implement and maintain a safety analysis program.

#### **Preamble:**

The *General Nuclear Safety and Control Regulations* require that a licence application contain a description and the results of any analyses performed.

The *Class I Nuclear Facilities Regulations* require, amongst other requirements, that a licence application contain a final safety analysis report, and additional supporting information.

The licensee holds the responsibility for ensuring that the safety analysis is accurate and meets the regulatory requirements, and shall maintain adequate capability to perform or procure safety analysis and to train safety analysts.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
REGDOC-2.4.1	Deterministic Safety Analysis	2014	April 1, 2018

##### **Licensee Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-508770-PDD-001	Safety Analysis	<a href="#">5262060</a>	NT
900-508770-PRD-001	Safety Analysis	<a href="#">5262060</a>	PN
900-508770-GDI-001	Safety Analysis	<a href="#">5262060</a>	NT
CRL-03510-SAB-001	CRL Site Characteristics	<a href="#">5107093</a>	NT
See e-Doc <a href="#">5238065</a>	Safety Analyses		NT <sup>1</sup>

<sup>1</sup> Notification is required only for non-administrative changes. Otherwise, the licensee shall provide lists of updated safety analyses to CNSC staff quarterly.

Part II and Appendix C of REGDOC-2.4.1 are applicable to research reactors at CRL. It may be used as guidance for performing the safety analysis for other CRL facilities.

Where probabilistic safety assessments (PSA) are performed, the licensee shall ensure that

- the limitations of the PSA are understood, recognized and taken into account in all its use, and the adequacy of a particular probabilistic safety assessment application is always checked with respect to these limitations;
- when the PSA is used for evaluating or changing the requirements on periodic testing and allowed outage time for a system or component, all relevant items, including states of the systems and components and safety functions they participate in, are included in the analysis; and
- the operability of components, that have been found by the PSA to be important to safety, is ensured and their role is recorded in the safety analysis report.

#### **Guidance:**

##### **Guidance Documents**

<b>Document Number</b>	<b>Document Title</b>	<b>Version</b>
REGDOC-2.4.2	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2014
IAEA GSR Part 4, Rev. 1	Safety Assessment for Facilities and Activities	2016

## Licence Condition 4.2: Nuclear Criticality Safety Program

The licensee shall implement and maintain a nuclear criticality safety program.

### Preamble:

This licence condition requires the licensee to develop, implement and maintain a nuclear criticality safety program to ensure that the upper subcritical limits established in the criticality safety documents will not be exceeded under both normal and credible abnormal conditions (events or event sequences having the frequency of occurrence equal to or more than  $10^{-6}$ /year) during operations with fissionable materials outside reactors.

### Compliance Verification Criteria:

#### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
RD-327	Nuclear Criticality Safety	2010	April 1, 2018

#### Licence Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-508550-PDD-001	Nuclear Criticality Safety	<a href="#">5198797</a>	NT
900-508550-PRD-001	Nuclear Criticality Safety	<a href="#">5198802</a>	PN
900-508550-GDI-001	Nuclear Criticality Safety	<a href="#">5198794</a>	NT
See e-Doc <a href="#">5238065</a>	Criticality Safety Documents		NT <sup>1</sup>

<sup>1</sup> Notification is required only for non-administrative changes. Otherwise, the licensee shall provide lists of updated criticality safety documents to CNSC staff quarterly.

The licensee shall establish and document the format and content of the criticality safety documents.

For any new activities or projects, the licensee shall comply with the criticality safety requirements included in the regulatory document RD-327 *Nuclear Criticality Safety*.

For legacy activities or projects, the licensee may implement the requirements of the nuclear criticality safety on a graded approach with appropriate criteria for categorization according to their safety significance. The legacy items are those nuclear criticality safety related activities and projects where work has begun prior to November 1, 2011.

### Guidance:

#### Guidance Documents

Document Number	Document Title	Version
GD-327	Guidance for Nuclear Criticality Safety	2010



## SCA – PHYSICAL DESIGN

### Licence Condition 5.1: Design Program

The licensee shall implement and maintain a design program.

#### **Preamble:**

The *Class I Nuclear Facilities Regulations* require that a licence application contain a description of the structures, systems and components, and relevant documentation of the facility design.

A design program ensures that the facility design is managed using a well-defined systematic approach.

Implementing and maintaining a design program confirms that safety-related SSCs and any modifications to them continue to meet their design bases given new information arising over time and taking changes in the external environment into account. It also confirms that SSCs continue to be able to perform their safety functions under all facility states. An important cross-cutting element of a design program is design basis management.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
RD-367	Design of Small Reactor Facilities	2011	April 1, 2018
REGDOC-2.5.7	Design, Testing and Performance of Exposure Devices	2017	April 1, 2018
	National Building Code of Canada	2015	April 1, 2018

##### **Licence Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-508120-PDD-001	Design Authority and Design Engineering	<a href="#">5185437</a>	NT
900-508120-PRD-001	Design Authority and Design Engineering	<a href="#">5185442</a>	PN
900-508120-GDI-001	Design Authority and Design Engineering	<a href="#">5262060</a>	NT
900-508120-LST-001	Design Authorities	<a href="#">5262060</a>	NT

#### **Guidance:**

##### **Guidance Documents**

Document Number	Document Title	Version
REGDOC-2.5.2	Design of Reactor Facilities: Nuclear Power Plants	2014
G-276	Human Factors Engineering Program Plans	2003
G-278	Human Factors Verification and Validation Plans	2003
GD-52	Design Guide for Nuclear Substances Laboratories and Nuclear Medicine Rooms	2010
CSA N290.13	Environmental Qualification of Equipment for CANDU Nuclear Power Plants	2005 (R2015)

N289.1	General requirements for seismic design and qualification of CANDU nuclear power plants	2008 (R2013)
N289.2	Ground motion determination for seismic qualification of nuclear power plants	2010 (R2015)
N289.3	Design procedures for seismic qualification of nuclear power plants	2010 (R2015)
N289.4	Testing procedures for seismic qualification of nuclear power plant structures, systems, and components	2012 (R2017)
N289.5	Seismic instrumentation requirements for nuclear power plants and nuclear facilities	2012 (R2017)

## Licence Condition 5.2: Pressure Boundary Program and Authorized Inspection Agency

The licensee shall implement and maintain a pressure boundary program and shall have in place a formal agreement with an authorized inspection agency.

### Preamble:

A pressure boundary program is comprised of the many programs, processes and procedures and associated controls that are required to ensure compliance with CSA standard N285.0, which defines the technical requirements for the design, procurement, fabrication, installation, modification, repair, replacement, testing, examination and inspection of pressure-retaining and containment systems, including their components and supports.

This licence condition also ensures that an authorized inspection agency (AIA) will be subcontracted directly by the licensee. An AIA is an organization recognized by the CNSC as authorized to register designs and procedures, perform inspections, and other functions and activities as defined by N285.0 and its applicable referenced publications (e.g. CSA standard B51 *Boiler, pressure vessel, and pressure piping code*). The AIA is accredited by the American Society of Mechanical Engineers (ASME) as stipulated by NCA-5121 of the *ASME Boiler & Pressure Vessel Code*.

### Compliance Verification Criteria:

#### Licensing Basis Publications

Document Number	Document Title	Revision	Effective Date
CSA N285.0/N285.6 Series	General requirements for pressure-retaining system and components in CANDU nuclear power plants / Material standards for reactor components for CANDU nuclear power plants	2017	April 1, 2018

#### Licence Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-508140-PDD-001	Pressure Boundary	<a href="#">5185445</a>	NT
900-508140-PRD-001	Pressure Boundary	<a href="#">5262060</a>	PN
900-508140-GDI-001	Pressure Boundary	<a href="#">5262060</a>	NT
CRL-508140-PRO-002	Classification and Design Registration of Pressure Retaining Systems/Components	<a href="#">5204049</a>	PN
CRL-508140-QAM-001	CRL Pressure Boundary Quality Assurance Manual	<a href="#">4807786</a>	NT
	Authorized Inspection Agency Services Agreement between Technical Standards and Safety Authority and Canadian Nuclear Laboratories Limited	<a href="#">4959736</a>	NT <sup>1</sup>

<sup>1</sup> Termination of the agreement is considered a change that requires prior notification to CNSC.

### **Pressure Boundary Program**

Where CSA standard N285.0 requires items to be submitted to CNSC for approval before implementation, the licensee shall: (a) document the item insufficient detail to ensure it is safe to proceed; and (b) submit the item to AIA for assessment and acceptance (if required by CSA standard N285.0 or its referenced publications). The licensee may implement that item without prior approval from CNSC staff if the AIA has given its acceptance.

Licensee documents describing the classification, registration and reconciliation processes and the associated controls are considered part of the pressure boundary program.

### **Formal Agreement with an Authorized Inspection Agency**

The licensee shall have in place a formal agreement with an AIA acceptable to the CNSC to provide services for the pressure boundaries of the nuclear facility as defined by CSA standard N285.0 and its applicable referenced publications.

The licensee shall always have a valid AIA agreement, and shall adhere to the following:

- (a) The licensee shall arrange for the AIA inspectors to have access to all areas of the CRL's facilities and records, and to the facilities and records of the CRL's pressure boundary contractors and material organizations, as necessary for the purposes of performing inspections and other activities required by the standards;
- (b) The licensee shall provide the inspectors of the AIA with: information, reasonable advance notice and time necessary to plan and perform inspections and other activities required by the standards;
- (c) Where a variance or deviation from the standard exists, the licensee shall submit the proposed resolution to the AIA for evaluation; and
- (d) Design registration services shall be provided by an AIA legally entitled under the applicable provincial boilers and pressure vessels acts and regulations to register designs in the province of installation.

The licensee shall obtain AIA acceptance for implementation of the licensee's programs and procedures for:

- (a) calibration, repair and maintenance of overpressure protection devices;
- (b) repair and maintenance of mechanical joints; and
- (c) periodic inspection of boilers and pressure vessels designed according to CSA standard B51.

## **Guidance:**

### **Guidance Documents**

Document Number	Document Title	Version
CSA N285.0.1	Commentary on CSA N285.0-12, General requirements for pressure-retaining systems and components in CANDU nuclear power plants	2016

## SCA – FITNESS FOR SERVICE

### Licence Condition 6.1: Fitness for Service Program

The licensee shall implement and maintain a fitness for service program.

#### **Preamble:**

The *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures to maintain the nuclear facility.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
REGDOC-2.6.3	Aging Management	2014	April 1, 2018
CSA N291	Requirements for Safety-Related Structures for CANDU Nuclear Power Plants	2015	April 1, 2018

##### **Licensee Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-508230-PDD-001	Maintenance and Work Management	<a href="#">5198754</a>	NT
900-508230-PRD-001	Maintenance and Work Management	<a href="#">5198756</a>	PN
900-508230-GDI-001	Maintenance and Work Management	<a href="#">5198735</a>	NT

#### **Guidance:**

##### **Guidance Documents**

Document Number	Document Title	Version
RD/GD-210	Maintenance Programs for Nuclear Power Plants	2012
CSA N287.8	Aging Management for concrete containment structures for nuclear power plants	2015

## SCA – RADIATION PROTECTION

### Licence Condition 7.1 : Radiation Protection Program

The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

#### Preamble:

The *Radiation Protection Regulations* requires that the licensee implement a radiation protection program and also ascertain and record doses for each person who performs any duties in connection with any activity that is authorized by the NSCA or is present at a place where that activity is carried out. This program must ensure that doses to workers do not exceed prescribed dose limits and are kept as low as reasonably achievable (ALARA), social and economic factors being taken into account.

The regulatory dose limits are explicitly provided in the *Radiation Protection Regulations*.

Action levels (ALs) are designed to alert licensees before regulatory dose limits are reached. By definition, if an action level is reached, a loss of control of some part of the associated radiation protection program may have occurred, and specific action is required. ALs are not intended to be static and are to reflect operating conditions in the facility.

#### Compliance Verification Criteria:

##### Licensee Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-508740-PDD-001	Radiation Protection Program Description Document	<a href="#">5222516</a>	NT
900-508740-PRD-001	Radiation Protection Program Requirements Document	<a href="#">5323163</a>	PN
900-508740-GDI-001	Radiation Protection Program Governing Documents Index	<a href="#">5222489</a>	NT
CW-508740-PRO-454	Action Levels for Internal and External Exposures	3914858	PN
CW-508740-PRO-199	Dose Control Points	5234563	PN
CW-508740-PRO-203	ALARA Review and Assessment - Planning and Control of Radiation Work	4803546	PN
CW-508740-REQ-112	Contamination Limits	3914857	PN
CW-508740-REQ-114	Radiation Protection Consideration During Design and Modifications	3914865	PN

ALs for radiation protection are included in table 7-1. In the event of a discrepancy between the table and the licensee documentation upon which they are based, the licensee documentation shall be considered the authoritative source considering that the licensee has followed its own change control process.

**Table 7-1: CRL Action Levels**

Type of Dose	Action Level	
	mSv (rem) per four week or longer monitoring period <sup>[1]</sup>	mSv (rem) per year
Effective Dose	6 (0.6) <sup>[2]</sup>	20 (2)
Shallow Dose	100 (10)	200 (20)
Extremity Dose <sup>[3]</sup>	100 (10)	N/A
Internal Contamination	0.05 x ALI <sup>[4]</sup>	
Localized area of the skin due to a single skin contamination incident <sup>[3, 5]</sup>	50 (5)	

Notes:

1. The monitoring period is normally four weeks, but may be longer if justified. The monitoring period shall not exceed 3 months.
2. Action levels for pregnant women shall be 0.3 mSv (0.03 rem) per four weeks to the abdomen.
3. Extremity dose action level applies in situations where an extremity TLD has measured a dose exceeding 100 mSv. All contamination events that result in a dose to the skin, irrespective of the location on the body of the exposed skin, will be recorded and reported as appropriate as a skin dose (with the associated action level being 50 mSv).
4. The Annual Limit of Intake (ALI) is defined as the activity of a radionuclide that, when taken into the body, will deliver an effective dose of 20 mSv over the next 50 years following the intake.
5. The averaging area shall never be less than 1 cm<sup>2</sup>, even in case of hot particles. When skin is unevenly irradiated, the equivalent dose received by the skin is the average equivalent dose over the 1 cm<sup>2</sup> area that received the highest equivalent dose. When the contamination is relatively uniform over the skin, the averaging area of 100 cm<sup>2</sup> may be used for operational convenience but not if significantly lowers the average dose.

## **Guidance:**

### **Guidance Documents**

Document Number	Document Title	Version
G-129, Rev. 1	Keeping Radiation Exposures and Doses “As Low as Reasonably Achievable (ALARA)”	2004
G-228	Developing and Using Action Levels	2001

The licensee should conduct a documented review and, if necessary, revise the ALs at least once every five years in order to validate their effectiveness. The results of such reviews should be provided to CNSC staff.

## SCA – CONVENTIONAL HEALTH AND SAFETY

### Licence Condition 8.1: Conventional Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

#### **Preamble:**

The *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed worker health and safety policies and procedures.

As a federal regulated site, CRL is also subject to the requirements of *Canada Labour Code* and *Canada Occupational Health and Safety Regulations*.

#### **Compliance Verification Criteria:**

##### **Licensee Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-510400-PDD-001	Occupational Safety and Health	<a href="#">5185473</a>	NT
900-510400-PRD-001	Occupational Safety and Health	<a href="#">5242679</a>	PN
900-510400-GDI-001	Occupational Safety and Health	<a href="#">5185470</a>	NT

The Minister of Labour is mandated with overseeing and enforcing compliance with the *Canada Labour Code* and its regulations. CNSC staff monitor licensee compliance with its conventional health and safety program, and will take regulatory actions for any potential unsafe work practice situations.

#### **Guidance:**

None provided.



## SCA – ENVIRONMENTAL PROTECTION

### Licence Condition 9.1 : Environmental Protection Program

The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

#### Preamble:

The *Class I Nuclear Facilities Regulations* requires that a licence application contain information related to environmental protection. The *General Nuclear Safety and Control Regulations* requires every licensee to take all reasonable precautions to protect the environment. The *Radiation Protection Regulations* prescribe the radiation dose limits for the general public of 1 mSv per calendar year.

#### Compliance Verification Criteria:

##### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
REGDOC-2.9.1	Environmental Principles, Assessments and Protection Measures, version 1.1, section 4.6	2017	April 1, 2018
N288.4	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills	2010 (R2015)	April 1, 2018
N288.5	Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills	2011 (R2016)	April 1, 2018
N288.6	Environmental risk assessment at Class I nuclear facilities and uranium mines and mills	2012 (R2017)	April 1, 2018
N288.7	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	2015	April 1, 2020
N288.8	Establishing and implementing action levels to control releases to the environment from nuclear facilities	2017	April 1, 2020

##### Licence Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-509200-PDD-001	Environmental Protection	<a href="#">5198856</a>	NT
900-509200-PRD-001	Environmental Protection	<a href="#">5198861</a>	PN
900-509200-GDI-001	Environmental Protection	<a href="#">5198853</a>	NT
CRL-509200-PRO-712	Administrative Levels and Action Levels for CRL Air and Liquid Radioactive Effluents	<a href="#">4798173</a>	NT
CRL-509200-RRD-001	Derived Release Limits (DRLs) for AECL's Chalk River Laboratories	Site specific	NT
CRL-509200-OV-126	CRL Environmental Monitoring Program Framework	Site specific	NT
CRL-509200-PLA-005	CRL Radioactive Environmental Monitoring Plan	Site specific	NT
CRL-509200-PLA-002	CRL Non-Radioactive Environmental Monitoring Plan	Site specific	NT

Document Number	Document Title	e-Doc	Notification
CRL-509200-PLA-003	CRL Non-Radioactive Effluent Verification Monitoring Plan	Site specific	NT
CRL-509200-PLA-004	CRL Radioactive Effluent Verification Monitoring Plan	Site specific	NT
CRL-509200-PRO-712	Administrative Levels and Action Levels for CRL and Liquid Radioactive Effluents	Site specific	NT
CRL-509244-PRO-001	CRL's Non-Radioactive Effluent Limits	Site specific	NT

The licensee shall control, monitor and record releases of radioactive and/or hazardous substances such that the releases do not exceed the reference levels (limits) specified in tables 9-1, 9-2 and 9-3.

The dose to the critical group due to the sum of all radioactive releases in any period of 12 consecutive months shall not exceed 0.3 mSv.

Action levels for environmental releases are included in tables 9-4 and 9-5. These action levels are for the release paths and radionuclides or radionuclides groups which account for more than 0.1% of the derived release limits.

The licensee shall implement all follow-up actions identified as a result of environmental assessments, and shall report the progress to CNSC staff on an annual basis.

**Table 9-1: Annual Release Limits for the Releases of Radioactive Substances to the Environment from Chalk River Laboratories**

Release Path	Radionuclide	Release Limit <sup>(a)</sup> (Bq/year)
<b>Airborne Releases</b>		
NRU Stack	Argon-41	6.60E+16
NRU Stack	Carbon-14	2.14E+15
NRU Stack, NRU Vents, MPF Stack, WMA B Tile Holes	Iodine-131	3.96E+12
NRU Stack, NRU Vents, WTC Vents	Tritium Oxide	1.25E+16
MPF Stack	Mixed Noble Gases <sup>(b)</sup>	4.96E+16
WMA B Tile Holes Cemented Molybdenum Waste	Xe-133	8.35E+17
<b>Liquid Releases</b>		
Process Outfall, Storm Outfall 4F6, Duke Stream Weir	Tritium Oxide	1.03E+17
Process Outfall	Gross Alpha	1.32E+12
Process Outfall, Perch Creek Weir	Gross Beta <sup>(c)</sup>	2.70E+13

<sup>(a)</sup>The sum of releases from all release paths for a given radionuclide shall be compared to the release limit (based on dose constraint of 0.3 mSv per year). These limits are based on the licensing basis for NRU operation and Mo-99 production.

<sup>(b)</sup>The releases of mixed noble gases are measured in BqMeV.

<sup>(c)</sup>Gross Beta for liquid releases includes Sr-90 and other radionuclides, predominantly short-lived activation products such as Zn-65, Ru-106, Ba-140, Fe-59, Sc-46, Ce-143, Np-239 and Nb-95.

**Table 9-2: Annual Reporting Levels for Airborne Releases from Powerhouse Stack**

Parameter	Annual Reporting Level (tonnes)
Carbon Monoxide (CO)	8.0
Nitrogen Oxides (NO <sub>x</sub> )	75.0
Sulphur Dioxide (SO <sub>2</sub> )	315.0
Total Particulate Matter (TPM)	24.0
Particulate Matter < 10 µm (PM <sub>10</sub> )	21
Particulate Matter < 2.5 µm (PM <sub>2.5</sub> )	15
Volatile Organic Compound (VOC)	0.5

Note: Estimated data is used for assessment against these limits.

**Table 9-3: Reference Levels (Limits) for Liquid Releases from Waste Treatment Centre  
Liquid Waste Evaporator (WTC\_LWE) and Process Outfall**

Parameter	Monitoring Point	Effluent Limits (Monthly Averages)
pH	Process Outfall	6-9
Total Phosphorus	WTC_LWE	1 mg/L
Total Suspended Solids	WTC_LWE	25 mg/L
Oil/Grease (Solvent Extractable Substances)	WTC_LWE	15 mg/L
Chromium	WTC_LWE	0.5 mg/L
Copper	WTC_LWE	0.5 mg/L
Lead	WTC_LWE	0.1 mg/L
Mercury	WTC_LWE	0.001 mg/L
Nickel	WTC_LWE	0.5 mg/L
Zinc	WTC_LWE	0.5 mg/L

**Table 9-4: Action Levels for Airborne Effluents Released from CRL**

Radionuclide	Facility	Release Path	Action Level (Bq/week)
Ar-41	NRU Reactor	Reactor Stack	6.35E+14
C-14	NRU Reactor	Reactor Stack	2.91E+11
Tritium Oxide	NRU Reactor	Reactor Stack	3.40E+13
I-131	NRU Reactor	Reactor Stack	1.24E+08
Tritium Oxide	NRU Reactor	Fan 12	3.51E+13
Tritium Oxide	NRU Reactor	Fan 15	5.14E+12
Tritium Oxide	NRU Reactor	Fan 24	8.63E+12
Tritium Oxide	NRU Reactor	Fan 39	1.78E+12
Tritium Oxide	NRU Reactor	Fan 71	7.56E+12

Radionuclide	Facility	Release Path	Action Level (Bq/week)
I-131	Mo-99 Production Facility	Mo-99 Stack	9.57E+08
Mixed Noble Gases*	Mo-99 Production Facility	Mo-99 Stack	3.17E+14
Tritium Oxide	Waste Treatment Centre	B574 Fan E2	2.17E+12

\* For Mixed Noble Gases, the Action Levels are given in Bq.MeV/week.

**Table 9-5: Action Levels for Liquid Effluents from CRL**

Radionuclide	Release Path	Action Level (Bq/month)
Tritium Oxide	Process Outfall	2.18E+13
Tritium Oxide	4F6 Manhole	2.97E+13
Gross Alpha	Process Outfall	1.39E+09
Gross Beta	Process Outfall	3.07E+11
Gross Beta	Perch Creek Weir	4.98E+10
Tritium Oxide	Duke Stream Weir	2.53E+12
Tritium Oxide	Bulk Storage Stream	4.42E+12

## **Guidance:**

### **Guidance Documents**

Document Number	Document Title	Version
CSA N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities	2014 (Update 1)
CSA N288.2	Guidelines for calculating the radiological consequences to the public of a release of airborne radioactive material for nuclear reactor accidents	2014

## SCA – EMERGENCY MANAGEMENT AND FIRE PROTECTION

### Licence Condition 10.1: Emergency Preparedness Program

**The licensee shall implement and maintain an emergency preparedness program.**

#### Preamble:

This licence condition requires the licensee to establish an emergency preparedness program to prepare for, to respond to, and to recover from the effects of accidental radiological/nuclear and/or hazardous substance release. As part of the emergency preparedness program, the licensee establishes an onsite emergency response plan and an emergency response organization and makes arrangements for coordinating off-site activities and cooperating with external response organizations throughout all phases of an emergency.

The [Class I Nuclear Facilities Regulations](#) requires measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of national security, including measures to assist, notify, report to off-site authorities including the testing of the implementation of these measures.

A security response to malevolent acts is governed by a separate plan under the Nuclear Security program (see LCH Section 12.1) but provisions of the licensee site security report apply to any associated potential threat of release of radioactive material - for example, the need for off-site notification, situation updates and confirmation of any radioactive releases.

Liquid release response and radioactive materials transportation emergency response plan are also governed by separate plans (See LCH Sections 9.1 and 14.1, respectively).

CRL has a communication program that covers a broad spectrum – community interface meetings, newsletters, websites, committees and various panels. Panels and committees that are a direct link between Emergency Preparedness and the community include: The Safety Review Committee, the provincial Nuclear Emergency Management Coordinating Committee and the local municipal/licensee Nuclear Emergency Preparedness Committee.

CRL provides the local municipalities and the province (as required, federal) with hazard information that can be used for community communications during an emergency.

#### Compliance Verification Criteria:

##### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
REGDOC-2.10.1	Nuclear Emergency Preparedness and Response, Version 2	2016	April 1, 2018

The requirements of REGDOC-2.10.1 related to a greater than 10 MWth reactor applies to the NRU reactor, prior to it being put in safe storage.

##### Licence Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-508730-PDD-001	Emergency Preparedness	<a href="#">5185454</a>	NT
900-508730-PRD-001	Emergency Preparedness	<a href="#">5185458</a>	PN
900-508730-GDI-001	Emergency Preparedness	<a href="#">5185448</a>	NT

Document Number	Document Title	e-Doc	Notification
CRL-508730-ERP-001	Chalk River Laboratories Site Emergency Response Plan	4742314	PN

## **Guidance:**

### **Guidance Documents**

Document Number	Document Title	Version
CSA N1600	General requirements for nuclear emergency management programs	2016
REGDOC 2.3.2	Accident Management	

## Licence Condition 10.2: Fire Protection Program

The licensee shall implement and maintain a fire protection program.

### Preamble:

Licensees require a comprehensive fire protection program (the set of planned, coordinated, controlled and documented activities) to ensure the licensed activities do not result in unreasonable risk to the health and safety of persons and to the environment due to fire and to ensure that the licensee is able to efficiently and effectively respond to emergency fire situations.

Fire protection provisions, including response, are required for the design, construction, commissioning, operation, and decommissioning of nuclear facilities, including structures, systems, and components (SSCs) that directly support the plant and the protected area. External events such as an aircraft crash or threats are addressed in LCH Section 12.1.

### Compliance Verification Criteria:

#### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
CSA N293	Fire protection for nuclear power plants	2012 (R2017)	April 1, 2018
CSA N393	Fire protection for facilities that process, handle, or store nuclear substances	2013 (R2016)	April 1, 2018
	National Fire Code of Canada	2015	April 1, 2018
	National Building Code of Canada	2015	April 1, 2018

#### Licence Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-508720-PDD-001	Fire Protection	<a href="#">5198844</a>	NT
900-508720-PRD-001	Fire Protection	<a href="#">5198849</a>	PN
900-508720-GDI-001	Fire protection	<a href="#">5198843</a>	NT
CRL-508720-PRO-598	Impairment, Notification and Compensatory Measures	<a href="#">4486067</a>	NT

A fire safe shutdown analysis for ZED-2 reactor is not required.

As required by CSA N293, the licensee shall ensure that a qualified third party performs a plant condition inspection annually and a fire protection program audit every three years. The resulting inspection and audit reports shall be submitted to CNSC staff.

Where CSA standard N393 requires items to be submitted to CNSC for review and/or acceptance, the licensee shall document the item in sufficient detail to ensure it is safe to proceed. The licensee may implement that item without prior review and/or acceptance from CNSC staff.

## **Fire Response**

In accordance with N293, the licensee shall arrange for third party audits of one industrial fire brigade fire drill once every two years. The purpose of a Third Party Audit is to provide an in-depth analysis of the Industrial Fire Brigade (IFB) fire response performance against applicable regulatory criteria. A fire response is a planned, coordinated and controlled activity to provide emergency response to a fire. The audit is to analyze and ensure competencies of the IFB against CSA N293 standard and the referred NFPA 600 and 1081 standards.

An independent third party auditor is required to be an expert in the discipline, normally firefighting and qualified through specific education and relevant experience. The third party auditor is required to be independent or at “arm’s length” from the facility to ensure impartiality. The review shall be of sufficient depth and detail to allow the reviewer to attest with reasonable confidence on the competencies of the IFB at the facility.

### **Guidance:**

Where CSA N293 or N393 does not address a fire protection topic or issue in whole, or where additional guidance is beneficial, the standards and recommended practices set out by the NFPA are used as guidance by CNSC staff in determining the adequacy of a fire protection measure. The guidance provided by the Nuclear Energy Institute in NEI 00-01 “Guidance for Post Fire Safe Shutdown Circuit Analysis” is used by CNSC staff to help determine the adequacy of safe shutdown electrical circuit analysis.

The results of the Third Party Audit report will typically consist of a report which compares the requirements of the applicable codes and standards against the implementation of the fire protection program or the Fire Response exercised (based on the scope of the audit). The report should identify any non-compliance and formulate a conclusion on whether the licensee fire protection program or IFB meets the requirements of N293.



## SCA – WASTE MANAGEMENT

### Licence Condition 11.1: Waste Management Program

The licensee shall implement and maintain a waste management program.

#### **Preamble:**

The *General Nuclear Safety and Control Regulations* require that a licence application contain information related to the management of radioactive waste or hazardous waste resulting from the licensed activities.

The *Class I Nuclear Facilities Regulations* require that a licence application contain the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
CSA N292.1	Wet storage of irradiated fuel and other radioactive materials	2016	April 1, 2018
CSA N292.2	Interim dry storage of irradiated fuel	2013 (R2015)	April 1, 2018
CSA N292.3	Management of low- and intermediate-level radioactive waste	2014	April 1, 2018

##### **Licensor Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-508600-PDD-001	Waste Management	<a href="#">5198811</a>	NT
900-508600-PRD-001	Waste Management	<a href="#">5262060</a>	PN
900-508600-GDI-001	Waste Management	<a href="#">5198807</a>	NT
CW-508600-PLA-002	CNL Integrated Waste Strategy	<a href="#">5198866</a>	NT

The licensee shall not produce, in the course of the licensed activities, or accept from outside clients, waste for which there is no identified treatment, or storage, or disposal facility.

#### **Guidance:**

##### **Guidance Documents**

Document Number	Document Title	Version
G-320	Assessing the Long term Safety of Radioactive Waste Management	2006
CSA N292.0	General principles for the management of radioactive waste and irradiated fuel	2014
CSA N292.5	Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substances	2011 (R2017)

## Licence Condition 11.2: Decommissioning Plan

The licensee shall maintain a decommissioning plan.

### Preamble:

*Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed plan for decommissioning of the nuclear facility or of the site. The decommissioning plan for CRL site is documented in the comprehensive preliminary decommissioning plan and the associated cost estimate.

### Compliance Verification Criteria:

#### Licensing Basis Publications

Document Number	Document Title	Version	Effective Date
CSA N294	Decommissioning of facilities containing nuclear substances	2009 (R2014)	April 1, 2018

#### Licensor Documents that Require Notification of Change

Document Number	Document Title	e-Doc	Notification
900-508300-PDD-001	Decommissioning and Demolition	<a href="#">5198760</a>	NT
900-508300-PRD-001	Decommissioning and Demolition	<a href="#">5198763</a>	PN
900-508300-GDI-001	Decommissioning and Demolition	<a href="#">5198758</a>	NT
CPDP-508300-PDP-001	Comprehensive Preliminary Decommissioning Plan	<a href="#">4413588</a>	NT
See e-Doc <a href="#">5238065</a>	Detailed Decommissioning Plans		NT <sup>1</sup>

<sup>1</sup> Notification is required only for non-administrative changes. Otherwise, the licensee shall provide lists of updated detailed decommissioning plans to CNSC staff quarterly.

#### *Facilities under Decommissioning*

For Class I and Class II nuclear facilities at CRL, the licensee shall prepare detailed decommissioning plans (DDP) and procedures as needed, and submit the DDP to CNSC staff for review.

For the decommissioning of radioisotope laboratories, storage rooms, contaminated buildings, support facilities, low-hazard nuclear structures and non-contaminated buildings, the licensee shall prepare facility/building clean-up (removal) plans, notify CNSC staff and submit the facility/building clean-up (removal) plans to CNSC staff for information.

#### *Release from Regulatory Control*

The licensee shall only release the decommissioned property, or any part thereof, for reuse upon the acceptance of the final end-state report by the CNSC.

### Guidance:

#### Guidance Documents

Document Number	Document Title	Version
G-219	Decommissioning Planning for Licensed Activities	2000

Typical elements supporting decommissioning that may be included or referenced in the detailed decommissioning plan are: characterization survey; safety assessment; cost estimate; financial assurance; environmental impact assessment; environmental protection; radiation protection; quality assurance; waste management; emergency response; physical security; safe enclosure; site preparation; surveillance and maintenance; final survey; health and safety; personnel training; human factors.

## SCA – SECURITY

### Licence Condition 12.1: Security Program

The licensee shall implement and maintain a security program.

#### **Preamble:**

The *General Nuclear Safety and Control Regulations* require that a licence application contain information related to site access control and measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information.

The *Class I Nuclear Facilities Regulations* require that a licence application contain the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility.

The *Nuclear Security Regulations* require that a licence application contain specific information related to nuclear security, stipulates the requirements for high-security sites, and contains specific requirements pertaining to the transportation of Category I, II or III nuclear material.

The *Nuclear Security Regulations* require that a licensee of a high security site:

- maintain at all times a qualified onsite nuclear response force;
- obtain the applicable certifications, before issuing an authorization to a nuclear security officer;
- prevent and detect unauthorized entry into a protected area or inner area; and
- prevent unauthorized entry of weapons and explosive substances into a protected area or inner area.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
RD-321	Criteria for Physical Protection Systems and Devices at High-Security Sites	2010	April 1, 2018
RD-361	Criteria for Explosive Substance Detection, X-ray Imaging, and Metal Detection Devices at High-Security Sites	2010	April 1, 2018
REGDOC-2.12.1	High-Security Sites: Nuclear Response Force	2013	April 1, 2018
REGDOC-2.12.2	Site Access Security Clearance	2013	April 1, 2018
REGDOC-2.12.3	Security of Nuclear Substances: Sealed Sources	2013	May 31, 2018
CSA N290.7	Cyber-security for nuclear power plants and small reactor facilities	2014 (R2015)	April 1, 2018

##### **Licence Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-508710-PDD-001	Security	<a href="#">5198826</a>	NT
900-508710-PRD-001	Security	<a href="#">5198837</a>	PN
900-508710-GDI-001	Security	<a href="#">5198818</a>	NT

Document Number	Document Title	e-Doc	Notification
900-511400-PDD-001	Program Description Document – Cyber Security		NT
900-511400-PRD-001	Program Requirements Document – Cyber Security		PN
900-511400-GDI-001	Governing Documentation Index – Cyber Security		NT
EPS-14000-RPT-17 (secret)	Chalk River Laboratories Site Security Report	4929522	NT

The CNL document EPS-14000-RPT-17 *Chalk River Laboratories Site Security Report* document is required to be updated periodically and resubmitted to the CNSC staff. The site security report shall be updated and resubmitted when there are significant changes to the program.

## **Guidance:**

### **Guidance Documents**

Document Number	Document Title	Version
G-208	Transportation Security Plans for Category I, II or III Nuclear Material	2003
G-274	Security Programs for Category I or II Nuclear Material or Certain Nuclear Facilities	2003

## SCA – SAFEGUARDS AND NON-PROLIFERATION

### Licence Condition 13.1: Safeguards Program

The licensee shall implement and maintain a safeguards program.

#### **Preamble:**

Safeguards is a system of inspection and other verification activities undertaken by the International Atomic Energy Agency (IAEA) in order to evaluate a Member State's compliance with its obligations pursuant to its safeguards agreements with the IAEA. The requirements for reporting to the CNSC staff on the inventory and transfer of fissionable and fertile substances are included in subsection 3.2 of the LCH.

The *General Nuclear Safety and Control Regulations* requires the licensee to take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement.

The *Class I Nuclear Facilities Regulations* requires that a licence application contain information on the licensee's proposed measures to facilitate Canada's compliance with any applicable safeguards agreement.

Canada has entered into a safeguards agreement with the IAEA pursuant to its obligations under the Treaty on the Non-Proliferation of Nuclear Weapons. The objective of the Canada/IAEA Safeguards Agreement is for the IAEA to provide assurance on an annual basis to Canada and to the international community that all declared nuclear materials are in peaceful, non-explosive uses and that there is no indication of undeclared nuclear materials or activities. This conclusion confirms that Canada is in compliance with its obligations under the following Canada/IAEA Safeguards Agreement:

- [\*Treaty on the Non-Proliferation of Nuclear Weapons\*](#);
- [\*Agreement Between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons\*](#); and
- [\*Protocol Additional to the Agreement Between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons\*](#).

These are reproduced in information circulars INFCIRC/140, INFCIRC/164, and INFCIRC/164/Add. 1.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
RD-336	Accounting and Reporting of Nuclear Material	2010	April 1, 2018

### **Licensee Documents that Require Notification of Change**

<b>Document Number</b>	<b>Document Title</b>	<b>e-Doc</b>	<b>Notification</b>
900-508510-PDD-001	Nuclear Materials and Safeguards Management	5198783	NT
900-508510-PRD-001	Nuclear Materials and Safeguards Management	5198784	PN
900-508510-GDI-001	Nuclear Materials and Safeguards Management	5198767	NT

The licensee shall provide the International Atomic Energy Agency (IAEA), an IAEA inspector, or a person acting on behalf of the IAEA, with such reasonable services and assistance as are required to enable the IAEA to carry out its duties and functions pursuant to a safeguards agreement.

The licensee shall grant prompt access at all reasonable times to all locations at CRL to an IAEA inspector, or to a person acting on behalf of the IAEA, where such access is required for the purposes of carrying on an activity pursuant to a safeguards agreement. In granting access, the licensee shall provide health and safety services and escorts as required in order to facilitate activities pursuant to a safeguards agreement.

The licensee shall disclose to the CNSC staff, to the IAEA, or to an IAEA inspector, any records that are required to be kept or any reports that are required to be made under a safeguards agreement.

The licensee shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable sampling and removal or shipment of samples required pursuant to a safeguards agreement.

The licensee shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable measurements, tests and removal or shipment of equipment required pursuant to a safeguards agreement.

The licensee shall, at the request of the CNSC, install safeguards equipment at CRL.

The licensee shall permit an IAEA inspector, or a person acting on behalf of the IAEA, to service safeguards equipment at CRL.

The licensee shall operate safeguards equipment at CRL in accordance with the methods and procedures specified by the IAEA.

The licensee shall provide the services required for the operation of the safeguards equipment at CRL, in accordance with the specifications of the IAEA.

The licensee shall not interfere with or interrupt the operation of safeguards equipment at CRL or alter, deface or break a safeguards seal, except pursuant to a safeguards agreement.

The licensee shall implement measures to prevent damage to or the theft, loss or sabotage of safeguards equipment or samples collected pursuant to a safeguards agreement or the illegal use, possession, operation or removal of such equipment or samples.

The licensee shall make such reports and provide such information to the CNSC staff, as are required to facilitate Canada's compliance with any applicable safeguards agreement.

The licensee shall obtain prior written approval of the CNSC, for any changes to operation, equipment or procedures requested by the licensee that would affect the implementation of safeguards measures.

## **Guidance:**

### **Guidance Documents**

<b>Document Number</b>	<b>Document Title</b>	<b>Version</b>
GD-336	Guidance for Accounting and Reporting of Nuclear Material	2010



## SCA – PACKAGING AND TRANSPORT

### Licence Condition 14.1: Packaging and Transport Program

The licensee shall implement and maintain a packaging and transport program.

#### **Preamble:**

The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the proposed procedures for transporting nuclear substances and hazardous substances.

The transport of nuclear substances or hazardous substances must be done in accordance with the requirements of the *Packaging and Transport of Nuclear Substances Regulations, 2015*, (PTNSR) and *Transportation of Dangerous Goods Regulations* (TDGR) set out by Transport Canada.

#### **Compliance Verification Criteria:**

##### **Licensing Basis Publications**

Document Number	Document Title	Version	Effective Date
IAEA SSR-6	Regulations for the Safe Transport of Radioactive Material (2012 Edition)	2012	April 1, 2018

##### **Licensor Documents that Require Notification of Change**

Document Number	Document Title	e-Doc	Notification
900-508520-PDD-001	Transportation of Dangerous Goods	<a href="#">5198788</a>	NT
900-508520-PRD-001	Transportation of Dangerous Goods	<a href="#">5198791</a>	PN
900-508520-GDI-001	Transportation of Dangerous Goods	<a href="#">5198787</a>	NT

The licensee shall implement and maintain a packaging and transport program that will be in compliance with all the regulatory requirements set out in the Transport Canada TDGR and in the CNSC PTNSR.

Every person who transports or causes to be transported radioactive nuclear substances (included in Class 7 of the Schedule to the *Transportation of Dangerous Goods Act*) shall act in accordance with the requirements of the TDGR set out by Transport Canada.

As used in the PTNSR, the *IAEA Regulations* means the IAEA requirements document SSR-6 *Regulations for the Safe Transport of Radioactive Material (2012 Edition)* as amended from time to time.

The PTNSR provides specific requirements for the design of transport packages, the packaging, marking and labeling of packages and the handling and transport of nuclear substances.

Shipments of nuclear substances within the CRL site where access to the property is controlled are exempted from the application of the PTNSR.

Based on the current versions of the PTNSR and TDGR, for the packaging and transport of nuclear substances

- (a) to and from the CRL site, both PTNSR and TDGR apply.
- (b) between the CRL facilities:
  - according to paragraph 2(2)(d) of the PTNSR, the PTNSR do not apply to the transport of nuclear substances within the CRL site, except for sections 6 and 7. Sections 6 and 7 refer to the CNSC *Nuclear Security Regulations*, specifically to the transport of Category I, II or III nuclear material.
  - TDGR do not apply per subsection 1.25 of those regulations.

## **Guidance:**

### **Guidance Documents**

<b>Document Number</b>	<b>Document Title</b>	<b>Version</b>
RD-364	Joint Canada-United States Guide for Approval of Type B(U) and Fissile Material Transportation Packages	2009
REGDOC-2.14.1	Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substances Regulations, 2015	2016

## APPENDIX A: LIST OF NUCLEAR AND SUPPORT FACILITIES

Table A-1: Class I Nuclear Facilities

Facility	Location
NRU Reactor	<ul style="list-style-type: none"> <li>• Building 150: the reactor, the rod bays, and experimental facilities</li> <li>• Building 171: the NRU instrument shop</li> <li>• Building 179: the NRU waste segregation building</li> <li>• Building 440: the emergency water supply</li> <li>• Buildings 109, 158, 160, 162, 163: the reactor ventilation system</li> <li>• Building 166: Sump House</li> </ul>
Nuclear Fuel Fabrication Facility, Building 429A & 429B	<ul style="list-style-type: none"> <li>• Building 429A: the LEU and HEU fuel fabrication systems and inspection equipment</li> <li>• Building 429B: the HEU billet casting equipment and systems</li> </ul>
Recycle Fuel Fabrication Laboratories	<ul style="list-style-type: none"> <li>• Building 375 (the south part)</li> </ul>
ZED-2 Reactor	<ul style="list-style-type: none"> <li>• Building 145 (the north-west end)</li> </ul>
Building 234 Universal Cells	<ul style="list-style-type: none"> <li>• Building 234: three hot cells and associated equipment and systems, and the ventilation system connection to Buildings 203/206</li> </ul>
Molybdenum-99 Production Facility	<ul style="list-style-type: none"> <li>• Building 225: Mo-99 and Xe-133 cells</li> <li>• Building 229: Fissile Solution Storage Tank</li> <li>• Building 229A: Retrieval and Transfer Facility</li> <li>• Building 225A: Delay system columns</li> <li>• Building 206: Ventilation system</li> <li>• Building 203: Ventilation stack</li> </ul>
Tritium Laboratory	<ul style="list-style-type: none"> <li>• Building 250 (the south end)</li> </ul>
Waste Treatment Centre and Associated Facilities	<ul style="list-style-type: none"> <li>• Building 570</li> <li>• Building 538: Waste Tank Farm</li> <li>• Active Area Liquid Waste Facilities (B205, B205X, B207, B222, B222A, B222X, and B224)</li> <li>• Building 574: Holding Tank Facility</li> <li>• Chemical Active Drain System including Emergency Storage Basin</li> <li>• Reactor Drain System</li> <li>• Decontamination Centre Drain System</li> </ul>
Fuels and Materials Cells	<ul style="list-style-type: none"> <li>• Building 375 (the south end)</li> </ul>
Waste Management Areas (Operating Facilities)	<ul style="list-style-type: none"> <li>• WMA B: Engineered Facilities (tile holes and cylindrical bunkers); Waste Reception Centre; PCB Storage Facilities; Waste Handling Building; FPS Facility; Building 596 administration building</li> </ul>

Facility	Location
	<ul style="list-style-type: none"> <li>• WMA C (Including WMA C Extension): Interim above-ground storage of offsite generated liquid waste; Above-ground storage of material that ensures no release of radioactive contaminants to the environment</li> <li>• WMA D: Above-Ground Potentially Contaminated Salvaged Equipment Storage; Low-Level Radioactive Waste Management Office Storage Buildings and seven luggers; Waste oils, organic liquids and contaminated fluids stored in marine containers</li> <li>• WMA H: Modular Above-Ground Storage of containerized low-level radioactive waste; Shielded Modular Above-Ground Storage of containerized low-level radioactive waste; Luggers</li> <li>• WMA J: Bulk Material Landfill of CRL Sewage Sludge</li> </ul>
Waste Management Areas (Non-Operating Facilities)	<ul style="list-style-type: none"> <li>• WMA A: Unlined Sand Trenches; 1952 NRX Liquid Dispersals; 1954 Experimental Liquid Dispersals; 1955 Experimental Liquid Dispersals; Special Storage</li> <li>• WMA B: Asphalt Lined Trenches; Unlined Sand Trenches; Rectangular Concrete Bunkers; Concrete Monoliths; Special Concrete Bunkers; Special Burials; Steel Holes</li> <li>• WMA C (Including WMA C Extension): Continuous Landfill Site; Unlined Sand Trenches</li> <li>• WMA E: Suspect contaminated soils and building materials</li> <li>• WMA F: Port Hope and Ottawa Soil Emplacement</li> <li>• WMA G: Site of Above-Ground Concrete Canisters Used to Store Spent Fuel</li> <li>• Liquid Dispersal Areas: Laundry Pit; Reactor Waste Dispersal Pit #1 (the Pot Hole); Reactor Waste Dispersal Pit #2; Chemical Waste Dispersal Pit</li> <li>• Others: Thorium Nitrate Dispersal (20 cubic metre waste from 233U Extraction Plant); Ammonium Nitrate Destruction Plant (1953); Acids, Chemicals and Solvent Pits, and Special Burials</li> </ul>
Nuclear Fuel Fabrication Facility Building 405	Building 405
CECEUD Test Facility	Building 215

**Table A-2: Class II Nuclear Facilities**

Facility	Class II Prescribed Equipment	Location
Health Physics Neutron Generator	Texas Neutron Generator Model 150-1H	Building 513, Room 177 with its control console located in Room 195
	ADELPHI Neutron Generator Model DD-109	Building 513, Room 177 with the console located in Room 195
Gamma Beam Irradiation Facility	Gamma Beam Irradiator Model 150C	Building 524, Room O103 with the control console in Room O102
	Gamma Beam Irradiator Model GC60-1000	Building 524, Room O103 with the control console in Room O102
Gamma Beam Irradiator	Gamma Beam Irradiator Model GC60	Building 513, Room 175 with the control console in Room 195
Van de Graaff Electron Accelerator	High Voltage Engineering Corporation, Model AS-2000, Van de Graaff Accelerator	Building 320, Room 218 with the control console in Room 221

**Table A-3: Radioisotope Laboratories**

Facility	Class	Building	Room
Tritium Facility (also listed in table A-1 as the Tritium Laboratory, a Class I nuclear facility)	A	250	45, 242, 244, 245, 248, 250, 250A
Irradiation Creep and Growth Laboratory	B	150	201B
Control/Loop Laboratory	B	150	219, 322, 326
Iodine Preparation Laboratory	B	226	113
TIMS Sample Preparation Laboratory	B	320	212
Chromatography Laboratory	B	320	317-320
Active Wet Chemistry Laboratory	B	320	324
Containment Chemistry (333) and Gammacell Laboratories (334)	B	320	333, 334
ICP-MS Laboratory	B	330	316, 318, 319
Neutron Activation Analysis and Radiochemistry Laboratories	B	330	321
Radiochemical Analysis Laboratory	B	330	325, 328
Radiochemical Analysis Laboratory	B	330	326
Hydrogen and Deuterium Analysis Laboratories	B	330	326A, 327
Imaging-XPS Laboratories	B	375	160
SIMS, SEM and Radioactive Specimen Preparation Laboratories	B	375	157, 157A, 159, 161
Research Reactor Fuel Development Laboratories	B	375	38, 40, 50, 162
Chalk River Advanced Fuel Technology Section Laboratory	B	375	43

Facility	Class	Building	Room
Chalk River Advanced Fuel Technology Ceramics Section Laboratories	B	375	258-262
Waste Processing Technology Development Laboratory	B	467	101, 102, 106, 106A, 110
Molten Fuel Moderator Interaction Laboratory	B	137	116, 116A, 117, 118, 119, 119A, 120
H-3 Loop Support Laboratory	C	250	112
Radioisotope Material Shipping & Receiving Room	C	250	114
Corrosion and Activity Transports Test	C	250	210
Decontamination Test Loops Laboratory	C	250	221
H <sub>3</sub> Loop	C	250	111, 111A
Activity Transport Loop Facility	C	250	213, 215
Chemical Cleaning Laboratory	C	250	415, 417
Instrumented Fuel Assembly Shop	C	300	133, 134
Chalk River Advanced Fuel Technologies – Element and Bundle Assembly Section Laboratory	C	300	222
Wet Chemistry Laboratory	C	320	326
ICP-AES Laboratory	C	320	309, 309A, 312
Fission Gas Laboratory	C	320	205
Metallographic Services Laboratory	C	375	125, 125A, 127, 127A
Surface Science Laboratory	C	380	114, 116, 117, 120
Fission Product Release Group Laboratory	C	469	105, 125, 126B
Radiochemistry Applications Laboratory	C	513	25, 27
Bioassay Laboratory	C	513	115, 219, 219A, 263-266
Tritium Monitor/Technique Development Laboratory	C	513	259
Environmental Radiochemistry Laboratory	C	513	153
Radiochemistry Research Laboratory	C	513	107
Health Physics Neutron Generator (also listed in Table A-2 as a Class II nuclear facility)	C	513	177, 178, 179
Biological Research Facility	C	524	101, 173-175, 177 – 179
Biological Research Facility	C	524	G168
Reactor Tooling and Calibration	C	610	103, 105, 121
Preparation and Testing Laboratory	C	250	216

**Table A-4: Nuclear Facilities in Extended Safe Shutdown State**

Facility	Location
MAPLE 1 Reactor	Building 110
MAPLE 2 Reactor	Building 111
New Processing Facility	Building 260

**Table A-5: Support Facilities**

Facility	Building Number
Security Monitoring Room (pursuant to section 15 of the <i>Nuclear Security Regulations</i> )	701
Fire Department Services	700
Powerhouse	420
Emergency Power Generator	135
Security Gatehouse to CA2	701
Administration, Security Department, and Fire Department Services	700

**Table A-6: Nuclear Facilities in Permanent Safe Shutdown State**

Facility	Location
NRX Reactor	Building 100 Control Room: Building 100A, Room 305 Electrical Room: Building 100A, Room 207
Active Waste Disposal System	Building 240 pump house, Tank 240-1, Tank 240-2 and Building 241 valve house

**Table A-7: Nuclear Facilities Undergoing Decommissioning Activities**

Facility	Location
Plutonium Tower	Building 223
NRX Ancillary Buildings	Heavy Water Salvage: Building 100X Fan House: Building 101 Filter House: Building 101X Valve House & Delay Tank No. 1: Building 103 Valve House & Delay Tank No. 2: Building 104 Exhaust Stack Base: Building 122 Effluent Monitoring: Building 126 Above Ground Ventilation Stack Duct: Building 157
Waste Water Evaporator	Building 228

Facility	Location
NRX Fuel Bays	J-Rod Bays: Building 204A X-Rod Bays: Building 204B
Plutonium Recovery Laboratory	Building 220

**Table A-8: Other Facilities/Buildings that Handle or Have Been Handled Nuclear Materials and/or Nuclear Substances**

Facility	Location
Decontamination Centre	Building 468
Nuclear Materials Storage Facility	Building 539, Rooms 4, 5, 6, 7 and 8
Nuclear Materials Storage Facility	Building 575
Nuclear Materials Storage Facility	Building 300 Lab 222A
Fuel and Fuel Channel Safety	Building 469, Rooms 124, 124A, 126A Hallway, 127, 128, 129, 130 (shielded room) and 205
Metallurgy Area C	Building 375
Manufacturing Services	Building 466
Shipping/Receiving Facility	Building 457
Low Background Counting Facility	Building 560, Room 115
Site Evacuation/Monitoring Building	Building 580
Instrumentation and Control Laboratories	Building 600, Rooms 3A, 3B, 19, 21, 208
Flasks/Radioactive-Contam Equipment	Building 557
Hydrogen Isotopes Technology Laboratory	Building 137
Waste Analysis Facility	Building 582
Active Laundry Building	Building 202
Active Area Maintenance Shop	Building 226
Chemical Engineering Building	Building 250
Corrosion Laboratory	Building 300A
Chemistry and Materials Buildings	Building 320
Chemistry and Materials Buildings	Building 330
Metallurgy Building	Building 375
Fuel Engineering	Building 469
Decontamination	Building 507
Decontamination Storage Building	Building 554
Spring B Facility	Building 594
Chemical Pit Facility	Building 595

Note: Buildings with floor area less than 50m<sup>2</sup> are not included



**Table A-9: Other Facilities/Buildings Undergoing Decommissioning**

<b>Facility</b>	<b>Location</b>
Former Reactor Bay Deionization System	Building 200A
Former MAPLE and Decommissioning Offices	Building 200B
Process Water Line Valve House	Building 125
Filtered Water Storage Reservoir	Building 442

Note: Buildings with floor area less than 50m<sup>2</sup> are not included

## APPENDIX B: DEFINITIONS AND ACRONYMS

### 1. DEFINITIONS

The following is a list of definitions of words or expressions used in the LCH that may need clarification; they are defined for the purpose of the LCH only. All other terms and expressions used in the LCH are consistent with the definitions provided in the NSCA, the regulations made pursuant to the NSCA, or in the CNSC regulatory document REGDOC-3.6 *Glossary of CNSC Terminology*.

**Accept/ed/able/ance** – meets regulatory requirements, which mean it is in compliance with the documents referenced in the LCH.

**Approval** – Commission's permission to proceed, for situations or changes where the licensee would be:

- not compliant with a regulatory requirements set out in applicable laws and regulations;
- not compliant with a licence condition; and
- not in the safe direction but the objective of the licensing basis is met.

**Boundary Conditions** – procedural, administrative rules and operating limits for ensuring safe operation of the facility based on safety analyses and any applicable regulatory requirements.

**Certified Staff** – trained licensee staff, certified by the Commission as qualified to perform the duties of their respective roles.

**Compliance Verification Criteria** – regulatory criteria used by CNSC staff to verify compliance with the licence conditions.

**Design Basis** – the entire range of conditions for which the nuclear facility is designed, in accordance with established design criteria, and for which damage to the fuel and/or the release of radioactive material is kept within authorized limits.

**Disused Source** – a (radioactive) source that is no longer used, and is not intended to be used, for the practice for which a licence has been granted. Note that a disused source may still represent a significant radiological hazard. It differs from a spent source in that it may still be capable of performing its function; it may be disused because it is no longer needed. A disused source does not include spent reactor fuel.

**Effective Date** – the date that a given document becomes effective within the licensing period. The effective date is either set to the licence issue date or to a future date when the given document becomes effective.

**Extended Safe Shutdown State** – a shutdown state achieved after a facility has been declared shutdown pending a decision on possible re use or repurposing. The operating governing documentation covers this state.

**Guidance** – guidance in the LCH is non-mandatory information, including direction, on how to comply with the licence condition.

**Important to Safety** – items important to safety include, but are not limited to:

- (a) SSCs whose malfunction or failure could lead to undue radiation exposure of the facility/site personnel, or members of the public;
- (b) SSCs that prevent anticipated operational occurrences from leading to accident conditions;
- (c) those features that are provided to mitigate the consequences of malfunctions or failures of SSCs; and
- (d) tasks, duties, activities, aging mechanisms, findings, or any work that improperly performed could lead to radiation exposure of the facility/site personnel, or members of the public.

**Program(s)** – a documented group of planned activities, procedures, processes, standards and instructions coordinated to meet a specific purpose.

**Qualified Staff** – trained licensee staff, deemed competent and qualified to carry out tasks associated with their respective positions.

**Safe Direction** – changes in facility safety levels that would not result in:

- (a) a reduction in safety margins;
- (b) a breakdown of barrier;
- (c) an increase (in certain parameters) above accepted limits;
- (d) an increase in risk;
- (e) impairment(s) of safety systems;
- (f) an increase in the risk of radioactive releases or spills of hazardous substances;
- (g) injuries to workers or members of the public;
- (h) introduction of a new hazard;
- (i) reduction of the defence-in-depth provisions;
- (j) reducing the capability to control, cool and contain the reactor while retaining the adequacy thereof; or
- (k) causing hazards or risks different in nature or greater in probability or magnitude than those stated in the safety analysis of the nuclear facility.

**Safety and Control Measures** – measures or provisions which demonstrate that the applicant:

- (i) is qualified to carry on the licensed activities; and
- (ii) has made adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and any measures required to implement international obligations to which Canada has agreed.

**Written Notification** – a physical or electronic communication between CNSC staff and a person authorized to act on behalf of the licensee.

## 2. ACRONYMS LIST

Acronym	Definition
ACC	Prior CNSC acceptance of change is required
AECB	Atomic Energy Control Board
AECL	Atomic Energy of Canada Limited
AIA	Authorized Inspection Agency
ALARA	As Low As Reasonably Achievable
ALI	Annual Limit of Intake
ASME	American Society of Mechanical Engineers
CAF	Change Approval Form
CECEUD	Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation
CNEA	Canadian National Energy Alliance
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CRL	Chalk River Laboratories
CSA	Canadian Standards Association
CSD	Criticality Safety Document
DDP	Detailed Decommissioning Plan
DG-DNCFR	Director General, Directorate of Nuclear Cycle and Facilities Regulations
EOC	Emergency Operations Centre
EOP	Emergency Operating Procedures
FISST	Fissile Solution Storage Tank
GBI	Gamma Beam Irradiator
IAEA	International Atomic Energy Agency
LCH	Licence Conditions Handbook
LII	List of Inventory Items
MAPLE	Multipurpose Applied Physics Lattice Experimental (reactor)
MOU	Memorandum of Understanding
NPF	New Processing Facility
NRU	National Research Universal
NRX	National Research Experimental
NSCA	Nuclear Safety and Control Act
NSDF	Near Surface Disposal Facility

<b>Acronym</b>	<b>Definition</b>
NT	Notification at time of making the change
PKMPIS	Physical Key Measurement Point Inventory Summary
PN	Prior Notification
PNERP	Provincial Nuclear Emergency Response Plan
PSA	Probabilistic Safety Assessment
PTNSR	Packaging and Transport of Nuclear Substances Regulations, 2015
SAMG	Severe Accident Management Guidelines
SMAGS	Shielded Modular Above Ground Structures
SSC	Structure, System, Component
SWS	Storage with Surveillance
TDGR	Transportation of Dangerous Goods Regulations
TLD	Thermoluminescent Dosimeter
USL	Upper Subcritical Limit
ZED	Zero Energy Deuterium



## **CURRENT LICENCE**

The current Licence is provided on the following pages of the document.

e-Doc 4934165 (WORD)

e-Doc 4935578 (PDF)







**NUCLEAR RESEARCH AND TEST ESTABLISHMENT  
OPERATING LICENCE  
CHALK RIVER LABORATORIES**

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**I) LICENCE NUMBER:** NRTEOL-01.00/2018

**II) LICENSEE:** Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:

**Canadian Nuclear Laboratories Limited  
Laboratoires nucléaires canadiens limitée  
286 Plant Road  
Chalk River, Ontario  
K0J 1J0**

**III) LICENCE PERIOD:** This licence is valid from JUL 06 2016  
to **March 31, 2018**, unless suspended in whole or in part,  
amended, revoked or replaced.

**IV) LICENSED ACTIVITIES:**

This licence authorizes the licensee to operate, as further defined in paragraphs (a) to (i) below, the Chalk River Laboratories (hereinafter "CRL") located in the Town of Deep River, County of Renfrew, Province of Ontario:

- (a) operate, wholly or in part, any nuclear facility;
- (b) maintain in storage with surveillance any nuclear facility, or any parts thereof;
- (c) decommission any nuclear facility, or any parts thereof;
- (d) construct, modify or abandon any nuclear facility;
- (e) produce, possess, process, refine, transfer, use, package, manage, store, dispose or abandon nuclear substances;
- (f) produce, possess, use, service, transfer or abandon prescribed equipment;
- (g) possess, use, transfer or abandon prescribed information;
- (h) process, store or dispose of waste received from offsite clients; and
- (i) receive, repair, modify, store and return contaminated equipment from offsite clients.

## **V) INTERPRETATION:**

- (a) Where in the conditions set out in this licence the Commission requires any matter to be approved, the Commission may
  - (i) modify, revise or withdraw either wholly or in part any such approval;
  - (ii) approve, either wholly or in part, any modification or revision or any proposed modification or revision to any matter for the time being approved;
  - (iii) delegate the approval authority for (a) and/or (b) to a person or to an authority identified by the Commission for that purpose.
- (b) In the conditions set out in this licence any reference to any approval, consent, notification or any formal communication between the Commission or CNSC staff and the licensee (and vice versa) shall be deemed to be a reference to a written document.
- (c) The Chalk River Laboratories Licence Conditions Handbook (hereinafter “CRL Handbook”) provides
  - (i) compliance verification criteria in order to meet the conditions set out in this licence;
  - (ii) information regarding delegation of authority to CNSC staff; and
  - (iii) applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria.
- (d) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* (hereinafter “NSCA”) and associated regulations.
- (e) The appendix attached to this licence forms part of the licence.
- (f) The licensee may use a graded approach to compliance with the licence.

## **VI) CONDITIONS:**

### **1. GENERAL**

#### **1.1 Licensing Basis**

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis for the CRL facilities.

#### **1.2 Changes to CRL**

The licensee shall ensure that all changes to CRL are appropriately designed, reviewed, controlled and implemented, and that all safety requirements are met.

### **1.3 CRL Site**

The licensee shall not change the ownership, possession or use of lands described in the Ontario Land Registry under the PINs 57075-0003(LT), 57074-0021(LT) and 57076-0049(LT) without the prior approval of the Commission.

### **1.4 Office Space for Onsite CNSC Staff**

The licensee shall provide, at the CRL site and at no expense to the Commission, office space for employees of the Commission who customarily carry out their functions on the premises of the CRL site.

### **1.5 Resolution of Conflicts or Inconsistencies**

The licensee shall, in the event of any conflict or inconsistency between licence conditions, codes or standards or regulatory documents used as compliance verification criteria in the CRL Handbook, direct the conflict or inconsistency to the Commission or to a person authorized by the Commission for resolution.

## **2. MANAGEMENT SYSTEM**

### **2.1 Management System**

The licensee shall implement and maintain a management system, including a written safety policy which places safety paramount within the management system, overriding all other demands, for activities carried out under this licence.

### **2.2 Management of Safety**

The licensee shall monitor the safety performance of the CRL facilities and upgrade them when substantial risk factors not recognized earlier appear during operation, or through research findings, or revised safety analyses.

### **2.3 Licensee Organization**

The licensee shall have an operating organization adequate to support safety and an appropriate response in emergencies.

## **3. HUMAN PERFORMANCE MANAGEMENT**

### **3.1 Human Performance Program**

The licensee shall implement and maintain a human performance program.

### **3.2 Training**

The licensee shall establish and maintain an overall training policy and initial and continuing training programs on the basis of long-term qualifications and competencies required for performing a job, and training goals that acknowledge the critical role of safety.

### **3.3 Staffing and Certification – NRU Reactor**

The licensee shall ensure that persons appointed to the positions of Senior Reactor Shift Engineer or of NRU Health Physicist hold certifications in accordance with the requirements of the NSCA.

### **3.4 Minimum Staffing Requirements**

The licensee shall have on site and at all times a sufficient number of qualified staff for both normal operation and to respond to accident and emergency conditions.

## **4. OPERATING PERFORMANCE**

### **4.1 Operations**

The licensee shall operate the facilities at the CRL site subject to the terms and conditions and within the limits specified in the operational limits and conditions documents.

### **4.2 New Nuclear Facilities**

The licensee shall only carry out construction and/or operation activities of any new nuclear facility at the CRL site with the prior approval of the Commission.

### **4.3 Nuclear Facilities in Storage-with-Surveillance State**

The licensee shall undertake maintenance, monitoring and surveillance activities for nuclear facilities in storage-with-surveillance state in accordance with documented plans and procedures.

### **4.4 Nuclear Facilities Undergoing Decommissioning Activities**

The licensee shall only decommission a nuclear facility, or any part thereof, at the CRL site in accordance with documented decommissioning plan(s) and procedures, and with the prior approval of the Commission to proceed with the decommissioning.

### **4.5 Modifications to Existing Facilities and Processes**

The licensee shall ensure that permanent and temporary modifications to systems, structures, equipment, component and software important to safety are adequately designed, reviewed, controlled and implemented, including the compliance with relevant safety requirements.

### **4.6 Operational Limits and Conditions**

The licensee shall develop, implement and maintain operational limits and conditions to ensure the CRL facilities are operated in accordance with design assumptions and design intent as documented in applicable safety analyses.

#### **4.7 Emergency Operating Procedures and Severe Accident Management**

The licensee shall develop, implement and maintain, where applicable, a comprehensive set of emergency operating procedures for design basis accidents and beyond design basis accidents, and guidelines for severe accident management.

#### **4.8 Nuclear Criticality Safety**

The licensee shall implement and maintain a nuclear criticality safety program to ensure that the upper subcritical limits will not be exceeded under both normal and credible abnormal conditions (events or event sequences having the frequency of occurrence equal to or more than  $10^{-6}$ /year) during operations with fissionable materials outside reactors.

#### **4.9 Pressure Boundary**

The licensee shall implement and maintain a pressure boundary program.

#### **4.10 Authorized Inspection Agency**

The licensee shall have a formal agreement with an Authorized Inspection Agency, designated by the Commission as authorized to register designs and procedures, perform inspections, and perform other defined functions at the CRL site.

#### **4.11 Fire Protection**

The licensee shall implement and maintain a fire protection program to address fire protection and prevention at the CRL site.

#### **4.12 Operational Experience Program**

The licensee shall develop, implement and maintain a program to collect, screen, analyze and document operating experience and events at the CRL site or reported by industry in a systematic way, and to apply the lessons learned to activities at the CRL site.

#### **4.13 Sealed Sources**

The licensee shall maintain an accurate inventory of their sealed sources, both in use and in storage, and provide details of this inventory when requested.

#### **4.14 Chemistry Control**

The licensee shall implement and maintain a chemistry control program at the CRL site.

#### **4.15 Reporting of Unplanned Situations or Events**

The licensee shall report to the Commission unplanned situations or events at the CRL site.

#### **4.16 Reporting of Annual Compliance Monitoring and Operational Performance**

The licensee shall submit annual compliance monitoring and operational performance reports to the Commission.

## **5. SAFETY ANALYSIS**

### **5.1 Safety Analysis (Assessment)**

The licensee shall conduct and maintain safety analyses that are of appropriate detail for the complexity of the facility or process analyzed.

## **6. PHYSICAL DESIGN**

### **6.1 Physical Design**

The licensee shall ensure that the defence-in-depth principle is applied in the design of new or modified nuclear facility at the CRL site in order to prevent, or if prevention fails, to mitigate the consequences resulting from radioactive releases.

## **7. FITNESS FOR SERVICE**

### **7.1 Maintenance, In-Service Inspection and Functional Testing**

The licensee shall develop, implement and maintain documented programs of maintenance, testing, surveillance, and inspection of structures, systems and components important to safety to ensure that their availability, reliability and functionality remain in accordance with the design over the lifetime of the facility.

### **7.2 Frequency of Calibration of Radiation Detection Instruments**

The licensee shall calibrate all monitoring instruments and associated/related equipment used to make radiation protection and environmental protection measurements such as radiation dose, dose rate, activity or radionuclide concentration when first taken into use; after any damage to or servicing (excluding battery changes) of the instrument; at any time the instrument's response is suspected of being incorrect; and within 12-month intervals thereafter or as specified by the manufacturer if the specified interval is shorter.

### **7.3 Control of Measuring and Test Equipment**

The licensee shall ensure that tools, gauges, instruments and other measuring and testing devices used in activities affecting safety, security or quality are properly controlled, calibrated and adjusted at specified periods to maintain accuracy within necessary limits.

### **7.4 Aging Management**

The licensee shall develop, implement and maintain an aging management program for nuclear and support facilities at the CRL site to identify all aging mechanisms relevant to structures, systems and components important to safety; to evaluate their possible consequences; and to provide direction for the activities required to maintain the operability and reliability of these structures, systems and components.

## **7.5 Environmental Qualification**

The licensee shall develop, implement and maintain an environmental qualification program at the CRL site.

## **8. RADIATION PROTECTION**

### **8.1 Radiation Protection Program**

The licensee shall implement and maintain a radiation protection program at the CRL site.

### **8.2 Occupational Radiation Exposure Action Levels**

The licensee shall notify the Commission within seven calendar days of becoming aware that an occupational radiation exposure action level has been reached, and shall submit a detailed report to the Commission within 60 calendar days of becoming aware of the matter.

## **9. CONVENTIONAL HEALTH AND SAFETY**

### **9.1 Occupational Health and Safety Program**

The licensee shall implement and maintain an occupational health and safety program for the CRL site.

## **10. ENVIRONMENTAL PROTECTION**

### **10.1 Environmental Management System**

The licensee shall implement and maintain an environmental management system, including an integrated environmental monitoring program that includes site-wide groundwater monitoring.

### **10.2 Release of Radioactive Substances**

The licensee shall control, monitor and record releases of radioactive nuclear substances from CRL such that the releases do not exceed the limits specified in Appendix A to this licence.

### **10.3 Release of Hazardous Substances**

The licensee shall control, monitor and record releases of hazardous substances.

### **10.4 Action Levels for Environmental Releases**

The licensee shall notify the Commission within seven calendar days of becoming aware that an action level for environmental releases has been reached, and shall submit a detailed report to the Commission within 60 calendar days of becoming aware of the matter.

## **10.5 Environmental Assessment Follow-up Program**

The licensee shall progress to completion all follow-up programs identified as a result of environmental assessments, and shall report the progress to the Commission on an annual basis.

## **11. EMERGENCY MANAGEMENT AND FIRE RESPONSE**

### **11.1 Emergency Management Program and Fire Response**

The licensee shall implement and maintain an emergency management program to prepare for and respond to emergency events, including fires, initiating at or impacting the licensed site, and for dealing with both the onsite and offsite effects of such emergencies.

## **12. WASTE MANAGEMENT**

### **12.1 Waste Management**

The licensee shall implement and maintain a waste management program documenting handling, processing, transportation, storage and safeguarding of nuclear wastes, including spent fuel and nuclear wastes mixed with other hazardous substance.

### **12.2 Decommissioning**

The licensee shall maintain a comprehensive preliminary decommissioning plan for the CRL site, and shall review and revise the plan at such times as the Commission may require and in any event, no later than ten years from previous revision.

### **12.3 Nuclear Legacy Liabilities**

The licensee shall ensure that nuclear legacy liabilities at the CRL site are addressed.

## **13. SECURITY**

### **13.1 Nuclear Security Program**

The licensee shall implement and maintain a nuclear security program to prevent persons from carrying out malevolent actions capable of affecting the safe operation of CRL facilities.

### **13.2 Nuclear Response Force**

The licensee shall maintain, train, test, equip and deploy a nuclear response force at the CRL site.

### **13.3 Nuclear Security Officer Fitness for Duty**

The licensee shall implement and maintain a program for medical, physical and psychological fitness of security officers employed at the CRL site.



## **14. SAFEGUARDS**

### **14.1 Safeguards Program**

The licensee shall implement and maintain a safeguards program and undertake all measures required to ensure safeguards implementation at the CRL site.

### **14.2 Changes that Would Affect the Implementation of Safeguards Measures**

The licensee shall not, except with the prior approval of the Commission or a person authorized by the Commission, make changes to any aspect of CRL or its operation, equipment or procedures that would affect the implementation of safeguards measures.

## **15. PACKAGING AND TRANSPORT**

### **15.1 Packaging and Transport Program**

The licensee shall implement and maintain a program for the packaging and transport of nuclear substances and radiation devices to and from the CRL site or between CRL facilities.

## **16. NUCLEAR FACILITY SPECIFIC**

### **16.1 NRU Reactor Integrated Safety Review Implementation Plan**

The licensee shall progress to completion the improvements identified during the NRU Reactor Integrated Safety Review, and shall report the status to the Commission every three months.

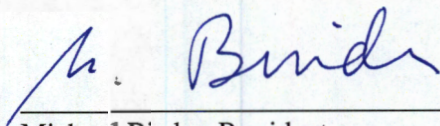
### **16.2 Public Information and Disclosure**

The licensee shall implement and maintain a public information program including a public disclosure protocol. The public disclosure protocol shall address routine radiological and hazardous emissions, and non-routine items or events at the CRL site.

### **16.3 Financial Guarantee**

The licensee shall maintain in effect a financial guarantee for decommissioning of CRL that is acceptable to the Commission.

SIGNED at OTTAWA, this 6<sup>th</sup> day of July 2016.



Michael Binder, President  
on behalf of the Canadian Nuclear Safety Commission

## APPENDIX A

### Release Limits for Radioactive Nuclear Substances to the Environment from Chalk River Laboratories

1. The dose to the critical group due to the sum of all releases in any period of 12 consecutive months shall not exceed 0.3 mSv.
2. The release of nuclear substances to the environment from Chalk River Laboratories shall not exceed the limits specified below.

Release Category	Radionuclide	Release Limit (Bq/year)
<b>Airborne Releases</b>		
	Argon-41	6.60E+16
	Carbon-14	2.14E+15
	Tritium Oxide	1.25E+16
	Iodine-131	3.96E+12
	Mixed Noble Gases*	4.96E+16
<b>Liquid Releases</b>		
	Tritium Oxide	1.03E+17
	Gross Alpha	1.32E+12
	Gross Beta**	2.70E+13

\* The releases of Mixed Noble Gases are measured in BqMeV.

\*\* Gross Beta for liquid releases includes Sr-90 and other radionuclides, predominantly short-lived activation products such as Zn-65, Ru-106, Ba-140, Fe-59, Sc-46, Ce-143, Np-239 and Nb-95.