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**Written submission from the
Canadian Nuclear Laboratories**

**Mémoire des Laboratoires
Nucléaires Canadiens**

Canadian Nuclear Laboratories

Laboratoires Nucléaires Canadiens

**Mid-Term Update of Licensed
Activities for the Chalk River
Laboratories Site**

**Rapport de mi-parcours au sujet
des activités autorisées sur le site des
Laboratoires de Chalk River**

Commission Meeting

Réunion de la Commission

November 1, 2023

1er novembre 2023

Chalk River Laboratories Midterm Update

2023



Canadian Nuclear Laboratories | Laboratoires Nucléaires
Canadiens

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Commission Member Document for Information

Chalk River Laboratories Midterm Update 2023

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Canadian Nuclear Laboratories respectfully acknowledges that the Chalk River Laboratories site is located on the unceded and unsurrendered territory of the Algonquin Anishinaabe Nation. CNL recognizes and appreciates their historical connection to this land and their role as customary keepers and defenders of the Ottawa River and its tributaries.

CNL recognizes the contributions that all First Nations, Métis, and Inuit peoples have made, and continue to make, in shaping this land we now know as Canada. CNL management and staff acknowledge, respect, and seek to better understand unique Indigenous history, rights, and titles on the lands where we work. We remain firmly committed to being an active participant on Canada's journey towards healing and reconciliation.



Executive Summary

Canadian Nuclear Laboratories (CNL) is Canada's premier nuclear science and technology organization. CNL's dedicated staff of over 4,200 employees continue to be our primary asset. The commitment, dedication and technical excellence of our personnel is key to establishing CNL as a leader in nuclear science and technology research, including providing the world with cleaner and sustainable energy, improving the health of the world's population through the development of advanced life-saving cancer treatments and tackling some of the world's most challenging environmental problems.

To help the Government of Canada achieve its national target of net-zero emissions by 2050, CNL is advancing clean energy technologies for today and tomorrow, including small and advanced nuclear reactors, hydrogen, and fusion technologies. Given CNL and its predecessor's historical involvement with CANDU® reactor technology, CNL has the necessary skills, facilities and expertise to pursue next generation energy solutions to fight climate change and bring energy security to all Canadians.

CNL's researchers were pioneers in nuclear medicine and leaders in Cobalt-60 and Molybdenum-99 radioisotopes, both crucial in the collective effort to save lives and fight cancer. Now, CNL's teams are working on new targeted radiopharmaceuticals that kill cancer at the source without exposing patients to chemotherapy, avoiding some of the negative effects of nuclear medicine.

And importantly, CNL is doing all this while safely addressing the nuclear industry's early environmental legacy and building a cleaner and more sustainable path for the future.

This Commission Member Document focuses on the operations and activities of CNL's Chalk River Laboratories (CRL). Following a three-day public hearing in Pembroke, Ontario, in 2018, the Canadian Nuclear Safety Commission (CNSC) granted a 10-year renewal of the CRL Nuclear Research and Test Establishment Operating Licence. The current licence, valid until 2028 March 31, authorizes CNL to operate CRL and its 11 Class I and four Class II nuclear facilities, and to construct, commission and modify the existing facilities at the CRL site. The licence also allows CNL to transition to and maintain facilities in safe shutdown and storage-with-surveillance states, decommission and demolish these facilities, and remediate lands on the site.

A midterm update providing an overview to the Commission of CRL's licensed activities and achievements over the past five years is required by the CNSC as part of the licence. This update will provide an overview of the CRL site and activities including site revitalization, Indigenous engagement, and public and stakeholder engagement. It will also describe CNL's three main strategic priorities and provide updates on key safety and control areas. The update will be shared with the public, local communities, municipal administrations and Indigenous Nations, communities and organizations.

As the birthplace of Canada's nuclear research in 1944, CRL has been home to some of the world's most exciting advances in nuclear science and technology. It is situated within the unceded ter-

ritory of the Algonquin Anishinaabe Nation. The CRL site is located on lands covered by the Williams Treaties 1923 and lands currently subjected to modern treaty negotiations between Canada and the Algonquins of Ontario. CRL is located in Renfrew County (population 106,000) in the Province of Ontario, adjacent to the communities of Chalk River and Deep River, on the southern shore of the Ottawa River.

CNL's major achievements at the CRL site in the last five years include:

- Tackling nuclear legacy and historical waste risks and issues;
- Expanding science and technology capabilities; and
- Expanding nuclear research and development.

Over the past five years, CNL has been reshaping how it will fit into the future of the Canadian nuclear industry. CRL will continue to advance nuclear science and technology to support the needs of the Government of Canada; restore and protect Canada's environment by reducing and effectively managing nuclear liabilities; provide the world with sustainable energy solutions including the extension of reactor operating lifetimes, hydrogen energy technologies, and fuel development for the reactor designs of tomorrow; and work collaboratively with medical/educational institutions and pharmaceutical companies to pioneer new alpha therapies for cancer treatments with the potential to save countless lives.

CNL remains committed to achieving high standards of operational safety and security through its core values: Safety, Respect, Teamwork, Accountability, Integrity and Excellence. Over the past five years, CNL has continued to carry out all licensed activities at the CRL site safely and securely. No member of the public has received a radiation dose exceeding any regulatory limit, and no CNL employees or contractor staff have received a dose in excess of any of the respective dose limits for radiation workers. All releases of radioactive material were below release limits approved by the CNSC. CNL's goal is to not only continue to operate safely, but to ensure its own high standards are exceeded.

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1. Introduction

As Canada's premier nuclear science and technology laboratory, CNL is a world leader in the development of innovative nuclear science and technology products and services. Guided by an ambitious corporate strategy known as Vision 2030, CNL fulfills three strategic priorities of national importance – restoring and protecting the environment, advancing clean energy technologies, and contributing to the health of Canadians.

By leveraging the assets owned by Atomic Energy of Canada Limited (AECL), CNL also serves as the nexus between government, the nuclear industry, the broader private sector and the academic community. CNL works in collaboration with these sectors to advance innovative Canadian products and services towards real-world use, including carbon-free energy, cancer treatments and other therapies, non-proliferation technologies and waste management solutions.

CNL currently maintains a [Nuclear Research and Test Establishment Operating Licence \(NRTEOL-01.00/2028\)](#) for its Chalk River Laboratories (CRL) site located in Renfrew County in the Province of Ontario on the southern shore of the Ottawa River, approximately 200 km northwest of Ottawa (Figure 1).

Per the Canadian Nuclear Safety Commission's (CNSC) [Record of Decision for the Chalk River Laboratories Licence Renewal](#), issued 2018 March 28, CNL is presenting to the Commission a comprehensive midterm update on CRL's licensed activities for the first half of the 10-year licensing period.

1.1 Chalk River Laboratories

CRL is situated on the unceded territory of the Algonquin Anishinaabe Nation. CRL is located on lands covered by the Williams Treaties 1923 and lands currently subjected to modern treaty negotiations between Canada and the Algonquins of Ontario. CRL is located in Renfrew County in the Province of Ontario on the southern shore of the Ottawa River, approximately 200 km northwest of Ottawa (Figure 1 and Figure 2).

The site is over 3,800 hectares and is situated within the boundaries of the Corporation of the Town of Deep River. The surrounding terrain consists of gently rolling hills interspaced with many small lakes, except for the Laurentian Mountains directly north and east across the Ottawa River. Canadian Forces Garrison Petawawa abuts the CRL site to the southwest. Most of the nuclear and associated support facilities and buildings are located in a relatively small built-up area of approximately 48 hectares adjacent to the Ottawa River (Figure 3). Various waste management areas for radioactive and non-radioactive wastes, which comprise another 32 hectares, are located within the CRL site along Plant Road, which leads from the Village of Chalk River to the built-up area of the site. Access to the CRL site is limited to CNL employees, authorized contractors and authorized visitors.

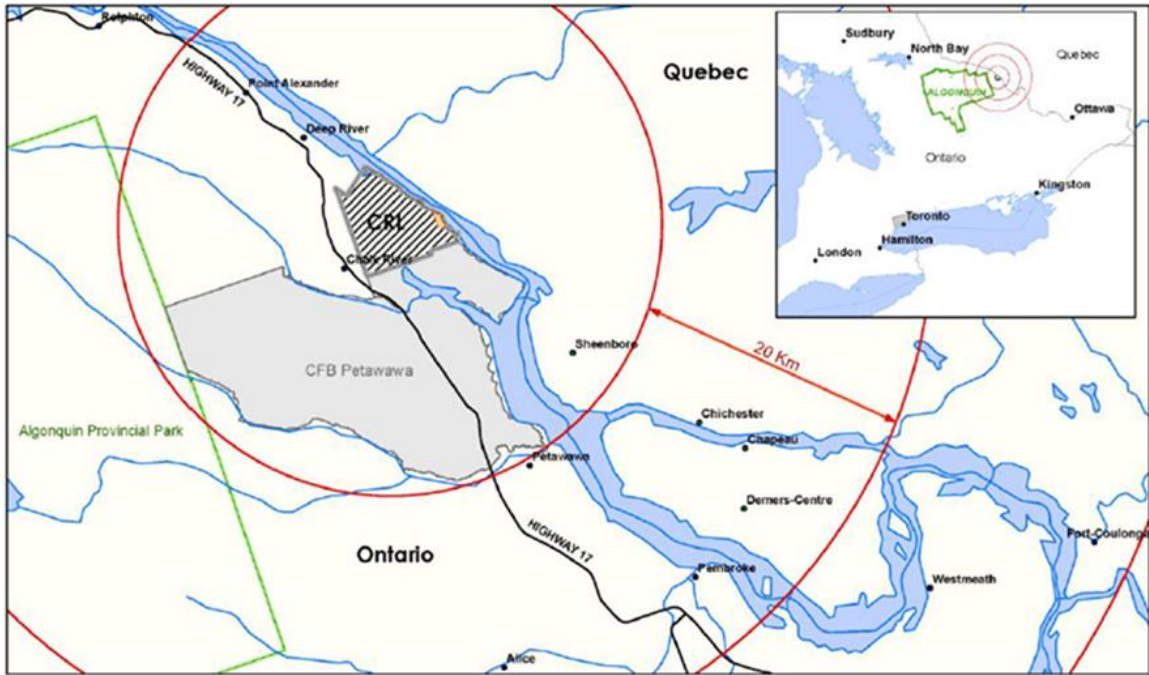


Figure 1: CRL Location Including Nearby Population Centres

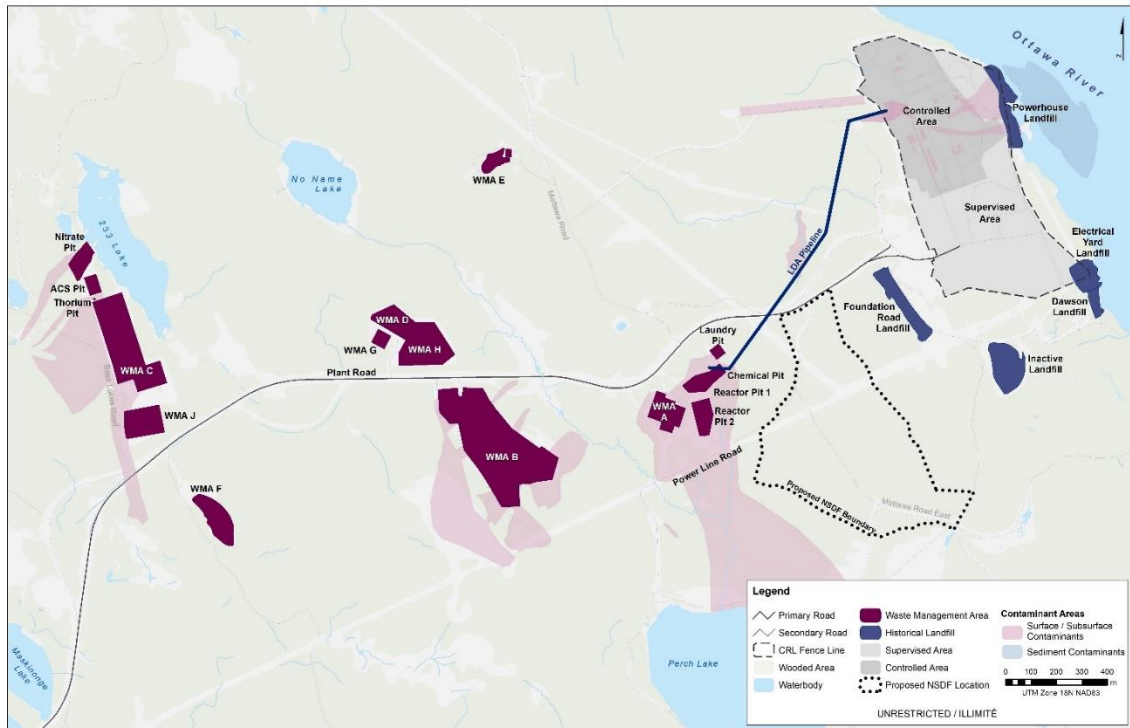


Figure 2: CRL Site with Built-up Area and Waste Management Areas



Figure 3: CRL Built-up Area

The CRL site represents the largest single complex within Canada’s science and technology infrastructure. The site contains 11 Class I nuclear facilities, four Class II nuclear facilities and more than 50 other unique laboratories (Table 1). The CRL site is also in the processes of preparing or decommissioning legacy Class I nuclear facilities and many ancillary and support buildings and structures. See Appendix A for an update on CRL’s nuclear facilities.

Table 1: CRL Class I and Class II Nuclear Facilities

Class I Nuclear Facilities	
Nuclear Fuel Fabrication Facility	Recycle Fuel Fabrication Laboratory
Fuels and Materials Cells	Tritium Laboratory
Waste Treatment Centre	Universal Cells
Molybdenum-99 Production Facility	Waste Management Areas (WMA)
Zero Energy Deuterium (ZED-2) Reactor	National Research Universal (NRU) Reactor
Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation Test Facility	
Class II Nuclear Facilities	
Health Physics Neutron Generator	Van de Graaff Electron Accelerator
Gamma Beam Irradiation Facility	Gamma Beam Irradiator

CNL ensures that the facilities run in accordance with their operating limits and conditions, facility authorizations, detailed decommissioning plans, storage-with-surveillance plans, and/or labora-

tory protocols. CNL has reported any non-compliances identified during the operation of the facilities and laboratories to CNSC staff, as required, and listed these occurrences on the CNL [Events](#) website.

The overall performance of the nuclear facilities is reviewed and assessed quarterly by CNL's Nuclear Performance Assurance Review Board. This includes the review of findings from internal audits and assessments of the facility operations, findings from CNSC Inspections and other third-party assessments, along with detailed examinations and assessments across all Safety and Control Areas.

1.2 Update on Government-Owned, Contractor-Operated Model

As a federal Crown corporation, Atomic Energy of Canada Limited (AECL) receives funding from the Government of Canada to enable the development of nuclear science and technology, and to manage the Government of Canada's radioactive waste liabilities.

Since 2015, AECL has delivered this mandate through a government-owned, contractor-operated model. CNL, as a private sector organization, is responsible for managing and operating AECL's sites. With this arrangement, both AECL (owner) and CNL (operator) are the enduring entities, with the contractor being either renewed or replaced through a competitive procurement process (Figure 4).

Under the government-owned, contractor-operated model, AECL owns the sites, facilities, assets, intellectual property and responsibility for environmental remediation and radioactive waste management. CNL is responsible for the day-to-day operations of the sites, employment of the workforce and all licences and permits.

This arrangement provides AECL the private sector expertise to achieve the best possible outcomes for the Decommissioning and Waste Management Program, advancing clean energy and contributing to the health of Canadians through nuclear science and technology, and to transform CRL into a world-class nuclear facility – all while reducing costs and risks to Canadians.

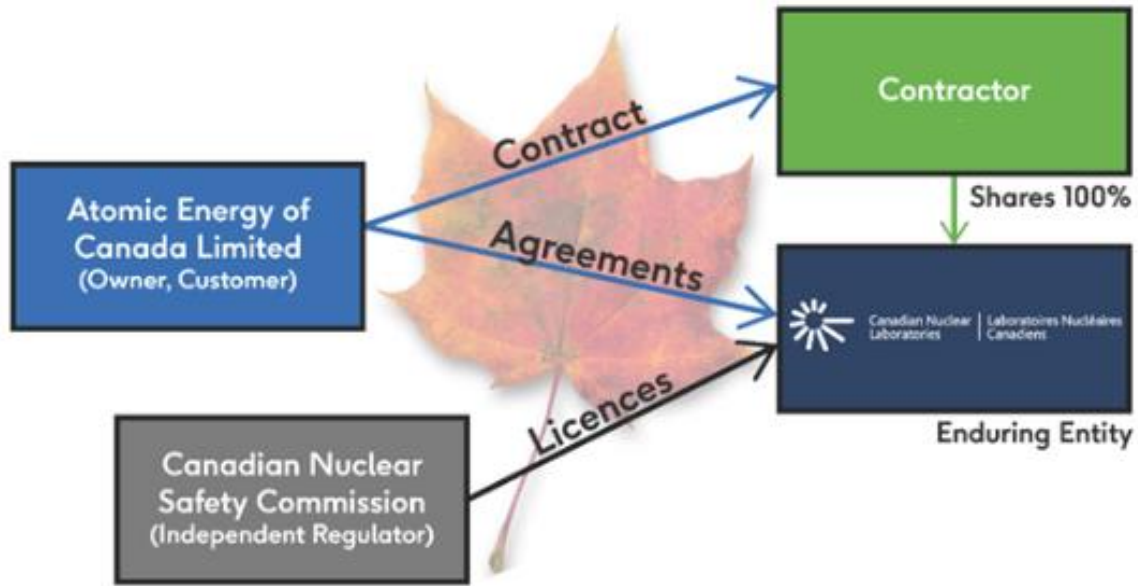


Figure 4: CNL and AECL Government-Owned, Contractor-Operated Model

In 2023 February, AECL launched a competitive procurement process to continue the management of CNL beyond the current contract, which will expire in 2025 September.

The objective of the procurement is to enter into a contract that will reduce and/or contain costs and risks for Canadian taxpayers while leveraging CNL’s capabilities and resources for the benefit of Canadians.

As the owner, AECL sets the priorities for CNL. As the enduring entity, CNL will continue to be responsible for operating CRL under the current operating licence and ensuring CNL’s [Vision2030](#) is accomplished. This procurement process will not affect CNL’s ongoing work, projects or priorities, and CNL will remain the licence holder for CRL.

As part of building a sustainable executive team, CNL has appointed Deputy Vice Presidents within all the Missions in order to provide additional oversight of the delivery of services. These Deputy Vice Presidents have been selected from CNL staff and will remain in place to maintain continuity of knowledge should the government-owned, contractor-operated contract be awarded to a new organization.

1.3 Sustainability

CNL acknowledges that actions taken today have consequences for tomorrow. That is why, as an organization, CNL continues to work to incorporate Environmental, Social and Governance strategies into all operations, programs and projects. CNL established a preliminary implementation plan for achieving its Environmental, Social and Governance Sustainability targets under 14 focus areas outlined in Figure 5. This long-term plan presents CNL’s sustainability efforts that support Environmental, Social and Governance goals through each of its missions. In 2023 and beyond, CNL will put the implementation plan into action and ensure rigorous reporting on performance,

including involvement in the Task Force on Climate-Related Disclosures and Global Reporting Initiative reporting.

To reinforce this commitment, CNL publicly released its first annual [Sustainability Report](#) in 2021 June and it's [second report](#) in 2022 November, which highlight key achievements and targets under each of the 14 focus areas. The key targets include items such as:

- Waste diversion in line with the AECL’s Environment, Social and Governance Strategy on radioactive waste management (section 4.1);
- Development of a Reconciliation Action Plan (section 3.1);
- Introduction of an Energy Efficiency Strategic Improvement Plan;
- Targets to protect Species at Risk and their habitats;
- Launch of an internal Diversity, Equity and Inclusion Program to help build a more productive, welcoming and respectful workforce; and
- Updates to the procurement policies to include sustainability requirements.



Figure 5: CNL’s Sustainability Focus Areas: Environmental, Social and Governance

A major component of the Sustainability Plan is a goal to achieve carbon neutrality on the CRL site by 2040 in support of the Government of Canada’s climate plan. CRL’s reduction in greenhouse gas emissions began in earnest by replacing #6 fuel oil in the Powerhouse with natural gas and continues with the development of a Carbon Neutral Strategy for the CRL site. Some of the key initiatives towards carbon neutrality are outlined in Figure 6.

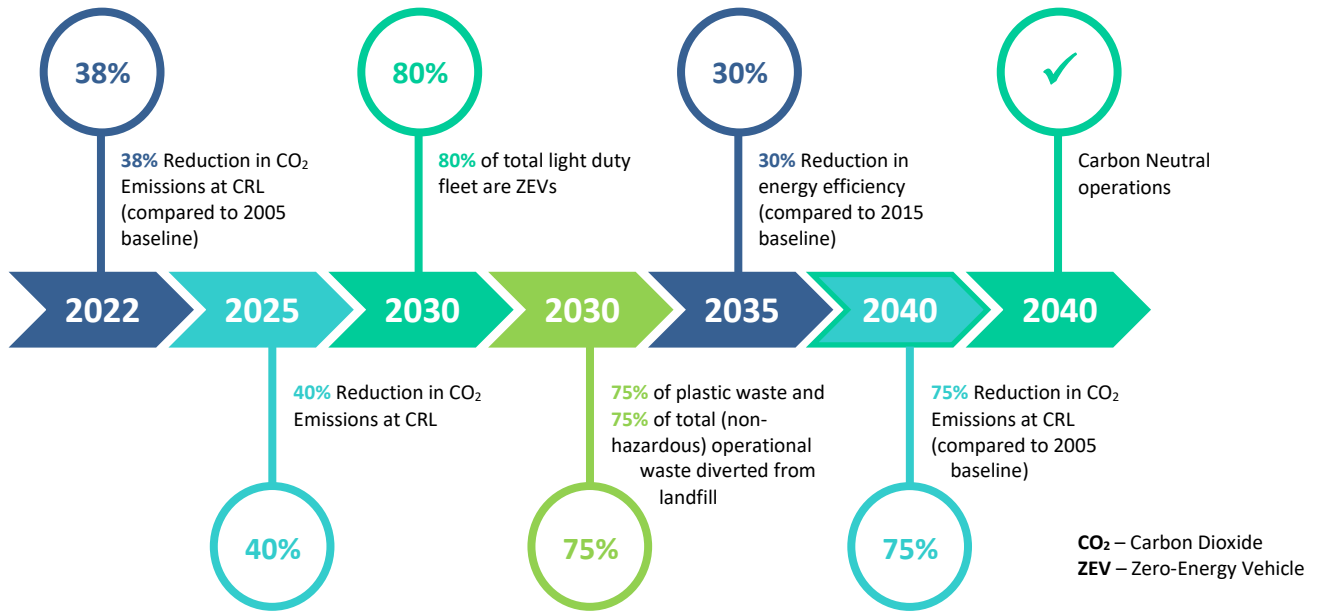


Figure 6: Key Initiatives Toward CRL's Carbon Neutrality

2. Revitalization of Chalk River Laboratories

The CRL site was established in the mid-1940s and has a history of various nuclear operations and facilities primarily related to research. For more than 75 years, CRL has achieved some of the world's most extraordinary advances in nuclear science and technology. These activities have led to the production of legacy radioactive and other hazardous wastes, which have been carefully managed in dedicated waste management areas (WMA). While the majority of the CRL site remains undisturbed, certain areas including the WMAs have been contaminated to varying degrees. As there remains buried waste that lacks engineered containment, localized contamination of soil and groundwater has occurred and remedial actions are required to reduce risks to the environment.

Over the years, CRL's infrastructure and research facilities have deteriorated. In order to maintain a leadership position on the world stage, and to address Canada's early environmental nuclear legacy, CNL has embarked on a massive transformation of the CRL site built-up areas using responsible decommissioning and radioactive waste management activities to clean up the site, protect the environment and make way for new buildings that will support the ongoing nuclear science and technology mission.

As part of the revitalization, legacy buildings are being safely decommissioned and modern research facilities and infrastructure are being erected in their place, transforming the site skyline and building the groundwork for a new era of scientific discovery and revitalizing a national icon (Figure 7).

The decommissioning and waste management activities ensure the protection of the environment, CNL's workforce and the public. These activities also create the space needed to accommodate cutting-edge research facilities and provide CNL with the necessary waste management, processing and disposal facilities to enable its scientific missions into the future.

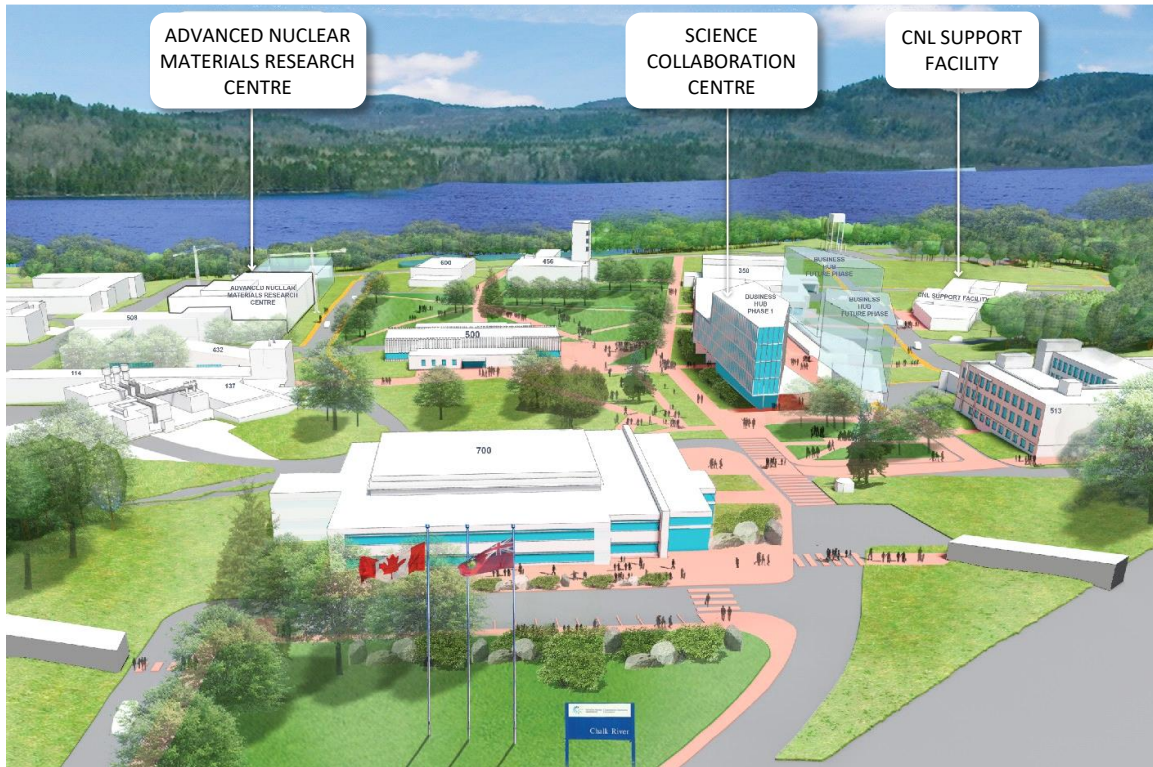


Figure 7: Partial View of Proposed CRL Site Revitalization

The scope of the CRL site revitalization includes:

- Construction new conventional and nuclear facilities;
- Modernization of current facilities; and
- Upgrading or replacing older CRL building infrastructure, utilities systems, information technology systems and software to ensure effective and efficient operation of such a large and complex site.

In 2022 January, CNL provided an update to the Commission on the future of CRL. The [presentation](#) included a [short video](#) on how CNL is transforming to meet challenges like climate change, global health, cybersecurity and energy independence, as well as CNL’s activities for the next decade: [Vision2030](#).

Figure 8 illustrates the timeline for the decommissioning, new construction and key functional (programmatic) updates that have occurred since re-licensing; Figure 9 shows the major activities anticipated at CRL over the remaining term of the licence.

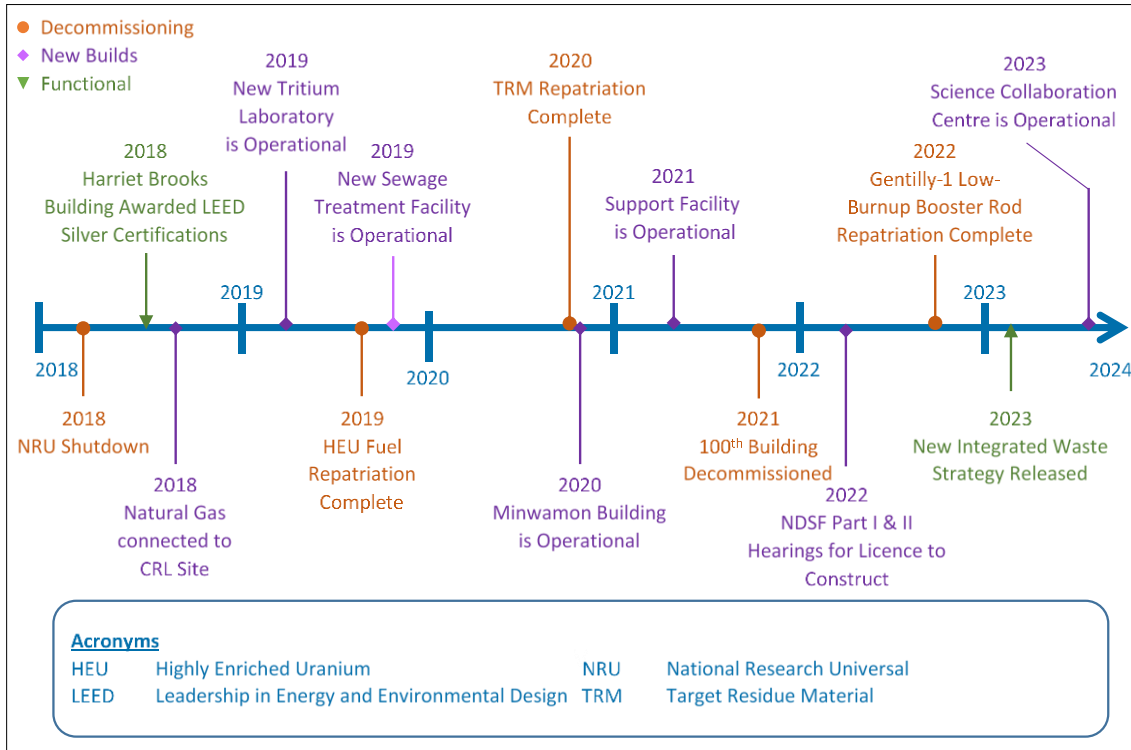


Figure 8: Timeline for CRL Major Activities, 2018 to 2023

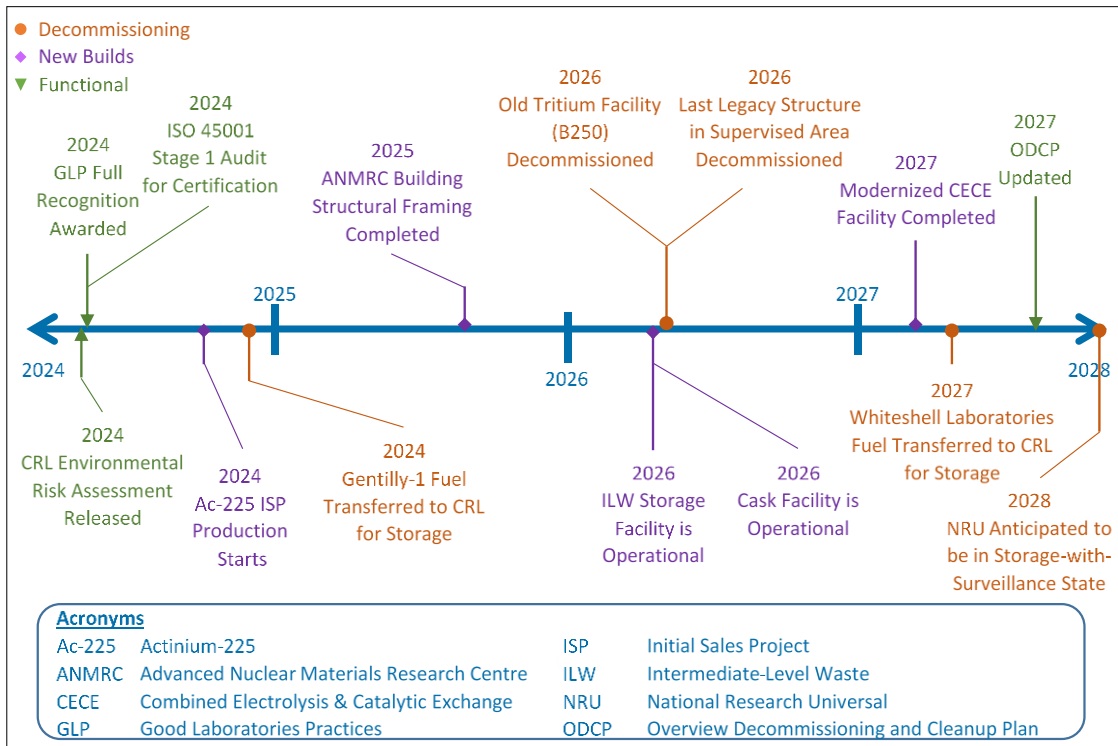


Figure 9: Timeline for Proposed CRL Major Activities, 2024 to 2028

2.1 Conventional New Builds

This transformation of the CRL site is already underway, and CNL is actively decommissioning aging infrastructure and building new, world-class buildings.



Formerly called the Logistics Warehouse, the **Minwamon Building**, meaning “Clear Path” in the Algonquin language, is the official site entry point to CRL. It was opened in the fall of 2020 and is the first of CNL’s new builds to be constructed out of [mass timber](#) (Figure 10). It replaced the previous site entry building, and in addition to housing CNL’s visitor and security check-in, it is also the supply chain and logistics hub. It replaces and consolidates multiple buildings across site and reduces vehicular traffic on Plant Road.



Figure 10: Stages of Construction - Minwamon Building

The **Support Facility**, the second of CNL’s mass timber builds, opened in the spring of 2021 (Figure 11). This facility is dedicated to maintenance and manufacturing activities, which were once spread throughout several buildings on site. It provides a more effectively designed workspace for instrumentation and control laboratories and electrical service, and streamlines CNL’s maintenance and manufacturing services.



Figure 11: Stages of Construction – Support Facility

The **Science Collaboration Centre**, is the third of CNL’s mass timber builds (Figure 12). The centre will serve as a central planning and collaboration space for CNL’s research programs. It will support CRL’s transformation by relocating important infrastructure such as science and technology supercomputing capabilities, a library, a new auditorium and a wide range of meeting facilities and office spaces. In 2023 March, CNL declared the facility weather-tight after installation of the windows. CNL anticipates scheduled completion of the Science Collaboration Centre in the fall of 2023.



Foundations of Science Collaboration Centre



Construction of Central Column



Nearly Complete Science Collaboration Centre



Figure 12: Stages of Construction – Science Collaboration Centre

2.2 New Nuclear Facilities

The **Harriet Brooks Building**, CNL’s materials science laboratory, was awarded [Leadership in Energy and Environmental Design Silver certification](#) in 2018 June (Figure 13). This achievement is aligned with the broader effort to create a more sustainable and energy-efficient site. This certification provides independent, third-party verification that a building was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health, sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.



Figure 13: Harriet Brooks Building

April of 2019 marked the transition of the [Tritium Laboratory](#) to a newly renovated modernized



Figure 14: Tritium Laboratory

laboratory space Figure 14(). This new space, together with the Harriett Brooks Building completed the Building 250 Relocation Project to remove, replace and modernize the laboratories and facilities in the aging building, allowing it to be transferred to decommissioning.

In August 2022, CNL broke ground and began construction of the **Advanced Nuclear Materials Research Centre (ANMRC)** in the CRL built-up area (Figure 15 and Figure 16). At over 2,700 m², the ANMRC will be the largest nuclear research facility in Canada. The ANMRC will consolidate key capabilities from several facilities such as the current shielded facilities (Universal Cells and Fuels and Material Cells), Recycle Fuel Fabrication Laboratory and CRL’s metallographic laboratories. It will feature 12 new shielded facilities to replace aging facilities that can then be decommissioned. The consolidation will enable examination and analysis of fuel components for Small

Modular Reactor and next-generation nuclear fuels in addition to glovebox facilities to support the development of advanced fuel fabrication concepts. The ANMRC will position CNL to effectively deliver its science and technology mission. It will support CNL’s clean energy goals through research into long-term reliability of power reactors, next generation nuclear technologies and critical research on Advanced Reactor and Small Modular Reactor fuels.



Figure 15: Advanced Nuclear Materials Research Centre (artist’s rendering)



Figure 16: Sub-foundation of the Advanced Nuclear Materials Research Centre

CNL has identified a need for a modern **Intermediate-Level Waste Storage Array** at CRL to provide an optimized safe solution for the intermediate-level radioactive waste storage needed to support CNL's operational needs. The site for the Storage Array will be within the current boundary area of WMA B and does not require the expansion of existing WMAs. The improvements over CRL's existing intermediate-level radioactive waste storage include a transition from aging below-grade bunkers to above-grade storage, a modernized loading process, and enhanced safety features and shielding. Completion of the Storage Array is anticipated for 2026, and the facility will be able to store up to 500 self-shielded containers for up to 50 years.

CNL owns and operates a fleet of casks to enable work in the Environmental Remediation Management and the science and technology missions. These casks are currently being stored and maintained outdoors and given the amount of waste transfers over the next few decades, a modern facility is needed to properly maintain and store these casks. The **Cask Facility**, currently in design, will allow for centralized receipt, maintenance and safe storage of all CNL's casks. The facility is expected to be completed in 2026 and will be operational for 50 years.

As part of the Tritiated Heavy Water Program, a **Modernized Combined Electrolysis and Catalytic Exchange** facility will be designed, constructed and operated. This will allow the production-scale operation to convert AECL's legacy inventory of tritium contaminated heavy water into two reusable products: detritiated heavy water and tritium gas immobilized as titanium tritide. Storing the tritium as a tritium tritide instead of as heavy water results in a reduction of risk since titanium tritide is a solid, is stable in air, and requires high temperatures to release the stored tritium inventory. There are a number of non-nuclear uses for heavy water and deuterium gas, such as use in manufacturing processes for novel Organic Light Emitting Diode and higher quality fibre-optic cables or semiconductors. In addition, deuterium can be substituted for hydrogen in some drug structures in order to slow the body's metabolism rate of the drug.

The modernized facility will be built to modern codes and standards, and include updates to safety, systems and components. The facility will be relocated adjacent to the Harriet Brooks Building on already disturbed land.

For additional facilities that are being developed to safely manage waste, see section 4.1.

2.3 Infrastructure and Facility Updates

CNL will complete the ongoing revitalization of existing assets to ensure they remain fit for purpose and service. It is anticipated that by 2026, the CRL site will have approximately a 50:50 ratio of newer, revitalized buildings compared to older operational buildings. CNL will be improving current building conditions so that they will be rated "good" under the industry standard facility condition index.

In 2019, a new 2,000 m² reservoir was constructed and commissioned just outside of the CRL built-up area. This reservoir supplies the CRL site with water from the Town of Deep River with the capability of providing potable water to the CRL facilities. A new water treatment system at the CRL reservoir is currently being designed. CRL's domestic water system achieved a certificate of conformance for the Quality Management System showing that CNL meets or exceeds the

requirements of the Drinking Water Quality Management Standards outlined in the *Safe Drinking Water Act*. In 2023 April, CNL declared that the water in all outer-area facilities is drinkable; the water supply for these buildings is from the Town of Chalk River. Over the next few years CNL is working to have all operational buildings on potable water.

The Powerhouse boilers were converted from firing #6 fuel oil, a heavy residual oil, to cleaner-burning natural gas in 2018. This switch resulted in a 30 % reduction in greenhouse gas emissions. The installation of two new 1,000 kW diesel-powered generators, a step-up transformer and an automatic transfer switch for upgrading the Class III (backup) power system at the Powerhouse was completed in 2023. This project ensures CRL's electrical supply is more robust during electrical events and also enables long-term energy cost reductions. In addition, a major revitalization of the Biological Research Facility laboratory and upgrades to the Industrial Hygiene Laboratory heating ventilation and air conditioning systems were completed.

As described in the [2018 Commission Member Document for the 2018 CRL Licence Renewal](#), the new Sanitary Sewer Treatment Facility was completed in 2018 and was declared operational in 2019. This upgrade was required to meet new regulations under the *Fisheries Act*. Storm Water Management upgrades and an expanded Bulk Material Landfill were also completed in 2018.

CNL continues to modernize and replace information technology systems, work that has included a new Environmental Data Management System, a waste data inventory system (eMWaste®) and a replacement Learning Management System (LearnCNL). The new Learning Management System is significant to worker safety and licence compliance as it governs, assigns, tracks, stores and reports training qualifications. CNL also began the Data Centre Relocation project, which required constructing a below-grade duct bank to relocate critical information technology infrastructure from a 1960s-era building, which is slated for decommissioning.

3. Indigenous and Public Engagement

3.1 Indigenous Engagement and Consultation

CNL recognizes and affirms all First Nations, Métis and Inuit communities in this land we now know as Canada. CNL acknowledges, respects, and seeks to better understand the unique Indigenous history, rights and title on the lands where CNL operates. CNL wishes to honour and respect the importance of the relationship between Indigenous peoples and their lands, waters and territories. As a commitment to continuous improvement in Indigenous Relations and building on our accomplishments to date, CNL is recognizing a movement to reconciliation as a corporate commitment to meaningful engagement, not solely within project activities, but rather in all that CNL does. CNL works closely with AECL in respect of its Indigenous Relations efforts, given the Government-owned, Contractor-operated model under which CNL operates.

CNL's movement to reconciliation is focused on Leadership and Governance, Relationships, People, Economic Empowerment and Environmental Stewardship. It is based in the true spirit of reconciliation, Canada's commitment to the United Nations Declaration on the Rights of Indigenous Peoples, Action #92 of the Truth and Reconciliation report, among other things. CNL is committed to building relationships and meaningfully engaging with Indigenous peoples on the activities and projects at CRL as part of the movement to reconciliation.

As part of CNL's implementation of Call to Action #92 from the Truth and Reconciliation Commission report, CNL developed an [Indigenous Relations Procurement Strategy](#) which aims to leverage our annual acquisition of goods and services in order to drive economic opportunities for interested Indigenous businesses whether through CNL's contractors or directly through the CNL supply chain. As part of this strategy, CNL is preparing an Indigenous Gateway, or vendor portal, tailored to providing Indigenous businesses with advanced notice of upcoming procurements, as Indigenous businesses may wish to be participants in economic development opportunities in their traditional and treaty territories.

The portal will also encourage CNL's contractors and suppliers to become part of CNL's Indigenous Business Network, creating opportunities for Indigenous businesses to participate in a larger supply network. Through this strategy, CNL rewards prime contractors that can demonstrate the use of Indigenous businesses, and the evaluation process encompasses a graded approach to encourage the use of regional Indigenous businesses to promote the greatest benefit to those Indigenous communities closest to CNL project activities.

The CNL Indigenous Relations Procurement Strategy is a living document and will be refined through ongoing engagement with Indigenous communities, businesses, and the overall supplier network, to ensure that our policies are having the most impact.

To add to this strategy, CNL also hosted the first [Supply Chain Meet & Greet](#) to build relationships between local Indigenous businesses and the nuclear supply chain. Feedback suggests that this event was a success and has facilitated introductions and opportunities for Indigenous businesses.

CNL is an active employer and supporter of diversity and inclusion. Approximately seven per cent of CNL's current work force has self-identified as Indigenous. In 2022, driven by CNL employees, CNL initiated a pilot program known as the Indigenous Millwright Apprentice program which was provided at no cost to the participants. Through this pilot, 14 indigenous youths enrolled in and completed the program, which was delivered in partnership with the Millwrights of Ontario and prepared the participants for direct entry into the workforce.

Building on this experience, CNL has undertaken discussions with Indigenous Nations, communities and organizations to explore the possibility of enhancing employment opportunities for Indigenous youth and individuals looking to re-enter the workforce. Based on the outcome from these engagements, CNL will collaborate with Indigenous Nations, communities and organizations to provide similar opportunities going forward.

Many of the activities which are in progress or are proposed for the CRL site in the remaining licence period will require Indigenous Nations, communities and organizations to be engaged by CNL, and consulted by the Crown, in order to satisfy the duty to consult and other statutory and common law obligations. CNL actively supports the Crown in the satisfaction of this duty and therefore in addition to advancing reconciliation, CNL has sought to build meaningful relationships with Indigenous Nations, communities and organizations.

CNL seeks to understand the interests and concerns of Indigenous Nations, communities and organizations in CNL's projects and activities. CNL seeks to reach a mutual understanding of the potential impacts of CNL projects and activities on Aboriginal and treaty rights and interests. CNL's engagement approach includes collaboration with Indigenous Nations, communities and organizations in order to share information; identify opportunities to collaborate; identify concerns and issues; identify potential impacts of a project or activity on Aboriginal and treaty rights and interests and work together to address these through incorporating Indigenous Knowledge Systems, values and perspectives when considering avoidance and mitigations strategies. CNL recognizes and values the ongoing participation of Indigenous Nations, communities and organizations on activities related to the general operation of CRL, as well as environmental, economic and employment matters.

CNL's engagement efforts have resulted in many cases in formal relationship agreements being entered into with an Indigenous Nation, community or organization. The agreement may provide capacity funding or other support to enable meaningful engagement, sharing of Indigenous knowledge and values, participation in environmental monitoring and protection activities and general relationship building. Some of these are described further below.

Much of CNL's engagement during the licence period related to the proposed [Near Surface Disposal Facility](#) (NSDF) and the visibility of this project as it approached licence hearings, a significant effort was made to ensure that members of the public, Indigenous Nations, communities and organizations and interested parties had access to accurate information. Outreach activities included road signs, billboards, a dedicated website, regular updates via social media, elected officials engagements, individual conversations and follow-up with interested parties, email campaigns, internal staff communications and a dedicated media day for journalists.

Engagement with Indigenous Nations, communities and organizations on the NSDF project started in 2015 October based on the proximity of their communities to CRL, treaty lands and/or unceded traditional territories on lands where the project is proposed, or due to previously expressing interest of being kept informed. CNL adapted engagement activities according to the unique interests, concerns, and information needs of Indigenous Nations, communities and organizations. The spectrum and depth of engagement has varied significantly between Indigenous Nations, communities and organizations, with some actively engaged with CNL early in the project, and others only more recently. CNL has had significant discourse and formal exchange of comments and responses with Indigenous Nations, communities and organizations that wished to do so, the results of which have been incorporated in the final [Environmental Impact Statement for the NSDF](#). CNL has made progress in advancing relationships with Indigenous Nations, communities and organizations, and all parties are learning about each other's concerns and how to work together to address them.

CNL remains committed to advancing environmental protection and remediation of the CRL site and believes that the NSDF is a responsible science-based solution, which can be informed by Indigenous Knowledge Systems and values. CNL is committed to collaboratively developing solutions throughout the project that address concerns in a meaningful way.

As the relationship between CNL and an Indigenous Nation, community or organization develops and fosters, the parties are able to continue to engage meaningfully, solicit input and feedback on projects and activities, share Indigenous Knowledge Systems and values, express issues and concerns and cooperatively develop accommodations, mitigations or other measures as necessary. For example, information provided on diet and harvest studies have helped to inform the derived release limits for CRL. This ensures that these limits – the radionuclide release rate that would result in a radiological dose to an individual living or harvesting food in proximity to CRL – are kept as low as possible.

Highlights from the Current Licensing Period:

- CNL, AECL and the Algonquins of Pikwàkanagàn First Nation have signed a [long-term relationship agreement](#) to formalize relations. The agreement will establish a working group to serve as the basis for ongoing collaborations, and will create a Neya Wabun (Guardian) Program that will establish a regular Indigenous-led monitoring presence at designated AECL sites, among other environmental, cultural and economic protection and promotion activities and programs. This historic milestone is an important step in the reconciliation journey to heal as well as build trust and is founded on transparency and mutual respect. The Algonquins of Pikwàkanagàn First Nation now have a significant say in CNL's operations, ensuring traditional knowledge and values are known to CNL and incorporated into projects or activities as well as to protect their Aboriginal and treaty rights and interests. Implementing the relationship agreement will be a key focus for the remainder of the licensing period.

- CNL held regular meetings with Algonquins of Pikwàkanagàn First Nation, Williams Treaties First Nations, the Kitigan Zibi Anishinabeg, Kebaowek First Nation, the Algonquins of Ontario and the Métis Nation of Ontario, typically with AECL in attendance as well.
- Memoranda of Understanding and/or contribution agreements have been established with Williams Treaty First Nation, Curve Lake First Nation, Hiawatha First Nation, Algonquins of Pikwàkanagàn First Nation, Métis Nation Ontario, Kebaowek First Nation, Wolf Lake First Nation and the Algonquins of Ontario.
- CNL arranged visits for Indigenous Nations, communities and organizations to the proposed NSDF site, as well as facilities undergoing decommissioning and WMAs.
- CNL increased Indigenous participation in the Environmental Stewardship Council and Citizens Advisory Panel.
- CNL has hosted and participated in numerous events to acknowledge and celebrate Indigenous peoples in Canada. An Indigenous welcome and land acknowledgement is now a standard practice for CNL events and gatherings and is on the internal and external websites. Staff are advised by their colleagues in Indigenous Relations on the importance and appropriate usage of a land acknowledgement.

CNL remains committed to continuing to seek engagement with all Indigenous Nations, communities and organizations that hold Aboriginal and treaty rights on the lands of the CRL site, as well as engaging with all interested Indigenous Nations, communities and organizations.

3.2 Public Engagement at Chalk River Laboratories

It is an organizational priority at CNL to build public awareness, understanding and appreciation of the value and relevance of its work on behalf of Canadians. Developing and maintaining meaningful relationships with all stakeholders ensures that the general public, local communities where CNL operates, news media, supply chain partners and other stakeholders, such as industry and academia, are informed about the ongoing activities at all CNL sites. CNL is committed to communicating in a timely manner and exchanging information with all stakeholders and recognizes the importance of listening and working with interested parties to resolve their concerns. CNL values the support and engagement of those communities where it operates, as this enables it to supply customers with the nuclear science and technology services that they need, while contributing to a strong economy, clean environment and healthy society.

This responsibility is guided and fulfilled through CNL's [Public Information and Disclosure Program](#), which outlines public activities that occur at CNL and aims to address the information needs of interested parties. The program has been prepared in accordance with the CNSC Regulatory Document REGDOC-3.2.1, *Public Information and Disclosure*, which was published in 2018.

CNL's corporate website (www.cnl.ca) provides a platform to inform the public of its unique facilities, ongoing science and technology projects and programs, environmental remediation mission, the revitalization of the CRL campus and upcoming events. It is also the primary touchpoint for significant activities such as major projects, environmental performance reporting, news and

event reporting, recruitment of potential employees, contact with alumni staff and providing access to detailed publications and reports.

CNL also publishes the list of events reported to CNSC staff on the [Events](#) page of the website. This list is published within 60 days of the end of the preceding quarter. In addition to posting event titles, CNL also publishes disclosures for specific events in the [Community Information Bulletins](#) section of the website.

The website, prepared in both official languages, also provides the public with a direct way to contact CNL using the [Contact Us](#) link. In 2022, CNL had 327 external website visitors who used the “Contact Us” function on a broad range of subjects.

CNL provides ongoing and extensive updates through its social media accounts and external website on the [News and Announcements](#) page. CNL also shares information with the public through a number of engagement activities and platforms, including public information sessions, media releases, corporate website updates, direct mail newsletters, a toll-free community information line and regular participation in a variety of local, national and international engagements.

Recognizing the important role an informed workforce plays in meeting its public engagement responsibilities, CNL employees are considered its greatest ambassadors and are kept up to date on company developments through the internal intranet site, all-staff engagements and employee newsletters. Employees are also encouraged to share the information they receive with relatives, friends and neighbours.

Highlights from the Current Licensing Period:

- CNL issued an average of 35 media releases per year to local, national and international media.
- CNL continued to grow its web presence: the corporate website experienced 162,333 views in 2022, an increase of 23%, while new users increased 17% and engagement time increased 8%. CNL’s social media presence also grew, with annual impressions now in excess of 1.6 million.
- CNL utilized paid media insertions and advertising in local and national media, including Maclean’s magazine and The Toronto Star to reach larger audiences.
- CNL has increased media relations activities by building rapport and relationships with key national media, which resulted in positive coverage in The Globe & Mail, in The Toronto Star, on CBC Radio and in other media outlets.
- There was exponential growth in the Education and Outreach Program as COVID-19 restrictions loosened, with an average of three school or educational engagements monthly, in addition to frequent event-specific engagements.



- CNL and the Girl Guides of Canada and Scouts Canada launched a Merit Badge in Nuclear Science (Figure 17). Badges were handed out to Embers-level children at locations across Ontario and Manitoba, and the program continues to grow.
- CNL hosted [Open House 2022](#), which drew approximately 3,500 members of the public to the CRL campus to learn about our program of work and activities. Over 95% of the attendees indicated they gained a better understanding of CNL through the event.
- Staff from CRL routinely participate in national and international conferences and events, including the Canadian Nuclear Association Conference and Tradeshow, Canadian Nuclear Society Annual Conference, the Generation IV and Small Reactors Conference, the Canadian Hydrogen Conference and the Waste Management Symposium. CNL's level of support and participation has grown since 2018.
- A series of eight Open Houses were held in local communities about CRL's ongoing environmental remediation program of work.
- CNL staff produce and publish a podcast series entitled "[Free of Charge: Conversations in Canadian Nuclear Science](#)." Each episode reaches several hundred listeners, and the content tackles CNL's programs and research, with a connection to topical items (e.g., clean energy, nuclear medicine and cyber security).
- CNL continues to provide support to the communities surrounding the CRL site through various initiatives, including an employee crowdfunding initiative.
- An annual Science Camp was launched, inviting local youth to the CRL campus to inspire interest in science, technology, engineering and math fields, and to learn more about CNL's operations.
- A [Kids CONTACT](#) newsletter is now mailed to 65,000 households in the CRL, Whiteshell Laboratories and Port Hope catchment areas.
- In an effort to better connect universities with the capabilities in the national laboratories, memoranda of understanding have been signed with the University of Ottawa, Ontario Tech University, Waterloo University, Queen's University and the University of Western Ontario, with more in progress.
- In conjunction with AECL and [McMaster University](#), CNL launched a new program to [enrich learning](#) and real-world experience in nuclear research for McMaster undergraduate students.
- Several collaborative research agreements with academia have been initiated, including:
 - Ontario Tech University and Memorial University of Newfoundland research on hydrogen production;



Figure 17: Nuclear Science Merit Badge

- McMaster University investigation on non-intrusive flow measurement techniques;
- University of Ottawa to study Blanding's turtle movements; and
- Trent University to study bat roosting habitats.
- CNL has formed a [commercial partnership with the University of New Brunswick](#) to provide chemistry services for nuclear power reactors.
- The strengths of industry and ancillary groups that share similar goals and approaches to CNL have been significantly leveraged. The North American Young Generation in Nuclear Chalk River chapter, supported by CNL, won the [top chapter in North America in 2022](#), and [Best Chapter In Public Information in 2021](#), demonstrating excellence in public engagement. This CNL partnership plays a key role in helping CNL reach new audiences and potential new employees, as the members serve as ambassadors, educators and recruiters helping carry communications about CNL's ongoing operations. Similar relationships exist with Women in Nuclear and Professional Engineers of Ontario.
- CNL introduced annual "Community Update" webinars, the latest of which can be found on CNL's [YouTube](#) channel. These 90-minute sessions are widely advertised and are intended to provide local residents and other interested parties with opportunities to receive updates on CNL's operations and ask questions of CNL's subject matter experts.
- Tapping into the experience gained during the COVID-19 pandemic, CNL introduced several webinar series or events that cover a wide range of topics. Webinar topics have included Small Modular Reactor development, low-dose radiation, the NSDF, reactor segmentation, supply chain, nuclear medicine and others. These webinars and videos are all available on the CNL [YouTube](#) channel.
- CNL participated in its first Nuclear Science Week; while well established in the United States, this is relatively new in Canada. For the inaugural year of participation, CNL arranged for displays and posters to be set up in 11 local civic locations (e.g., town halls and libraries) in Renfrew and Pontiac counties. CNL hosted two specific school tours, delivered a full week of webinars and maintained a strong social media presence throughout the week.

Note on COVID-19 Impacts:

Overall, CNL's target audience is diverse and includes neighbouring communities, industry, customers, non-governmental organizations, employment prospects, academia and others. In this current licence period, CNL continued to maintain its public engagement and adapted its [Public Information and Disclosure Program](#) to engage all stakeholders in the face of shifting pandemic restrictions, while adhering to all COVID-19 public health protocols. Accomplishing this required agility and adaptability, as many in-person events, tours, gatherings and engagements needed to move online. These restrictions drove the introduction of novel tools such as the "[Virtual Visitors Centres](#)" for CNL's key projects, the launch of webinars and online presentations, digital meetings

with school groups, increased content on CNL’s websites and social platforms, the creation of an internal employee portal to connect staff while not physically on site, a daily email bulletin, and several other tools and techniques.

Environmental Stewardship Council

The [Environmental Stewardship Council](#) comprises representatives from local communities and stakeholders, Indigenous Nations, elected officials and community interest groups. Its mandate is to provide an opportunity for open dialogue between community stakeholders and senior management on various environmental projects. The following is a list of council membership/representation.

- City of Ottawa
- Concerned Citizens of Renfrew County
- Deep River Horticultural Society
- Four Seasons Conservancy
- Garrison Petawawa
- The Town of Laurentian Hills
- Old Fort William Cottagers’ Association
- Municipalité régionale de Comté de Pontiac
- Pembroke Area Field Naturalists
- Petawawa Research Forest
- Renfrew County Council
- City of Pembroke
- Town of Deep River
- Ottawa Riverkeeper
- Town of Petawawa

There are also Official Observers to Environmental Stewardship Council proceedings; they are: AECL, the CNSC, Anishinabek Nation for the Southeast Region and the Algonquins of Pikwàkanagàn (as per their request).

Completing its 16th consecutive year of operation, the Environmental Stewardship Council marked its 50th meeting in 2023.

Community Advisory Panel

Launched in 2021, the CRL’s [Community Advisory Panel](#) brings new voices from the community into the dialogue between CNL and the Renfrew and Pontiac region. The panel consists of a diverse group of community members with varying backgrounds, most of whom are residents of Renfrew County.

Through the panel, CNL is able to increase understanding, grow appreciation of our communities’ diverse perspectives and enable members of the community to access first-hand knowledge about CNL and, in particular, CRL activities. Discussions between CNL and the Community Advisory Panel focus on the activities that are subject to licensing and environmental regulation as well as activities that may affect the social and economic life of the community.

Panel meetings are facilitated by an independent third party. Notes documenting all questions and actions are taken at each meeting and are posted on the Community Advisory Panel website for public access and later reference.

4. Update of CNL Strategic Priorities

The [Commission Member Document for the 2018 CRL Licence Renewal](#) presented to the Commission the newly developed corporate vision, mission and identity for CNL, which stands proud as a global leader advancing nuclear science and technology for a clean and secure world.

Through the services offered, including research and development, design and engineering of specialized technology, waste management, and environmental remediation and decommissioning, CNL is committed to ensuring that Canadians and people around the world are confident that they are safely and securely receiving energy, health and environmental benefits from nuclear science and technology. CNL works to safely deliver all work activities and to provide the highest level of performance in meeting the commitments expected of them by regulators, customers, stakeholders and the public.

CNL's activities are organized into three strategic priorities that guide CNL in its pursuit of next-generation solutions to address the nation's biggest challenges. CNL's three strategic priorities, and how the work conducted in our CRL site facilities contribute to these, are detailed below.

RESTORING AND PROTECTING THE ENVIRONMENT

CNL is managing the largest and most complex environmental cleanup missions in Canada, including the Chalk River and Whiteshell Laboratories sites, and the remediation of historical waste sites through the Port Hope Area Initiative. CNL is also leading a number of major nuclear remediation waste management projects, including the NSDF Project, the Nuclear Power Demonstration Closure Project and the Whiteshell Reactor-1 Closure Project.



CLEAN ENERGY FOR TODAY AND TOMORROW

In clean energy, CNL is working to bring the next generation of clean energy technologies to Canada – Small Modular Reactors. But CNL's work also includes technical advances in hydrogen energy, the development of advanced nuclear fuels, the integration of clean energy technologies and research to enable the safe and reliable operation of today's nuclear fleet.



CONTRIBUTING TO THE HEALTH OF CANADIANS

With over one billion medical treatments conducted using isotopes produced at the Chalk River campus, CNL has been a world leader in the production of radiopharmaceuticals for decades. CNL is leveraging this expertise to become an international hub in the development of a new generation of medical isotopes, including actinium-225, a rare isotope that enables a revolutionary new cancer treatment.



4.1 Restore and Protect the Environment

CNL’s mission to restore and protect the environment is twofold: to responsibly address the legacy nuclear waste of the early decades of nuclear research and development in Canada, and to be a world leader in decommissioning and nuclear waste management.

CNL has developed an [Integrated Waste Strategy](#) to outline the lifecycle management of all types of waste at CNL-operated sites across Canada (Figure 18). It also outlines the enabling facilities that are required to complete the remediation of the CRL site as well as the waste hierarchy framework to minimize the quantities of all waste types (clean, non-radioactive, hazardous and radioactive wastes) (Figure 19). The CNL Integrated Waste Strategy will continue to be updated periodically and will be a key mechanism for engagement with the public and Indigenous communities.

Another key strategic document for CNL that supports implementing the clean-up of the CRL site is the Overview Decommissioning and Cleanup Plan. The Overview Decommissioning and Cleanup Plan provides a strategic cleanup approach to decommissioning CRL buildings and infrastructure as well as remediating contaminated lands. It highlights a consolidated review of near-term needs, plans and priorities, while also integrating the input from current operations, future science and technology development projects, waste management capabilities, remediation, and site constraints.

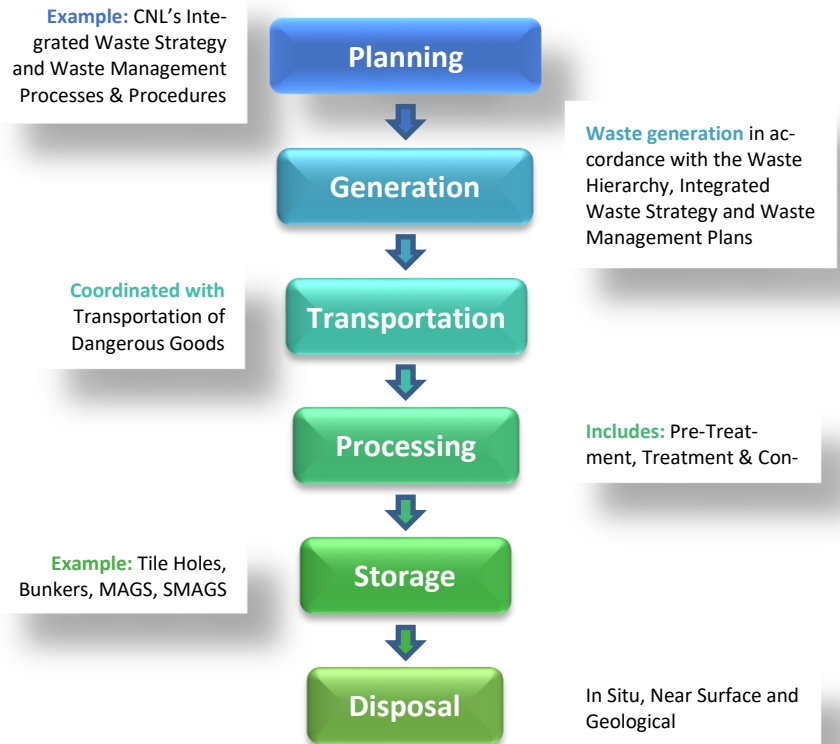


Figure 18: Waste Management Lifecycle



Figure 19: Waste Management Hierarchy

The various facilities and activities included in the Integrated Waste Strategy and Overview Clean-up and Decommissioning Plan are further described below.

Waste Facilities

In order to ensure CNL is able to continue reducing AECL's liabilities and to manage the large-scale remediation at the site, there are several current facilities at the CRL site that ensure waste is managed effectively.

- The **Sort and Segregation Facility** is located in the WMAs and is used to ensure all legacy waste is characterized and segregated according to modern standards and practices in preparation for low-level radioactive waste disposal.
- The **Waste Analysis Facility** verifies solid waste as clearable (non-radioactive, non-hazardous) and then routes the segregated waste streams to the appropriate disposition routes reflective of the application of the waste hierarchy (Figure 19).
- The **Waste Characterization Facility** acts as a hub for waste characterization equipment and processes. Characterization of waste is supported by several pieces of equipment that function both as stationary and deployable to perform waste characterization in the field.
- Above-ground storage areas and buildings for low-level radioactive waste ensures sufficient storage capability is maintained at CRL to enable the facilities decommissioning program of work.
- Various structures including below-grade tile holes and concrete bunkers and **Shielded Modular Above-Ground Storage** facilities for above-ground storage of intermediate-level radioactive waste.
- Below-grade tile holes, above-grade canister storage and the **Fuel Packaging and Storage Facility** for storage of high-level radioactive waste and selected legacy research reactor fuel rods.
- The **Waste Treatment Centre**, which processes radioactive liquid waste generated through various activities at CRL facilities. This liquid waste is evaporated and solidified in drums to produce a stable product that can be safely stored in order to minimize the impact to the environment.

A number of new enabling waste facilities, which are currently at preliminary stages of development or design, will complement the current facilities and capabilities at the CRL site to address waste processing, storage and disposal requirements.

- The **Cask Facility** will centralize and house transportation casks and transfer flask operations, storage and maintenance activities that are occurring in various locations around the CRL site.
- Intermediate-level and high-level radioactive waste storage capabilities and facilities, including an **Intermediate-Level Waste Storage Array** and expanded storage capacities

within existing WMAs, will receive and store used fuel consolidated at CRL until the national used fuel Deep Geological Repository is available.

- Work is currently underway to determine requirements for intermediate-level and high-level radioactive waste conditioning capabilities and facilities in order to meet CNL needs, including the stabilization/conditioning of the legacy waste inventory.



Figure 20: Optimization of Existing Waste Management Area (artist's rendering)

A significant portion of the mission to restore and protect the environment involves de-inventorying and remediating the legacy WMAs at the CRL site. CNL is assessing the current land area available within the WMAs to optimize already disturbed lands for siting of the new enabling waste facilities mentioned above, which will then in turn minimize the impacts on the environment (Figure 20).

The **NSDF** Project is a proposed waste disposal facility comprising an engineered containment mound built at ground surface that will hold up to 1 million m³ of low-level radioactive waste (Figure 21). This project is currently awaiting a licensing decision from the CNSC following a two-part public hearing in 2022 and a supplementary public hearing in 2023.



Figure 21: Near Surface Disposal Facility (artist's rendering)

In a Procedural Direction, issued 2022 July 5, the Commission decided to leave the record open to allow more time for engagement and consultation with Kebaowek First Nation and Kitigan Zibi Anishinabeg First Nation and for the filing of additional information about these efforts. The hearing for final submissions related to the Procedural Direction will occur 2023 August 10.

Decommissioning Activities

To better understand how legacy facilities on the CRL site are decommissioned and demolished, a [webinar](#) was held for the community.

The Facilities Decommissioning department has decommissioned and removed 59 buildings and structures since 2018 March, bringing the total structures decommissioned to 116 since 2015. The removal of these 59 structures has resulted in a reduction of 15,870 m² in floor space, of which approximately 95.84% was clean (non-radioactive, non-hazardous) waste and was either recycled or disposed of in a conventional landfill. The remaining 4.16% of the waste has been safely stored in CRL’s WMAs. CNL disposes of clean waste following the waste management hierarchy in Figure 19. CRL makes every attempt to reuse or recycle clean waste before disposing of it through third-party facilities.

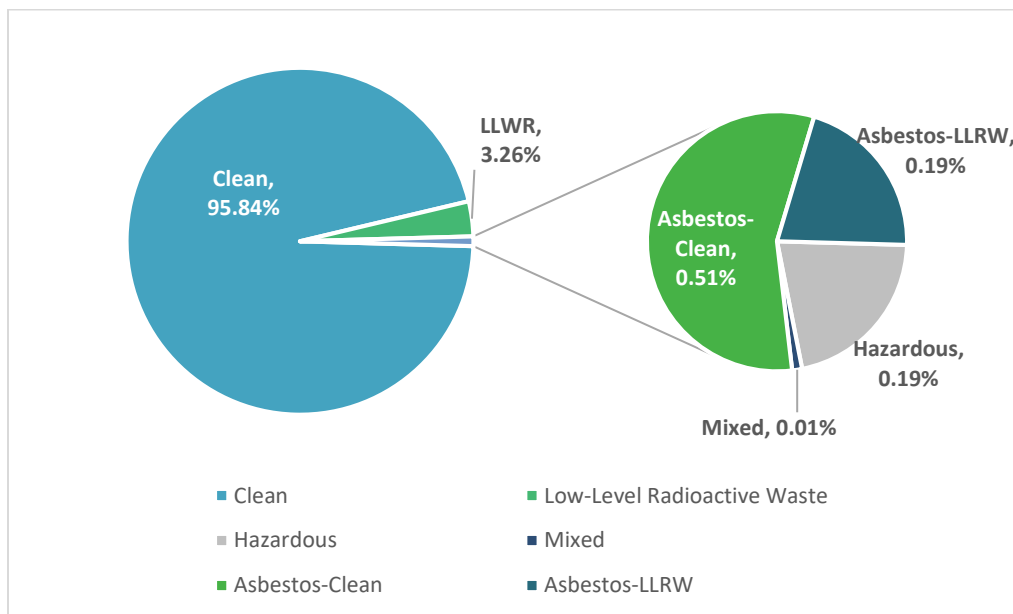


Figure 22: Wastes Generated from Decommissioning Activities

Decommissioning work underway in the CRL built-up area is focused on reducing the hazards associated with redundant buildings previously used for office space, laboratories, nuclear processes, nuclear materials storage and waste processing. The buildings are typically constructed of wood and metal frames with concrete foundations, range from 30 to 60 years in age, and are generally in poor condition.

An important part of the decommissioning process is the hazard reduction undertaken to support the ultimate demolition of the facility. One important facility in the hazard reduction phase is [Building 250](#), which was identified as having the most significant health and safety risk at the CRL site due to its age, construction, type of work that took place in the facility and past incidents (Figure 23). The CNSC staff approved the Detailed Decommissioning Plan for Building 250 in 2019. The project team continues to safely accelerate hazard reduction in the facility, including the abatement and removal of asbestos, and removal of high-hazard radiological sources and materials, such as glove boxes from the former Tritium Laboratory, and the active storage tank that was located in the basement. Due to the age of many buildings, decommissioning of internal hazards is greatly reducing the hazards associated with the CRL site.



Figure 23: Building 250

Over the past several years, Facilities Decommissioning has demolished several key facilities. Figure 24 to Figure 28 show facilities prior to their decommissioning in 2018 April (left), followed by the current state in 2023 June (right).



Figure 24: National Research Experimental Reactor Effluent Experimental Building – *Before, After*



Figure 25: Mixed Waste Storage – Former Heavy Water and Drum Cleaning Building / Former Change House – *Before, After*



Figure 26: Machine, Welding, and Sheet Metal Shops and Administration Services – *Before, After*



Figure 27: Former Filtered Water Storage Reserve – *Before, After*



Figure 28: Emergency Process Water Cooling for National Research Universal – *Before, After*

In 2021 June, demolition of the Emergency Process Water Cooling building resulted in a major milestone: the 100th building to be decommissioned at CRL.

One of the oldest buildings on site was demolished by Facilities Decommissioning in 2023 July. Building 412, built in 1944, formerly housed a Machine Shop, a Quality Control Branch, a Welding Shop, a Tool Crib and an office area. Also demolished was the attached Building 457, which was built in 1951. This building was the former Central Stores Facility with a shipping and receiving area, offices and a Site Maintenance Shop. The area will be used by ANMRC for a laydown area before being turned into a green space/park setting (Figure 30).

It was CRL's largest Type 3 asbestos abatement project to date, with all drywall requiring abatement. Approximately 85% of the general non-asbestos containing construction waste, along with 34 bins of metal was segregated and will be sent for recycling. All of the concrete will be staying on site and reused as gravel.



Figure 30: Demolition of Buildings 412 and 457

CNL will be preparing storage-with-surveillance plans and/or detailed decommissioning plans for several facilities over the next five years, including the Maple 1 and 2 Reactors, New Processing Facility (Figure 29), Dedicated Isotope Facility, Molybdenum-99 Production Facility and Universal Cells. These plans will be submitted to CNSC staff for acceptance, prior to these facilities entering the decommissioning lifecycle phase and commencement of decommissioning.

The NRU Reactor, Figure 31, which was permanently shut down in 2018 March, is currently being prepared for transition to a storage-with-surveillance state. The transition of the facility to storage-with-surveillance had originally been planned to occur by 2021 April; however, CNL made the decision



Figure 29: Facilities to be Decommissioned



Figure 31: NRU Reactor

to delay in order to continue the work on installation of the stand-alone ventilation system and ongoing hazard reduction throughout the facility. For additional information on the NRU reactor, see Appendix A.

Shortly after shutdown of NRU, CNL released the documentary [*Of Great Service: The Story of National Research Universal*](#), which celebrates and memorializes the contributions of the NRU reactor through the stories and memories of those who worked within it. Filmed at the CRL site, it examines the history of the NRU and its role as one of Canada's most important scientific and research facilities. Residents of the Ottawa Valley were invited to attend initial [screenings](#) before the film was released to the general public.

Remediation Activities

There are more than 60 areas where contamination is suspected or confirmed on the CRL site that are either undergoing or will require some form of remediation. These include WMAs, where much of the environmental remediation work will be focused with priority placed on locations that are the source of contaminated groundwater plumes. Other areas of concern include six historical landfills, former pipelines, three firing ranges, snow dump sites, several research and development facilities, old farm buildings and other legacy facilities and structures resulting from more than 75 years of site operations. In areas such as wetlands, where sediments and groundwater show evidence of contaminant migration, four groundwater treatment systems are in place to limit the migration of contaminants toward downgradient receptors. For example, the Spring B groundwater treatment facility was designed to treat strontium-90 contaminated groundwater emanating from the unlined sand trenches in the northwest corner of WMA B. This groundwater treatment facility was replaced with a new facility in 2019 that significantly increased the amount of groundwater that is treated. In 2021, the automated Groundwater Treatment Facility began operations and the old treatment plant was successfully taken offline and is being prepared for decommissioning.

For most contaminated areas, more detailed soil and groundwater characterization will be required to determine the extent of cleanup efforts required or the type of mitigation measures that will be needed to allow safe future land use of those contaminated areas.

Consolidation of Radioactive Waste

A key component of CNL's [Integrated Waste Strategy](#) involves the consolidation of radioactive wastes at the CRL site. This includes the consolidation of low-level radioactive waste, intermediate-level radioactive waste and used nuclear fuel at CRL as part of the lifecycle plan for each type of waste that CNL is responsible for managing.

CNL's Fuel Consolidation Program involves the retrieval of used fuel inventories currently in storage at Gentilly-1 and Whiteshell Laboratories, and the transportation to CRL's WMAs for storage. The CRL site is preparing to accept this used fuel, with shipments planned to begin in 2024 with completion in 2027. This used fuel will be stored at the CRL site until the long-term solution, a Deep Geological Repository under development by Nuclear Waste Management Organization, is finalized.

All radioactive waste consolidation activities are regulated by the CNSC and Transport Canada, and each shipment complies with the *Canadian Packaging and Transport of Nuclear Substance Regulations*, which are based on the International Atomic Energy Agency's *Regulation for the Safe Transport of Radioactive Materials*. CNL continues to effectively leverage decades of experience in safely and compliantly completing radioactive material shipments, including over 170 repatriation shipments since 2015.

Repatriation of Fuel and Nuclear Material

Since 2018, CNL has significantly reduced AECL's liability by [repatriating](#) eligible fuel and nuclear material to the US. In 2019, CNL completed the repatriation of all National Research Experimental (NRX) / National Research Universal (NRU) highly enriched uranium fuel rods under the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program. In 2020, CNL completed the [Highly-Enriched Uranium Target Residue Material Repatriation campaign](#), which repatriated target residue material resulting from medical isotope production. Finally, in 2022, CNL repatriated the Gentilly-1 low burn-up booster rods and a highly enriched uranium scrap shipment.

Building on this expertise, CNL continues to evaluate and pursue opportunities to repatriate AECL's unirradiated nuclear material inventories, including the repatriation of AECL's high-assay low-enriched uranium to the US Department of Energy.

Stored Liquid Waste

The Stored Liquid Waste Project continues the retrieval and processing of legacy liquid waste from tanks located throughout the CRL site. To date, four tanks have been emptied and are being transferred to decommissioning. Legacy liquid waste is currently stored in the remaining 16 tanks, with contents originating from a variety of historical operations at CRL. The project will remove the legacy radioactive liquid from the tanks, condition and pre-treat the liquid based on content chemistry as needed and complete the final processing of the tank's contents at the existing Waste Treatment Centre using the liquid waste immobilization system. A hazard reduction skid has been developed for cesium removal from several tanks to reduce the radiological hazard associated with these liquids.

The processing of legacy liquid waste using the Waste Treatment Centre is expected to continue until 2032; however, ways to optimize the schedule to accelerate this project are being investigated.

4.2 Clean Energy for Today and Tomorrow

To help the Government of Canada achieve its national target of net-zero emissions by 2050, CNL is advancing clean energy technologies for today and tomorrow, including small and advanced nuclear reactors as well as hydrogen and fusion technologies. As developers of the CANDU® reactor technology, CNL has the necessary skills, facilities and expertise to pursue next generation energy solutions to fight climate change and bring energy security to all Canadians.

There are two main areas within Science and Technology that focus on advancing clean energy technologies: Hydrogen and Tritium Technologies and the Advanced Reactors.

Hydrogen and Tritium Technologies

CNL executes the Hydrogen and Tritium Technologies focus area program of work through the use of various Class B and C radioisotope laboratories along with the **Tritium Laboratory**, a Class I nuclear facility. The newly updated laboratory began operations in 2019 and is capable of handling significant amounts of tritium for research and development activities. The facility supports the tritium technology needs for current and future CANDU® reactors and utilities.

The capabilities of the Hydrogen and Tritium Technologies focus area include heavy water (deuterium oxide) production and management; tritium handling, separation and management, including applications in fusion energy development areas; hydrogen safety and control for nuclear and nonnuclear applications; hydrogen production processes using nuclear and renewable energy sources; energy storage strategies; and applications of catalysts and polymers.

One of the major projects in the Hydrogen and Tritium Technologies focus area is the development of the **Modernized Combined Electrolysis and Catalytic Exchange Facility** at the CRL campus as discussed in Section 2.2.

Advanced Reactors

The Advanced Reactor focus area includes five main themes: Reactor Sustainability, Advanced Fuels and Materials, Reactor Safety, Small Modular Reactors and the [Clean Energy Demonstration, Innovation and Research Initiative](#). Reactor sustainability and advanced fuels both support long-term reliability of existing reactors and the development of Advanced Reactors. They also support advanced nuclear fuel concepts, which offer improved performance, failure tolerance, safety, proliferation resistance and accident tolerance, and result in products that are recycled or recyclable. Many next-generation nuclear fuels demand new fabrication methods because they cannot be manufactured via the conventional processes.

The program of work is executed through the use of various Class B and C radioisotope laboratories and multiple Class I nuclear facilities including the **Shielded Facilities, Zero Energy Deuterium (ZED-2) reactor, Nuclear Fuel Fabrication Facility** and **Recycle Fuel Fabrication Laboratory**. Many of these capabilities will be moved to the new ANMRC once it is constructed and commissioned.

CRL's **shielded facilities**, located within **Fuels and Materials Cells** and **Universal Cells** (Class I nuclear facilities), conduct post-irradiation examinations services for nuclear fuel and fuel channels, and on large and small highly contaminated components to provide operational support and failure response for various reactor components. Fuel characterization through full fuel post-irradiation examination services, as well as modelling and characterization for long-term fuel storage, can also be done within these facilities.

CRL's **ZED-2** reactor has been used to confirm the reactor physics design of all of Canada's power reactors. The ZED-2 reactor has supported development of the CANDU® industry by testing a wide range of fuel bundle designs and fuel arrangements at low power under a variety of operating conditions and simulated accident scenarios. The ZED-2 reactor continues to support and improve reactor operations and life extension initiatives, including the development of Small Modular Reactors.

Located in various CRL facilities and laboratories including the **Nuclear Fuel Fabrication Facility** and the **Recycle Fuel Fabrication Laboratory**, CNL's Fuel Development Laboratories play an integral part in the development of future opportunities for reactor design in the nuclear industry. It also encompasses the development and delivery of experimental and theoretical nuclear fuel science and technology, including fuel cycles, fabrication and testing. The extensive technical expertise and fabrication facilities at CRL allow relatively large-scale fabrication and testing of fuel under a variety of simulated reactor conditions.

Small Modular Reactors

CNL will be submitting an application to revise the CRL site licence to partition a portion of land from the current built-up area so that it may be subleased, under a landlord-tenant arrangement, for the possible construction of a Micro Modular Reactor. CNL is in negotiations with Global First Power to locate their unit at the CRL site and demonstrate potential applications which could include electricity production, district heating and hydrogen production. Through the agreement, Global First Power will be the licensee and will be subject to all regulatory processes and requirements for this project, with CNL providing access to site utilities and to CNL's many technical and operational support services.

Clean Energy

CNL is advancing the science behind clean energy technologies working alongside other renewable energy sources. The Clean Energy Demonstration, Innovation and Research (CEDIR) Park is a concept demonstration platform of a low-carbon system. This type of innovation will assist Canada in achieving its target of net-zero emissions by 2050. CNL's CEDIR Initiative is evolving the development of hybrid energy systems and energy storage by solving the key challenges in their deployment.

Reactor Safety and Security

CNL's safety and security teams are developing and implementing cutting-edge capabilities for modelling and passive safety simulation to support the development of Small Modular Reactors.

CNL is leading the development of analytical, scientific and design safety analysis codes for reactor safety and security. These safeguards can be applied to current and emerging nuclear fuel cycle facilities, nuclear proliferation detection and nuclear disarmament verification, These safeguards can also be applied for combatting illicit chemical, biological, radiological, nuclear and explosives activities and use of nuclear techniques for non-nuclear applications.

4.3 Contributing to the Health of Canadians

The work being conducted under this priority is aimed at advancing knowledge in low-dose radiation health effects, helping to mitigate health risks, and providing isotopes and pre-clinical research and development services. Canada has a long history of leadership in nuclear medicine. For over half a century, CRL has been at the forefront in the development and production of medical isotopes. CNL maintains the capabilities to advance this mission into the future to produce, process and manage the large-scale production of radiopharmaceuticals, and leverages its robust and scalable licensed framework, facilities and equipment to conduct isotope research and development, while also safely managing the waste by-products. Notably, over the decades, CNL has built unique capabilities and strong expertise in radiobiology to understand the effects of radiation and radionuclides on living things, public and worker protection in the nuclear industry, and international recommendations and determination of health risk.

Biological Research Facility

The CRL campus has unique facilities and expertise to study the effects of low-dose radiation on living things. The [Biological Research Facility](#) is a state-of-the-art animal facility that contains various environmentally controlled radiologically and biologically classed laboratories, which support a wide range of biological research. It houses the **Gamma Beam Irradiation Facility**, which is a 30 m irradiation hall used for open beam gamma-irradiation to animals, cells and other materials that can deliver a wide range of low doses of radiation at a variety of dose rates.

A walk-in radon inhalation chamber is under development in the Biological Research Facility. As there is considerable uncertainty regarding risk at low-dose exposures to radon over extended periods of time, and since an estimated 7% of Canadian homes have radon levels greater than the Canadian radon guideline of 200 Bq/m³, further study is pertinent to the health of Canadians.

The Biological Research Facility has also recently obtained [Good Laboratory Practices Facility-Only recognition](#), with full recognition targeted for early 2024. Good Laboratory Practices recognition facilitates the acceptance of study results by national and international regulators, including Health Canada and the Food and Drug Administration in the United States.

CRL's **Health Physics Neutron Generator** Facility, in addition to the **ZED-2 Reactor**, permits neutron dosimetry and radiobiological research to be conducted at the CRL site. Both facilities are essential for carrying out research for establishing the relative biological effectiveness of thermal and fast neutrons through their biological effects on cells and human blood, for use in dosimetry and estimating risk, as well as for mimicking the neutron fields at CANDU® work places for the projects aimed at improving the detection and measurements of neutron dosimetry.

Building on the long-term studies of biological impacts of low-dose radiation exposure and the numerous samples that have been collected, a Canadian tissue bank dedicated to low-dose radiation research is being established at CRL to securely store the tissues and cells derived from the extensive and unique radiobiological studies completed. This collection will benefit and increase collaborations nationally and internationally, aligning with the global effort on low-dose radiation research led by the Nuclear Energy Agency.

Medical Isotopes

Research is also focused on producing medical isotopes (with [actinium-225](#) currently at the forefront of the efforts), developing radiopharmaceuticals, optimizing safe and effective targeted alpha therapeutics, providing preclinical research and development services for radiopharmaceuticals testing and in vivo evaluation, and exploring the innovative use of low-dose radiation for medical treatment.

Currently, CNL is conducting several projects in this rapidly growing area, including a collaboration with the University of Saskatchewan to develop and evaluate the preclinical performance of novel actinium-225 radiolabelled antibody drug conjugates for the clinical treatment of breast cancer; an investigation of the biological effects of targeted alpha therapy on healthy haematopoietic stem cells during treatment of acute myeloid leukemia through the use of patient-derived samples, in collaboration with the Ontario Heart Research Institute and the University Health Network; and establishing a computational modelling tool to predict or evaluate efficacy and toxicity of actinium-225 antibody drug conjugates.

Of key importance is that the CRL site is one of a limited number of institutions worldwide with a thorium-229/actinium-225 generator, whereby an annual production of more than 100 mCi of high-purity actinium-225 is produced with in-house quality control using specific analytical and radioanalytical instrumentation. CNL is taking a phased and risk-measured approach to scaling up this capability. It is currently developing an interim scale capability through a combination of partnerships and leveraging in-house capabilities and infrastructure to validate and then initiate production at levels that are 20 to 30 times higher than the current capabilities, prior to considering a full-scale new facility.

CNL's interim plans mentioned above involve using existing shielded facilities (Universal Cells) under the current licensing basis to process radium-226 recycled from brachytherapy needles and other suitable forms into targets. These targets will be shipped to a third-party partner facility to be irradiated and then shipped back to CRL for a final process to extract and purify the actinium-225.

5. Safety and Control Areas

CNL's integrated Management System comprises 14 safety and control areas to define, interpret and maintain requirements in addition to supporting the implementation of the CNL missions. Through these areas, CNL ensures that associated regulations (REGDOCs) and standards are implemented company wide.

Over the first half of the licensing period, CNL has routinely been given a classification of Satisfactory for safety and control areas as part of the yearly CNSC Regulatory Oversight Reports, with the exception of the Security safety and control area, which was rated Below Expectation, for the 2021 and 2022 calendar years.

As the CNL Management System continues to evolve, so do the functions and programs. As indicated in the [Record of Decision for the CRL Licence Renewal](#), CNL continues to conduct gap analyses and produce implementation plans for newly updated or issued REGDOCs and standards as they are issued and deemed applicable to CNL and the CRL site. Since relicensing, CRL has implemented the following REGDOCs and standards, as was requested in the Record of Decision:

- REGDOC-2.2.4, *Fitness for Duty: Managing Worker Fatigue* (2017);
- CSA N286-12, *Management system requirements for nuclear facilities* (Reaffirmed 2022);
- CSA N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills* (Reaffirmed 2020);
- CSA N288.8-17, *Establishing and implementing action levels for releases to the environment for nuclear facilities* (Reaffirmed 2022);
- CSA N294-09, *Decommissioning of facilities containing nuclear substances* (Reaffirmed 2019); and
- IAEA SSR-6, *Regulations for the Safe Transport of Radioactive Material* (2018).

CNL has specifically included details related to the Management System, Radiation Protection, Occupational Safety and Health, and Environmental Protection as they provide a good measure of the safety of workers at CNL sites and an outlook of the safety of the public and the environment (through the provision of the environmental protection data). CNL has also provided an update on Security, Fitness for Service, and Training as these three areas are undergoing intensive work to close known gaps in implementation.

5.1 Management System

CNL's integrated management system is applicable to all operations and activities at CNL sites and is ISO 9001:2015, *Quality Management Systems* registered.

CNL's initial company-wide Safety and Security Culture Assessment in 2019 had been implemented under REGDOC-2.1.2, *Safety Culture*, and the assessment results were rated for maturity, which resulted in the establishment of CNL's baseline Safety and Security Culture Maturity

Model. Annual self-assessments and company-wide Safety Excellence Climate and Chemistry surveys have been used to continually monitor CNL's culture journey against the 16 Maturity Model Indicators, as identified in REGDOC-2.1.2, *Safety Culture*. As the journey has progressed, the assessments have demonstrated strong organizational commitment to safety and security.

As CNL continues its pursuit of safety excellence, two key initiatives, the Safety Excellence Team and the Strike team, have been launched to support the transformation to greater organizational excellence. The goal of these initiatives is to drive efficiency, encourage creativity and promote collaboration to solidify CNL's place in the commercial market.

First, CNL has established a Safety Excellence Team representing working groups from all of the major CNL missions and sites. The team is comprised of staff with diverse positions, job knowledge, tenure and skills, who are well respected and called upon for support and advice from their colleagues. The objectives of the Safety Excellence Team include:

- Steer CNL through the "Strategic Targets for Excellent Performance in Safety" process to Safety Excellence;
- Make recommendations on how to address gaps, identify themes, and develop a safety strategy;
- Actively participate in workshops to complete the multi-year safety performance and cultural improvement strategy;
- Lead continuous improvement activities and address issues;
- Represent individual missions and business lines in identifying and addressing issues;
- Reach back to missions for support in initiatives identified through the safety strategy; and
- Work collaboratively with existing CNL safety committees to coordinate efforts.

Second, to enhance CNL's pursuit of the high-learning organization ideal, a Strike Team has been chartered to develop and support the deployment of a rigorous, sustainable problem-solving approach to significant events. Independent subject matter experts are convened to investigate events. The intended outcome is to increase the safety margin and maximize defense-in-depth relative to potential problems with severe consequences. Organizational excellence is a state where problem-solving, teamwork and leadership unite to drive continual organizational improvement.

5.2 Radiation Protection

CNL's Radiation Protection Program is designed to ensure that CNL complies with or exceeds the level of radiation safety that is required by the relevant regulations pursuant to the *Nuclear Safety and Control Act*.

The Radiation Protection Program continues to be effectively implemented at CRL by monitoring and seeking improvements to radiological safety while ensuring the radiation dose to workers

and the public is maintained As Low As Reasonably Achievable (ALARA). In the last five years, the CNL Radiation Protection Program has made a number of important improvements to ensure the radiation dose is kept well below the CNSC regulatory dose limits and that all regulations made under the *Nuclear Safety and Control Act* are effectively implemented at the CRL site.

In 2018 April, CNL released the first version of a comprehensive Radiation Protection Improvement Plan. Within this plan, improvements and updates to the Radiation Protection Program over the course of five years are specifically listed, including:

- Tailoring existing Radiation Protection Training to meet requirements and to better support future CNL priority missions;
- Establishing and implementing ALARA assessments and reviews, radiological work plans and radioisotope laboratory protocols;
- Establishing, implementing and maintaining radiation protection performance models and metrics;
- Establishing CNL staff as technical experts in dosimetry-related services by working with the CANDU® Owner’s Group to strengthen industry networking and advance industry research; and
- Reducing the radiological footprint in operational, storage-with-surveillance and decommissioning facilities.

In 2021, the CNSC amended the *Radiation Protection Regulations*. CNL has fully incorporated the required changes into the Corporate Radiation Protection Program to ensure compliance with the revised regulations as well as guidance provided in CNSC REGDOC-2.7.1, *Radiation Protection*.

A new version of the Radiation Protection Improvement Plan, released in 2022 March, builds on progress made in the original version of the plan. The Radiation Protection Improvement Plan has five key initiatives (Figure 32): the Radiation Protection Program, qualification and training, radiation exposure control, radioactive materials controls, and radiation monitoring and measurements.

As part of the plan, CNL has established radiation safety committees for localized (area-specific) implementation. The committees have executive oversight to ensure operational challenges related to radiation exposure are addressed, methods to decrease both the individual and collective dose are investigated, and CNL’s ALARA initiatives to drive gainful improvement are emphasized. The ALARA



Figure 32: Radiation Protection Improvement Plan Key Initiatives

initiatives CNL has implemented over the past five years has decreased the number of skin and clothing contamination events from 66 in 2018 to 28 in 2022 (Figure 33).

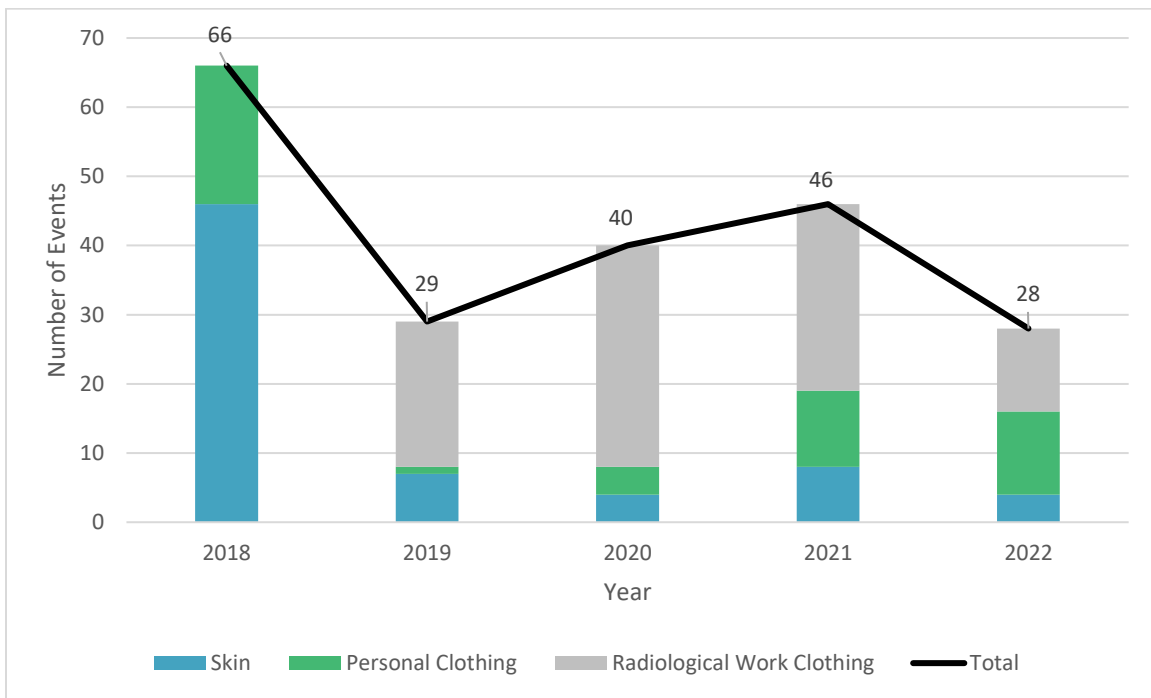


Figure 33: CRL Skin and Clothing Contamination Events

Radiation Dose

Radiation dose to workers and the public continues to be closely monitored by CNL. The maximum individual effective dose to a Nuclear Energy Worker at the CRL site has decreased over the past five years from 12.5 mSv/a in 2018 to 5.7 mSv/a in 2022. This decrease in maximum individual dose coincides with the shutdown of both the NRU and the Molybdenum-99 Production Facility, the higher-hazard work performed during operations of these facilities as well as effective dose reduction strategies implemented at CRL.

Between 2018 and 2020, the collective dose at CRL decreased from approximately 1,400 person·mSv in 2018 to approximately 650 person·mSv in 2020 due first to the shutdown of NRU then due secondly to the reduced operations during COVID-19. Since 2020, the collective dose at CRL has increased to approximately 1,100 person·mSv in 2022 owing to the increased scope of work being performed at CRL related to management of legacy waste and in Facilities Decommissioning where over 100 legacy buildings have been removed to date. During this time, however, the maximum individual dose to a nuclear energy worker continued to decrease as a result of the implementation of strict ALARA work controls. A summary of CRL’s effective dose can be found in Figure 34. The dashed line in the figure indicates the overall trend of maximum individual dose from 2018 to 2022.

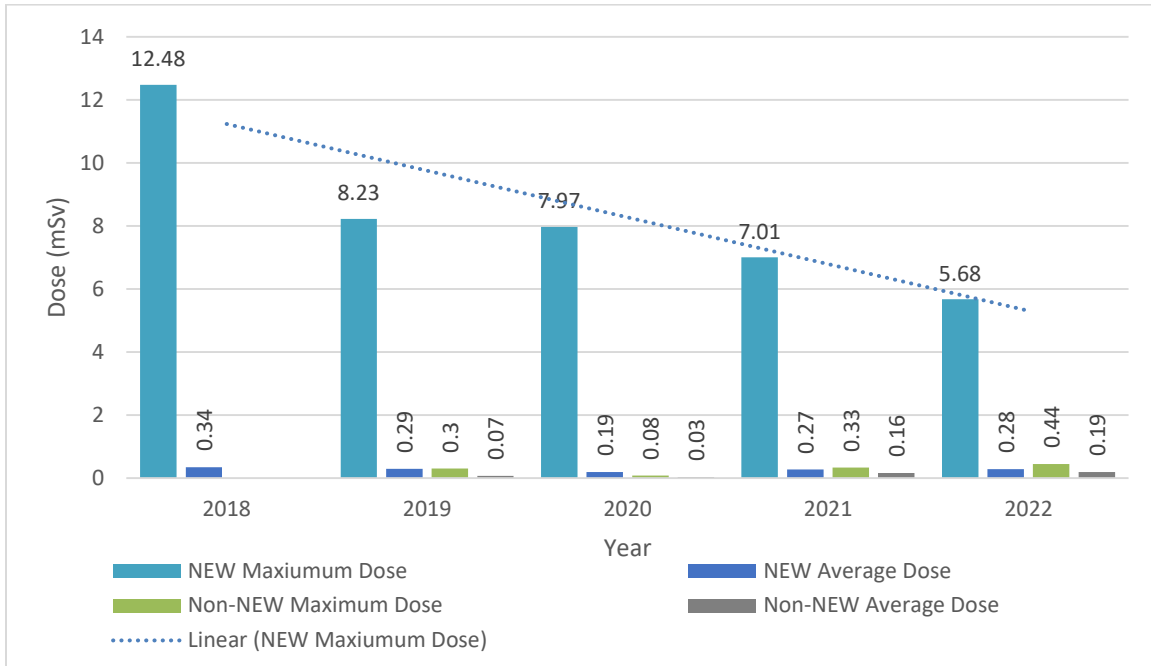


Figure 34: CRL Effective Dose Summary

CNL has established action levels as part of the Radiation Protection Program, which are set at a lower level than the CNSC regulatory dose limit. Exceeding an action level may indicate a loss of control of the Radiation Protection Program and requires CNSC notification. CNL reviews the established action levels on an annual basis and adjusts them as required to ensure radiation dose to workers is closely managed. Between 2018 and 2022, CNL had two instances of action level exceedance that were reported to the CNSC. These exceedances occurred as expected based on projections for planned work that was approved under CNL’s Radiation Protection Program. The CNSC had been made aware of the planned dose exceedance prior to the action level exceedances, both of which occurred in the same work group in the same period in 2021 and were for the committed effective dose for tritium set by CNL at 1.0 mSv/a, two workers exceeded a committed effective dose of 1.09 and 1.01 mSv.

Over the first half of the licensing period, CNL did not have any regulatory dose limit exceedances.

5.3 Occupational Safety and Health

Since the licence renewal in 2018, there has been an improving trend in the recordable lost-time injury frequency for activities by CNL employees at the CRL site. Similarly, an improving trend is noted for the severity of lost-time accidents.

Occupational Safety and Health personnel provided direct support to corporate safety improvement initiatives, acting as key team members in groups such as the Strike Team and the Safety Excellence Team. Improvements to safety procedures such as Hazardous Energy Control; Confined Space Management; Working at Heights; and Digging, Drilling, Cutting and Coring have all

contributed to strengthening the occupational safety and health processes. The CRL Health Centre continues to support effective oversight by management of the return-to-work component of the Workers Compensation Program.

Close collaboration with CNL’s Health and Safety Policy Committee encourages worker involvement in procedure development and strengthens both the processes and the safety culture.

As indicated in the [2018 Commission Member Document for the 2018 CRL Licence Renewal](#), the Occupational Safety and Health Program continues work toward alignment with the standard ISO 45001, *Occupational Safety and Health Management System* and is preparing for the Stage 1 audit in the first quarter of 2024.

CRL’s injury rate data, presented in Table 2, reflect some variability inherent to human behaviour; the general trend shows an improvement over the last three years.

Table 2: Summary of CRL Injury Rates

	2018	2019	2020	2021	2022
Person Hours Worked	5,396,450	5,729,010	5,346,690	5,358,630	5,709,410
Lost-Time Injuries	5	1	4	3	2
Working Days Lost	69	75	78	40	3
Frequency ^a	0.19	0.03	0.15	0.11	0.07
Severity ^b	2.56	2.62	2.92	0.15	0.15

a Frequency rate equals # of Lost-Time Injuries × 200,000 h of exposure divided by person hours worked (based on 100 Full-Time workers).

b Severity rate equals # of Working Days Lost × 200,000 h of exposure divided by person hours worked (based on 100 Full-Time workers).

CRL’s five-year average reportable lost-time injury rate of 0.11 is consistent with the industry performance of the Professional, Scientific and Technical Industrial Sector within the Workplace Safety and Insurance Board injury database. Figure 35, shows how CNL performed compared to the contractor performance at the US Department of Energy sites.

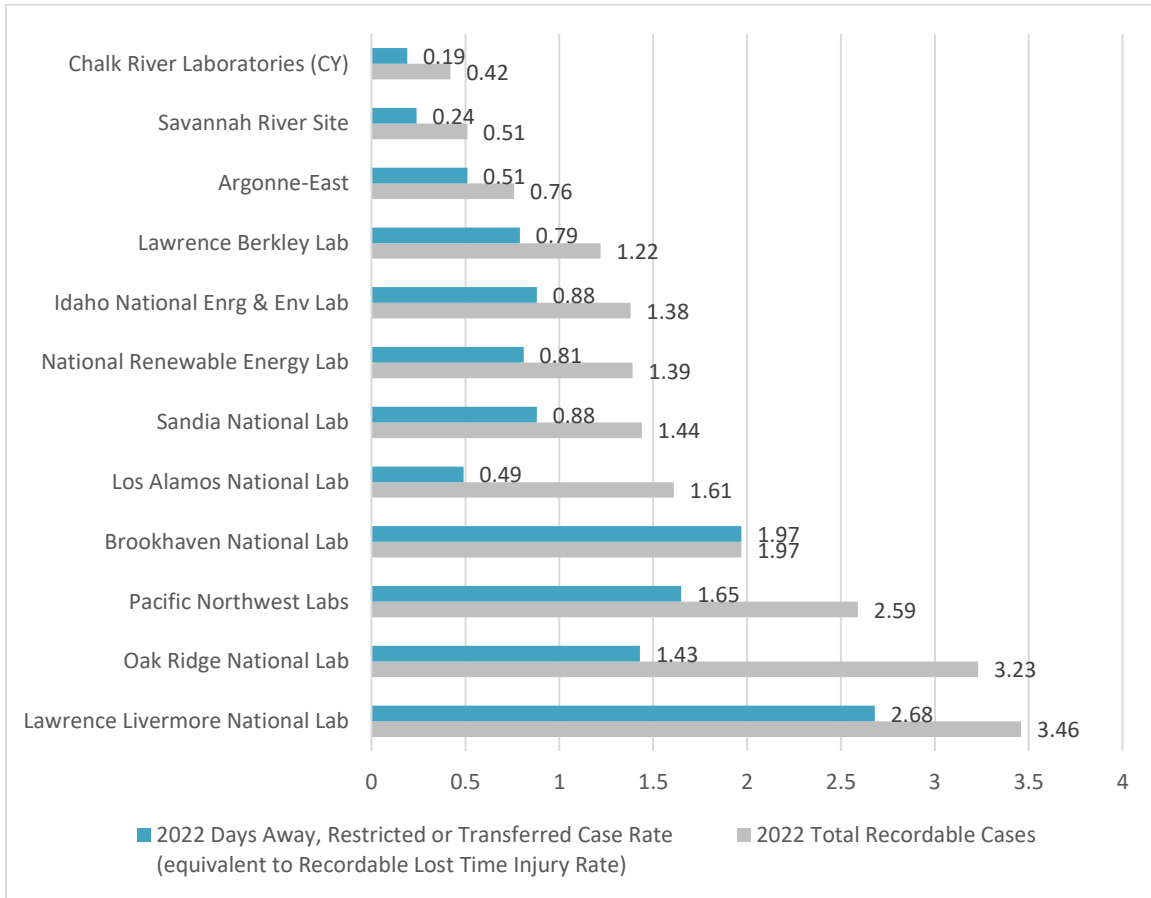


Figure 35: CNL Comparison of US Department of Energy Contractors

Impacts of COVID-19 pandemic

As a result of the COVID-19 pandemic and in alignment with actions recommended by the Canadian government and public health authorities, CNL opted to reduce operations at the CRL site beginning 2020 March 18. The reduced operations state meant that only the work necessary to ensure that CRL facilities, equipment and grounds were maintained and kept safe and compliant with regulatory requirements was conducted. CNL actively addressed COVID-19 pandemic concerns and implemented numerous mitigating measures aligned with public health protocols to prevent or limit the spread of the COVID-19 virus.

When over 600 CNL employees opted to enroll in the remote work program after resumption of operation, several enhancements were made to ensure employees were appropriately supported, including designating an Ergonomics Specialist to support the transition to remote work and a Wellness Specialist to coordinate wellness activities, and expanding virtual psychologically safe workplace and mental health services.

5.4 Environmental Protection

CNL's Environmental Protection Program is applicable to all operations and activities at CNL sites. The CRL site maintains an Environmental Management System, registered to ISO 14001:2015, *Environmental Management Systems* standard, as a means of achieving protection of the environment and continual improvement in environmental performance.

CNL continues to maintain extensive effluent, environmental and groundwater monitoring programs to help track environmental performance. The CRL [Environmental Risk Assessment](#) also serves as an indicator of environmental performance of the site through its provision of human health and ecological risk assessments. The CRL *Environmental Risk Assessment* published in 2019 is being updated with a target completion date of early 2024, per the required five-year update schedule under CAN N288.6-22, *Environmental Risk Assessment at Class I Nuclear Facilities and Uranium Mines and Mills*. These updates include follow-up activities to further improve the understanding of environmental health at the site. For example, current follow-up activities underway include studies on the health of benthic invertebrate communities within impacted wetlands on the site, with a focus on carrying out toxicity tests and assessing the bioavailability of contaminants of potential concern in water and sediment.

Efforts are also underway to characterize and confirm local site-specific background concentrations of numerous radiological and non-radiological parameters in surface water, sediment and soil, as part of a larger evaluation of the potential for adverse effects of elevated background concentrations.

Since the licence renewal in 2018, the following safety improvements and initiatives were completed:

- Implementation of CSA N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills* in 2020 December.
- Implementation of CSA N288.8-17, *Establishing and implementing action levels for releases to the environment for nuclear facilities* in 2019 December.
- Certification to the revised ISO 14001:2015, *Environmental Management Systems* in 2018 with recertification in 2021.
- Roll-out of the company-wide Environmental Data Management System, a central repository for CNL environmental data, in 2018. The system is populated with both historical and current environmental data ranging from air emissions, liquid effluents, soil, surface water, groundwater, vegetation, ambient air, game and wild animals to biodiversity and cultural heritage information.

Effluent and Environmental Monitoring

Radiological releases over the last 10 years are presented in terms of percentage of the derived release limit in Figure 36. With the shutdown of the NRU research reactor in 2018, airborne emis-

sions noticeably decreased with the cessation of argon-41 emissions and decreases in both tritium and iodine-131 emissions. A similar decrease in radiation doses to critical groups (members of the public) is evident in Figure 37.

Monitoring results verified that the levels of radiation and radioactive contaminants in the environment outside the CRL site due to operations at the site and the resulting radiation doses to members of the public did not exceed the annual dose limit of 1 mSv in a year for the most exposed members of the public, and that the dose to the public due to the sum of all releases from CRL did not exceed 0.3 mSv in any period of 12 consecutive months.

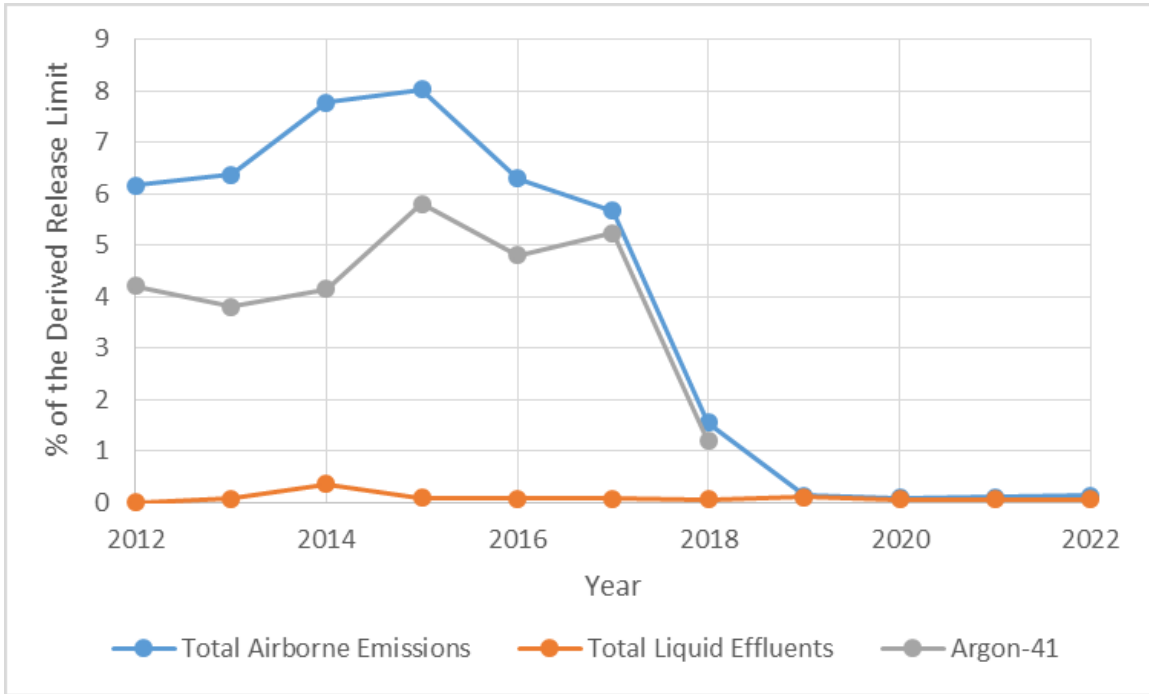


Figure 36: Summary of CRL Radiological Releases, 2012 to 2022

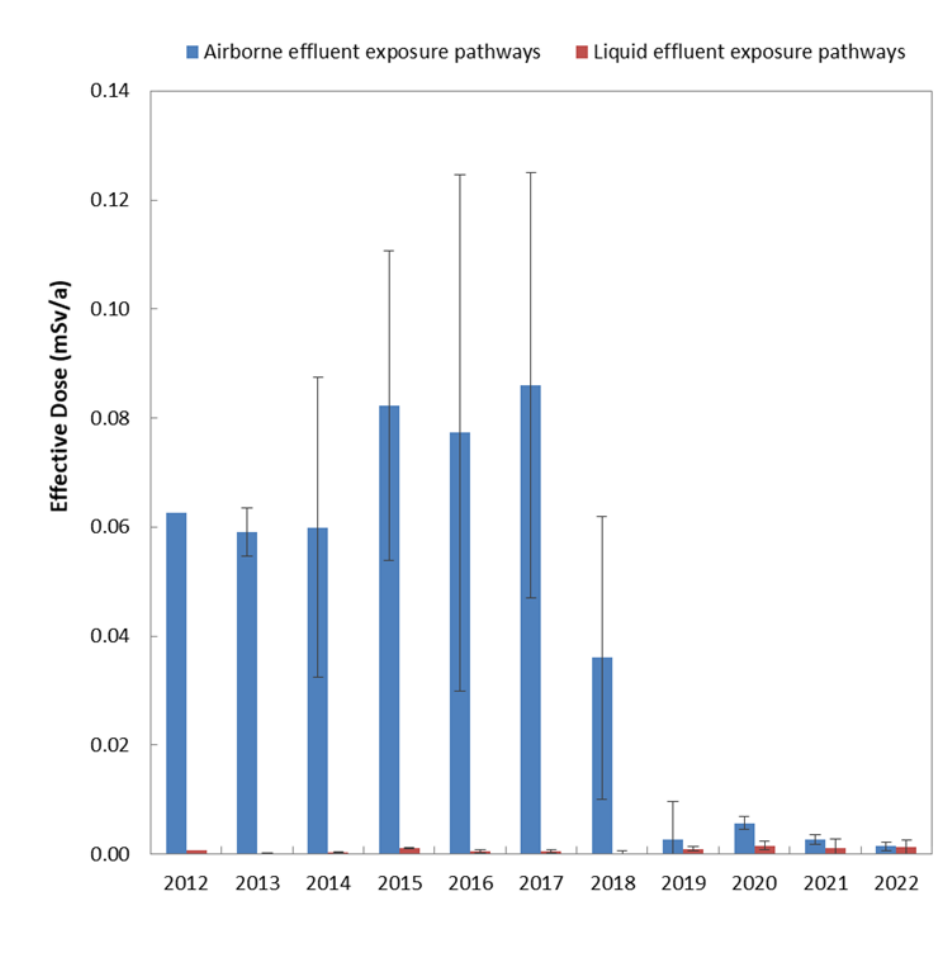


Figure 37: Dose Trends to Critical Groups, 2012 to 2022

Liquid effluents from CRL continued to be monitored for non-radiological contaminants in order to measure conformance and compliance with a number of guidelines and limits for chemical substances within these effluents. Overall, the majority of non-radiological effluents have remained stable, with results demonstrating that the controls for the release of potentially hazardous substances currently in place at CRL continue to provide adequate protection to the environment. Any exceedances of limits are reported annually in the Annual Compliance Monitoring Report and are summarized in Table 3.

Groundwater concentrations of a large suite of radiological and non-radiological parameters are reported annually to the CNSC for samples collected from approximately 180 monitoring wells located at 34 different monitoring sites at CRL. For the most part, the results from monitoring have not varied substantially from year to year, which is expected of the subsurface (i.e., hydrogeological) environment, where contaminant migration in groundwater flow systems is very slow compared to transport in effluents and surface waters. Where groundwater contamination is present, trends show that in many cases the groundwater concentrations at the monitoring sites have remained at similar levels or have decreased (indicating stable or improved environmental

performance), and the changes that occurred were consistent with long-term trends. Overall, most of the groundwater monitoring results for 2018 to 2022 indicate stability or slight improvement in the performance of facilities and operations impacting groundwater contamination levels at CRL.

Action levels for radiological contaminants in effluents/emissions were maintained over the licensing period. Action levels were developed for non-radiological hazardous contaminants in effluents in 2019 December as part of the implementation of the CSA N288.8-17, *Establishing and implementing action levels for releases to the environment for nuclear facilities*. These action levels remain performance-based and release-point specific, represent a level of release that is significantly below regulatory limits (i.e., below the derived release limits) and, in the case of radiological constituents, is sufficiently low and close to operational performance such that the requirement to keep doses ALARA is not jeopardized if this level is reached. In addition to action levels, CNL also compares releases with the reference limits in the CNL *Licence Conditions Handbook* and, for the Sewage Treatment Plant, limits established through the *Wastewater Systems Effluent Regulations*. A summary of the exceedances of these limits and levels during the licence period is provided in Table 3. CNL reports any exceedance of an action level to the CNSC and/or the Department of Fisheries and Oceans as required, conducts an investigation, evaluates the limit and implements corrective actions if deemed necessary.

Table 3: Effluent Monitoring Program Exceedances

Year	# LCH Reference Limit Exceedances	# WSER Limit Exceedances	# Action Level Exceedances
2018	1	0	3
2019	0	1	3
2020	0	0	0
2021	0	1	1
2022	1	1	0

LCH – Licence Conditions Handbook
 WSER – Wastewater System Effluent Regulations

Biodiversity

CNL continuously improves the responsible management of the CRL sites by undertaking activities to ensure the protection of local wildlife and the environments that surround them. CNL recognizes that the sites it manages are located in some of the most beautiful locations in Canada and that the work is carried out on the habitat of a rich variety of plant and animal species. In conducting operations, CNL is committed to carrying out work in harmony with the local environment and through engagement and collaboration with Indigenous Nations, communities and organizations, ensuring the protection of the biodiversity that inhabits the CRL site for future generations.

With its environment policy, CNL ensures that protection of the environment is an integral component of decision making in all phases of its business activities, including project development,

project planning, project implementation, operations and decommissioning. For example, the new buildings under construction at CRL incorporate bird-friendly designs to prevent collisions. Among other features, the Science and Collaboration Centre uses a glazed window with an internal timber grid providing light tones and sun and glare protection that serve as a visible deterrent intended to prevent bird strikes.

As part of its turtle road mortality mitigation plan, CNL recognized an important opportunity to better protect species at risk at the CRL site when it replaced some road culverts that were nearing the end of their design life. Most of the culverts around the site were undersized and needed to be larger in order to encourage wildlife such as turtles to use these passageways instead of crossing over the road.

To date, a total of seven eco-passages have been installed to allow the free inter-wetland movement of reptiles and amphibians without having to cross the road (Figure 38). CNL also built exclusion fencing to direct animals towards crossing structures as well as artificial nesting mounds within the eco-passage area to help limit the need for turtles to cross roads to access suitable nesting habitat. All eco-passages have been successful and used by several species including, bats, raccoons, snapping turtles, bears and the iconic Blanding's turtle.



Figure 38: Blanding's turtle using EcoPassage at the CRL site (2021)

In collaboration with Trent University, CNL recently completed a two-year telemetry study on its bat population.

With a permit issued by Environment and Climate Change Canada under the *Species at Risk Act*, the project encompassed the live trapping and release of bats at the point of capture, and tracking of the species to their roost over the subsequent days. The data collected were used to develop a Habitat Suitability Index, which demonstrates areas of the site where preferred bat habitat was previously unavailable. The study helped CNL confirm that the 16 bat boxes installed in eight locations at the CRL site were being used by little brown myotis bats (Figure 39). Lactating female bats were also monitored exiting the bat boxes, which confirms that the bat boxes are being used as maternity roosts as intended, which is a key habitat for bats.



Figure 39: Bat Box at CRL Site (left) during the 2019 Bat Telemetry Study in Collaboration with Trent University and Captured Bat (right)

CNL is finalizing a Sustainable Forest Management Plan, which was developed in collaboration with the Canadian Forest Service. In addition to information collected through its telemetry study on bats, wildlife habitats that were modelled to develop optimal harvesting scenarios included moose, deer and bear. CNL is now engaging with local Indigenous Nations to finalize the plan, ensuring that all of the values that are important to these communities have been carefully assessed and considered before CNL advances to the implementation phase of the project. This plan was recognized by the Canadian Forest Service, which awarded CNL the Canadian Forest Service Merit Award for Collaboration for 2022 as part of their annual Canadian Forest Service Assistant Deputy Minister Merit Award Program.

In 2022, CNL was once again recognized by the Wildlife Habitat Council for its commitment to environmental stewardship in the management of the CRL site. The Wildlife Habitat Council

awarded CNL with [Gold Certification for the CRL site](#), a designation that CNL also received in 2019 and that represents the highest tier of environmental certification given by the Council. In addition to the Wildlife Habitat Council certification, CNL also received the Wildlife Habitat Council 2022 Reptiles and Amphibians Project Award for the installation of new turtle eco-passages at the CRL site, was named a finalist in the Wildlife Habitat Council 2022 Bats Project Award for the bat telemetry study and bat box monitoring project, and was a candidate for the Gold Program Award, which recognizes one exceptional program in the Gold Certified tier.

5.5 Security

The CNL Corporate Security Program is responsible for ensuring the protection of CNL personnel, facilities and nuclear materials. The Security program at CRL has continually worked to improve the quality and capability of its program of activities at the CRL site. Since 2018, CRL Security has initiated and completed 77 separate improvement activities as part of an annual improvement strategy covered under a 10-year strategic security plan aimed at streamlining existing processes and modernizing its capabilities for the future. These include the development and ongoing analysis of key performance indicators relative to security, enhancements to personnel screening and access control equipment, implementation of fully digital security clearance screening processes and significant upgrades to its alarm detection and assessment capability. Improvement initiatives are continuing into 2023 and beyond.

In 2021, CNSC issued an Order to CNL related to CRL Security. CNL has been working to complete activities necessary for that Order to be closed. In 2023 May, CNL submitted a Tactical Response Plan to CNSC staff which was accepted in 2023 June; CNL is awaiting a response. While the CRL site was never at risk or vulnerable from a security perspective, CNL did fall short of its very high standards. In ensuring that all regulatory requirements continue to be met, the following activities have been implemented:

- A Security Program Oversight Plan to ensure appropriate leadership oversight and alignment with the CNL Management System;
- Project execution plans to complete activities necessary for closing the CNSC Order;
- Internal quality audits comparing CRL Security Program compliance against CNSC regulatory requirements;
- Establishment of an Executive Security Council to provide a forum at the senior management level to routinely discuss and disposition security issues; and
- The inclusion of a special Security Nuclear Performance and Assurance Board session on a quarterly basis to allow for peer analysis and feedback on Security issues.

5.6 Fitness for Service

CNL's Fitness for Service Program incorporates the management of aging of facilities in various maintenance and equipment reliability programs. Using performance monitoring plans, age-related degradations and maintenance strategies help maximize the reliability of equipment and facilities.

In 2022, an Aging Management self-assessment was conducted and identified deficiencies at several CRL facilities, which were communicated to CNSC staff. To address these issues, CNL has undertaken a full revision of the management system documentation on Aging Management, and an implementation plan was created. CNL has been performing and continues to perform preventive maintenance tasks; condition-based maintenance on categorized structures, systems, and components; and routine monitoring of facility data to mitigate the risk of component failure due to age-related degradation mechanisms. This preventive maintenance, along with routine inspections and facility monitoring routines, ensures the safety margin is being adequately managed at the facilities.

5.7 Training

CNL's Training and Development organization maintains the training program's governing documents and oversees the implementation of a Systematic Approach to Training (SAT) per the Training and Development's program description documents. Training and Development's SAT-based program satisfies the licensing conditions and legislative/regulatory requirements as outlined in CNL's Management System documents.

CNL maintains a SAT program that provides a standardized approach to training and qualification to ensure that personnel and positions identified as requiring SAT are trained, competent and qualified for the work they are assigned. CNL maintains a list of positions and roles requiring SAT-based training programs in compliance with REGDOC-2.2.2, *Personnel Training*.

The Training and Development Program is implementing an action plan to ensure that all necessary components of the SAT programs are in place. To date, 65% of the actions have been completed, with planned completion of all actions by 2023 October. In the interim, while training program documentation is being upgraded, CNL has ensured that employees' assignments to perform listed positions and roles are controlled and that CNL staff serving in these positions and roles are assessed for their ability to competently perform these assignments. CNL maintains a sufficient number of qualified staff to perform their licensed activities.

CNL continues to maintain two NRU Certified Health Physicist positions at CRL, with the recertification of one Health Physicist required in 2026 September and the other in 2027 December. CNL will continue to maintain a sufficient number of NRU Health Physicist certifications until CNL has reduced the NRU radiological risks to demonstrate the position is no longer required.

In 2022 July, CNL transitioned to a new Learning Management System, a cloud-based solution that is recognized as the gold standard in compliance-based learning management systems.



By upgrading the Learning Management System platform to a cloud solution, CNL has gained the ability to:

- Easily create, catalogue, manage and track all types of learning activities, including web-based, instructor-led, blended and virtual courses and classes to improve training delivery options for the growing remote workforce across several time zones;
- Safeguard and backup all training content and training records on off-site Canadian servers, which will ensure cloud access to training qualifications from any mobile device or from an Emergency Operations Command Centre in the event of an emergency;
- Silently audit user actions, approvals and workflows to ensure tracking of the evolution of training programs;
- Integrate first class computer programming and technology to build and publish standardized self-serve global reporting templates to ensure consistent delivery of official training data reports at all levels of the company; and.
- Distill multiple complex training program requirements into simplified task-based training assignments, which will provide the background architecture to return a compliant or non-compliant status in an easy-to-use Qualification Checker Report.

CNL is currently creating SAT-based safety-training-related roles within the new Learning Management System that support conventional safety training across CNL. These roles can be assigned by managers to ensure that the training required for performing additional safety roles outside of position-specific training is captured and tracked.

6. Conclusion

The long-term vision of CNL is that the CRL site continues as a sustainable world-class national nuclear laboratory delivering science and technology structured to meet current and changing Canadian federal, commercial, and public priorities. CNL's enduring purpose is to continue the advancement of nuclear science and technology to achieve CNL's three primary priorities: restoring and protecting the environment, developing clean energy for today and tomorrow, and enhancing the health of Canadians.

Over the first half of the licensing period, CNL realized several major achievements to address the nuclear legacy and historical waste liabilities, to expand the science and technology capabilities, and to fully enable the need for in-depth nuclear research and development. Over the second half of the licence period, CNL will continue to advance work in radioisotopes with increased production of actinium-225, decommissioning and cleanup of the legacy liabilities at the CRL site, and focusing on Small Modular Reactors and other clean energies.

Safety is the utmost priority for CNL operations. Conventional, radiological, environmental performance and security requirements have been met or exceeded and will continue to be met through the dedicated staff and safety culture that has been established by the implementation of the processes, procedures and programs governed by the improved integrated Management System. Safe operation extends protection to CNL employees working at the site and remotely, contractors, visitors, members of the public and the environment.

In support of true and lasting reconciliation with Indigenous peoples, including economic reconciliation, CNL aims to develop and strengthen capacity and competencies by building partnerships and collaboration with Indigenous Nations, communities, organizations and businesses, and by helping to reduce barriers to procurement opportunities and enhance economic outcomes for Indigenous Nations, communities and organizations.

CNL is committed to meaningful engagement with Indigenous Nations, communities and organizations in respect of its projects and activities at the CRL site and to cooperatively address any interests and concerns that may be raised.

Appendix A Update on CRL Class I and Class II Nuclear Facilities

Nuclear Fuel Fabrication Facility

The Nuclear Fuel Fabrication Facility was previously used to produce the driver fuel and isotope targets for the NRU reactor. Following completion of the NRU reactor fuel production mission, the fuel fabrication equipment was placed in a safe shutdown state and the facility was re-tasked with repackaging activities related to the repatriation to the United States of high-assay low-enriched uranium. In support of the repatriation activities, the Criticality Safety Document for Nuclear Fuel Fabrication Facility was updated, which resulted in the removal of legacy workstations and the addition of a new fuel press station to create compacts from scrap material for repatriation. The second floor of the facility, formerly office space for the staff related to NRU fuel production, was repurposed as Class B laboratory space to house the Fuel Assembly Science and Technology laboratory.

Recycle Fuel Fabrication Laboratory

The Recycle Fuel Fabrication Laboratory continues to focus on projects in support of CNL's science and technology mission and commercial work, including work associated with molten salt synthesis and Small Modular Reactor fuel development.

In 2019, installation of two new inert atmosphere, negative pressure gloveboxes for research into actinide salt fuels was completed. While required improvements to one of the gloveboxes are being conducted, the inert atmosphere glovebox has been temporarily converted to an air-swept glovebox in order to remove the argon atmosphere purifier unit for maintenance. It will remain in this state until the improvements are completed.

In 2020, the facility became aware that dissolution activities in the chemistry gloveboxes were not adequately described in its Criticality Safety Document. All dissolution activities and the movement of fissionable material within the laboratory were suspended while an amendment to the Criticality Safety Document was created to ensure work could proceed safely.

In 2021, permanent klaxon repeaters were installed the facility when it was discovered that criticality klaxons are inaudible in some parts of the attic. This was found during routine inspections, and at no time were the staff of the facility at risk.

Zero Energy Deuterium Reactor

The ZED-2 Reactor continues to perform reactor physics measurements and fuel studies in support of CANDU® reactor operations and life extension initiatives, neutronic equipment calibrations, as well as facilitating dosimetry and radiobiology research. It has operated approximately 325 hours over 198 operating periods in the last five years.

In response to several temperature-related and humidity-related trips to the reactor, a new cooling system was installed to maintain environmental conditions in the control system cabinets. Replacement amplifiers to alleviate the sensitivity to environmental conditions are undergoing testing.

Additionally, in conjunction with the Nuclear Materials Operations group, the quantity and type of fuels used and stored in the ZED-2 facility were evaluated with the goal of minimizing the fuel in the facility to that which was required for current and expected future work. This work is ongoing.

Tritium Laboratory

The Tritium Laboratory supports various commercial opportunities and science and technology projects and provides tritium expertise to CNL programs. Tritium Laboratory operations during the licence period have included dispensing tritium and preparing tritium gas standards, supporting tritium betavoltaics development, and other research and development.

In 2019 April, CNL relocated the Tritium Laboratory from Building 250 to a newly renovated facility, built and designed to modern codes and standards, and transferred Building 250 to decommissioning. This move provides the facility with a modernized space, improving safety and enabling continued advancement of tritium research.

In 2021 January, the contents from the temporary tritium vault, located in the Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation Test Facility, were transferred to the permanent tritium vault in the Tritium Laboratory.

Fuels and Materials Cells

CRL's Fuels and Materials Cells facility is part of the overall facilities known as Shielded Facilities and is where post-irradiation examination of irradiated fuel bundles, reactor core components and material specimens in support of the CANDU® reactor fleet is conducted. These examinations are offered to the reactor community to enable compliance testing of fuels or materials to ensure safety compliance with the regulator. The suite of examinations is divided between the Fuels and Materials Cells and the Universal Cells.

The testing and examination of light water reactor fuel was successfully added to the suite of testing when testing techniques were modified to adapt to the different fuel type. New fuel coring equipment has been developed, tested and put into service. This equipment prepares a section of fuel by removing the fuel from the sheath where it then sent to the Universal Cells for burst testing.

A new scanning electron microscope / focused ion beam is in the process of being installed within the facility. This new equipment will replace the microscope that failed in 2018. This new equipment will also give the facility a new capability of milling out samples using the focused ion beam small enough (size of a pepper flake) to be sent to other facilities for examination as the radiation fields and contamination levels will be within lab protocols.

Universal Cells

As with the Fuels and Materials Cells, the Universal Cells are part of the overall facilities known as Shielded Facilities. The primary operations in the Universal Cells facility have included the processing of cobalt-60, radioisotope process development, and conducting post-irradiation examination of irradiated fuel bundles, reactor core components and material specimens in support of the CANDU® reactor fleet.

Universal Cells also added testing and examination of light water reactor fuel to the suite of testing conducted at the facility. Tooling and procedure upgrades were performed allowing safe completion of the new testing including gamma scanning, profilometry, visual examinations, gas puncture and fuel sheath burst testing. These new testing capabilities will be carried forward to the new ANMRC that is presently being designed and built.

CNL has identified the Universal Cells facility as uniquely suited to support production of actinium-225 – a very promising radionuclide that can be used for targeted alpha-particle therapy.

Various upgrades and maintenance to the Universal Cells have been completed to ensure staff safety is maintained; this includes the installation of two whole body monitors to provide better contamination detection and control, removal of remaining cobalt-60 processing equipment that is no longer in use and replacement of the dolly drawbridges on two cells to provide better reliability.

Waste Treatment Centre

The Waste Treatment Centre is the primary facility at the CRL site for treatment of low-level radioactive liquids generated by CNL operations and decommissioning activities.

The primary generator of liquid waste has historically been from operations at the NRU reactor; however, since NRU was permanently shut down, the annual volumes treated have been decreasing, as noted in Table 4.

Table 4: Primary Sources of Liquid Waste and Volumes

Sources of Liquid Waste	2018	2019	2020	2021	2022
Decontamination Centre Waste (m ³)	669	642	399.3	375.9	52
Chemical Active Drain System Waste (m ³)	52	73	21.6	19.5	0
Reactor Active Drain System Waste (m ³)	790	152	85	40.9	272.7
Other Liquid Waste (m ³)	69	153	47.5	52	8.6
Total Liquid Waste Processed (m³)	1,580	1,020	533.4	488.3	333.3
Liquid Waste Immobilization (Bitumen)					
Number of Drums of Bituminized Waste Product	47	42	28	0	10

The primary sources of liquid waste to the Waste Treatment Centre are currently from various laboratories at the CRL site via the active drain system or through overland transfer.

The overall reduction in liquid wastes since the shutdown of the NRU reactor has resulted in less frequent operation of the liquid waste evaporator, and consequently less need to produce drums of solidified waste product.

As the Waste Treatment Centre will also be the primary treatment facility for the Stored Liquid Waste Project, as discussed in Section 4.1, several facility upgrades have been recently completed including:

- Installation of a shielded receipt system to safely receive stored liquid wastes;
- Upgrades to the chemical injection skids (improved ventilation and upgrades of the piping);
- Improvements to the thin film evaporator cell ventilation;
- A chemical storage shed to store drums of acid needed to neutralize waste;
- Improvements to the delivery of bitumen (solidifier) to the thin film evaporators; and
- A system to add acid directly to tanks in the Holding Tank Facility.

Waste Management Areas

The WMAs provide facilities for safely storing and processing a variety of radioactive wastes, ranging in activity from very low levels up to that of irradiated nuclear fuel. The WMAs consist of both operational and non-operational areas. The operational areas include areas within B, D, G, H and J. The non-operational areas include areas within A and components of B, C, E, F and liquid dispersal areas.

Significant physical security improvements have been made at the CRL WMAs since 2018. These include enhancements to intrusion detection, delay and assessment capabilities and its supporting infrastructure, and advancements in emergency response planning to support CNL current and future operations in the WMAs.

Radioactive wastes continued to be emplaced in the operating areas in from 2018 to 2023. Table 5 summarizes the volume of waste added to areas B, D and H from waste generators categorized as CNL and non-CNL or other off-site generators from 2018 to 2022. In the last five years, the liquid dispersal area; thorium nitrate dispersal; ammonium nitrate destruction plant; and areas A, C, E and F continued to be managed as non-operational facilities and thus received no additional waste.

Table 5: Annual Volume of Waste Emplaced in Waste Management Areas B, D and H

Location	Facility	Waste Source	Waste Volume Additions (m ³)				
			2018	2019	2020	2021	2022
WMA B	Bunkers	CNL ^a	27.53	12.578	9.138	9.994	17.095
		Non-CNL	0.557	0	2.837	0.013	0
		Total	28.09	12.578	11.975	10.007	17.095
WMA B	Tile Holes	CNL ^a	11.96	9.623	4.601	3.823	5.159
		Non-CNL	2.849	2.849	4.44	2.96	2.701
		Total	14.81	12.472	9.041	6.783	7.86
WMA B	Fuel Packaging and Storage	Total	3.50^b	0	0	0	0
WMA H	MAGS / SMAGS ^c	CNL ^a	827.04	879.05	180.69	310.86	346.43
		Non-CNL	46.23	52.23	38.92	16.819	22.111
		Total	873.28	931.28	219.61	327.684	368.54
WMA D and H	Surface Storage	CNL ^a	3,086.89 ^d	6,857.05 ^d	3,143.96 ^d	3,492.235	1,089.703
		Non-CNL	21.6	0	41.43	5.52	20.81
		Total	3,108.49^d	6,857.05^d	3,185.39^d	3,497.755	1,110.513
Total Waste Emplaced (All Facilities)			4,028.17	7,813.38	3,426.02	3,842.229	1,504.009

a Includes waste generated from any CNL sites that is transferred to CRL (e.g., returned from supply chain volume reduction processing).

b Final fuel within the Fuel Packaging and Storage Project scope transferred into the Fuel Packaging and Storage Facility.

c MAGS = Modular Above-Ground Storage; SMAGS = Shielded Modular Above-Ground Storage.

In 2022, WMA G was returned to an operational area status in preparation for receiving used fuel inventories from the Whiteshell and Gentilly-1 sites as part of the consolidation of radioactive waste discussed in Section 4.1. In 2019, the construction of 10 new concrete canisters was completed, and in 2022 active commissioning was completed. Also in 2022, an additional 12 concrete canisters were constructed and are awaiting active commissioning later this year. Other upgrades included an outer perimeter road that was constructed around the compound fence line to enhance security of the area.

In 2020, the Fuel Packaging and Storage Project was concluded and the facility has now been placed in long-term monitoring and surveillance. The objective of the Fuel Packaging and Storage Project was to enable the retrieval of the most corrosion-vulnerable experimental fuel from older tile holes, transfer them to the new facility for drying and long term above ground storage. This was a significant milestone in reducing future environmental risk and a major step towards the environmental cleanup. This project has successfully retrieved, dried and stored 96 historical used fuel cans, placing them in a safe state.

In 2020, the Sort and Segregation Pilot came into operation, and in 2022 the full-scale Sort and Segregation Facility commenced processing low-level radioactive waste. The purpose of these

facilities is to allow for the sorting and segregation of legacy waste to apply modern waste practices and reduce the volume of radioactive waste. An example of segregation includes dismantling an item by reducing it into individual pieces to segregate contaminated and non-contaminated sections. During Sort and Segregation activities in 2022, 173 m³ of legacy waste was processed, allowing 46% by volume to be redirected as clean waste.

In 2018, storage capabilities for low-level radioactive waste were expanded through above ground storage in sea-containers. This includes current surface storage areas in WMA D and H. In 2022, physical modifications to the surface of WMA C commenced in preparation for returning the area to an operational area status in order to expand the available surface storage. Construction activities are anticipated to be completed later this year.

Molybdenum-99 Production Facility

The Molybdenum-99 Production Facility continues to focus on heating, sampling and monitoring the contents of the Fissile Solution Storage Tank. The tank was filled from 1986 to 2003 with target residual material solution, an acidic and radioactive solution that was generated during the processing of the molybdenum-99 targets used for cancer treatments. CNL initiated a program to repatriate this material from the facility to the US Department of Energy, and the project was safely completed in just under eight years. This included a three-year operations phase to complete 115 shipments, with the final shipment in 2020 August. The successful completion of the Target Residual Material Project reduced Canada's nuclear liability through the elimination of more than 4,000 TBq in fission products with the safe retrieval and transfer of approximately 23,000 L of target residual material from the Fissile Solution Storage Tank to the US Department of Energy.

The Molybdenum-99 Production Facility is currently planning the cementation of the remaining heel of target residual material solution in the tank. The project is in the design phase and operations are scheduled to start in 2024. The facility continues to control and monitor the solution to ensure chemical stability.

Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation Test Facility

The Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation test facility has been in a safe shutdown state since 2001 May. In 2021 January, the contents of the temporary tritium vault located in the facility were transferred to the permanent tritium vault in the Tritium Laboratory, amalgamating all tritium work into the new Tritium Laboratory, and reducing hazards in the test facility.

In 2022 September, CNL submitted a licensing basis assessment to CNSC staff to modernize the facility and permit production-scale detritiation of AECL's legacy inventory of tritium-contaminated heavy water. CNL provided systematic hazard assessments to support the licensing basis assessment, comparing the hazards between the current facility and the proposed new modernized facility. CNL demonstrated that the proposed modernized facility, known as the Modernized Combined Electrolysis and Catalytic Exchange Facility, results in a decrease in hazards compared

to the existing facility and that no new activities are being introduced. The licensing basis assessment for the proposed modernized facility received CNSC staff concurrence in 2023 April. CNL intends to transition the existing Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation test facility to a permanent safe shutdown state and ultimately to a storage-with-surveillance state. The storage-with-surveillance plan for the existing facility is in progress. See Section 2.2 for information on the Modernized Combined Electrolysis and Catalytic Exchange Facility.

National Research Universal Reactor

The NRU Reactor ended operation in 2018 March after over 61 years of operation, at which point the process to prepare the facility for permanent safe shutdown was initiated. The reactor was defueled of both reactor driver fuel and experimental loop fuels, followed by draining of the heavy water from the reactor vessel and main heavy water system. All control and adjuster rods were removed from the reactor and transferred to the NRU Rod Storage Bays.

The Permanent Safe Shutdown Project has systematically completed the permanent shutdown of 65 reactor and support systems between 2018 March and 2023 April to achieve a state suitable for storage-with-surveillance. The Permanent Safe Shutdown Project included construction of a stand-alone ventilation system to replace the existing reactor ventilation system (Figure 40), and reconfiguration and amalgamation of the NRU electrical system to reduce their operational and maintenance requirements.



Figure 40: Replacement of the Reactor Ventilation System

The transition of the facility to storage-with-surveillance had been planned to occur by 2021 April, but the decision was made to delay transition to continue the work on the stand-alone ventilation system and the electrical amalgamation project and continue with ongoing hazard reduction throughout the facility.

Nearly all of the heavy water inventory drained from the reactor and the main heavy water system, along with the inventory stored in the heavy water storage tanks (approximately 120,000

litres), was purified using the heavy water purification system and safely transferred to drums then transferred to the LaPrade Facility for safe storage.

Post-operations clean-out is in progress and has resulted in a significant reduction in material throughout the facility. Equipment that can be re-used or repurposed is transferred to groups that can make use of the equipment to reduce contributions to waste volumes (e.g., neutron spectrometers from the reactor face were transferred to another licensed facility to support their neutron scattering program).

The NRU Rod Storage Bays continue to operate to serve the needs of the science and technology mission with experimental fuel and material storage, as well as receiving and storing all NRU driver fuel. All NRU driver fuel was transferred to the WMAs for long-term storage, reducing the overall radiological hazard associated with the Rod Storage Bays. Experimental fuel inventories were reviewed to keep the least amount of irradiated fuel in the bays as possible. In the future, the rod bays will be operated as a stand-alone facility under their own Facility Authorization and supporting Safety Analysis.

Completion of existing projects, post-operations clean-out and rod bays clean-out will be the primary activities occurring during the remainder of the licensing period.

Class II Nuclear Facilities

The CRL site contains four Class II Facilities:

- **Health Physics Neutron Generator**—contains two neutron generators and one californium-252 device for the purposes of neutron interaction studies, instrument/dosimeter development, testing and calibration, and radiobiology studies. An additional neutron generator has been installed in the facility and will soon undergo commissioning.
- **Van de Graaff Electron Accelerator**—is a high-energy electron irradiator that can be used to imitate reactor dose rates in small volumes. It continues to be used to study radiation chemistry and has been used to support research for the CANDU® reactor fleet and Advanced Reactors.
- **Gamma Beam Irradiation Facility**—houses two cobalt-60/cesium-137 irradiators, which are used for open beam gamma-irradiation for a variety of applications supporting science and technology initiatives investigating the effects of ionizing radiation on various biological systems and processes, including effects on cancer development and immune system function.
- **Gamma Beam Irradiators**—houses a cobalt-60/cesium-137 gamma irradiator and X-Ray irradiator. It is used for the calibration of CNL radiation monitoring equipment, testing of radiological detection instrumentation and regulation-related dosimeter inter-comparisons with Canadian utilities.

Nuclear Facilities in Extended Shutdown State

Since relicensing, the Dedicated Isotope Facilities building are the only nuclear facilities at CRL in the extended shutdown state. These facilities are comprised of the Maple 1 and Maple 2 reactors and the New Processing Facility. These facilities remained non-operational and in the extended shutdown state. CRL staff from other facilities provide support for surveillance and maintenance activities within these buildings to ensure they are safely maintained in their extended shutdown states.

Nuclear Facilities Undergoing Decommissioning Activities

The following facilities or buildings are currently undergoing decommissioning activities:

- NRX Reactor Building
- NRX Fuel Storage Bays
- Wastewater Evaporator
- Plutonium Recovery Laboratory
- Filtered Water Storage Reservoir
- Active Waste Disposal System
- Chemical Engineering Lab/Offices including the former Tritium Facility (Bldg 250)
- NRX Ancillary Buildings
- Process Water Live Valve House
- Former Reactor Bay Deionization System
- Plutonium Tower
- Nuclear Fuel Fabrication Facility (Bldg 429)
- Former Maple and Decommissioning Offices

Routine monitoring, maintenance and surveillance programs continue in all these buildings and facilities as decommissioning progresses.

Acronyms

AECL: Atomic Energy of Canada Limited

ALARA: As Low As Reasonably Achievable

ANMRC: Advanced Nuclear Materials Research Centre

CEDIR: Clean Energy Demonstration, Innovation & Research

CNL: Canadian Nuclear Laboratories

CNSC: Canadian Nuclear Safety Commission

CRL: Chalk River Laboratories

NRU: National Research Universal

NRX: National Research Experimental

NSDF: Near Surface Disposal Facility

SAT: Systematic Approach to Training

WMA: Waste Management Areas

ZED-2: Zero-Energy Deuterium-2

