Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 22-H7.1

File / dossier : 6.01.07
Date: 2022-01-24
Edocs: 6722433

Written submission from the Canadian Nuclear Laboratories

Mémoire des Laboratoires Nucléaires Canadiens

In the Matter of the

À l'égard de

Canadian Nuclear Laboratories, Chalk River Laboratories

Laboratoires Nucléaires Canadiens, Laboratoires de Chalk River

Application to amend its Chalk River Laboratories site licence to authorize the construction of a near surface disposal facility

Demande visant à modifier le permis du site des Laboratoires de Chalk River pour autoriser la construction d'une installation de gestion des déchets près de la surface

Commission Public Hearing
Part 1

Audience publique de la Commission
Partie 1

February 22, 2022

22 février 2022

Canada

Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

Commission Member Document for Licensing Decision

Chalk River Laboratories Site Licence Amendment to Authorize the Construction of the Near Surface Disposal Facility

232-508760-REPT-002

Revision 0

Approved by: P. Boyle — 2022/01/24

P. Boyle
VP, CTA & CNO

Date

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EXECUTIVE SUMMARY

Canadian Nuclear Laboratories (CNL) is applying to the Canadian Nuclear Safety Commission (CNSC) to construct a Near Surface Disposal Facility (NSDF) for the safe disposal of solid low-level radioactive waste at Chalk River Laboratories (CRL) in Deep River, Ontario.

CNL respectfully acknowledges that the CRL site is located on the unceded and unsurrendered territory of the Algonquin Anishnaabe 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 title on the lands where we work.

This Commission Member Document is presented to the Commission Registry for an amendment of the Nuclear Research and Test Establishment Operating Licence for CRL (NRTEOL-01.00/2028) to add a new Class IB Nuclear Facility, the NSDF, to the CRL licensing basis. This document summarizes the evidence that demonstrates the NSDF meets all requirements of the *Nuclear Safety and Control Act* and associated regulations, and that CNL is fully equipped to carry out the licensed activities associated with the NSDF Project to ensure the protection of people and the environment.

CNL is Canada's premier nuclear science organization and a world leader in developing technology for peaceful and innovative applications. This work includes the production of medical isotopes for the diagnosis and treatment of over one billion patients worldwide, as well as developments in clean energy that reduce greenhouse gas emissions. The revitalization of the CRL campus, which is currently underway, will allow that innovative science to continue into the future.

These advancements in nuclear science and technology, and the efforts to revitalize CRL, have created waste. Although CNL has been safely managing low-level radioactive waste at the CRL site, past waste management practices are no longer acceptable. The practice of continuing to build additional temporary storage systems is not consistent with modern waste management principles, and a permanent disposal solution is required to ensure continued protection of surrounding environmental features, including the Ottawa River.

The purpose of the NSDF Project is for the permanent disposal of current and future low-level radioactive waste at the CRL site. The CRL site is owned by Atomic Energy of Canada Limited (AECL), a federal Crown corporation. AECL has contracted CNL to manage and operate its sites. The NSDF Project will enable CNL to fulfill its strategic priorities to advance nuclear science and technology and restore and protect Canada's environment.

The proposed location for the NSDF is entirely within the licensed site boundary of the CRL site, where a robust set of policies, processes, and controls, known as the CNL Management System, are firmly in place. Over many years of experience, CNL has developed controls for all aspects of its operations including, but not limited to, human performance and training, radiation protection, conventional health and safety, physical and cyber security, emergency response,

and environmental protection. This management system is designed to protect workers, Indigenous Peoples, the public, and the environment.

The NSDF has a footprint of approximately 37 hectares, which is less than 1% of the total area of the CRL site. The facility will include an engineered containment mound to fully isolate the waste from the surrounding environment, and a dedicated wastewater treatment plant for the collection and treatment of precipitation that comes into contact with the waste, producing treated effluent that meets discharge targets established to be protective of surrounding waterways. Following a 3-year construction phase, the disposal facility is expected to be operational for at least 50 years, and the containment mound has a design life of 550 years, which is appropriate for low-level radioactive waste. The facility has been designed to endure extreme environmental conditions such as heavy rain storms and seismic events.

The NSDF will only hold low-level radioactive waste. This consists of contaminated soils, building materials (mainly from decommissioning activities underway at the CRL site), and general items such as mops, protective clothing, and rags. Approximately 90% of the low-level radioactive waste planned to be placed in the NSDF is currently located on the CRL site. A small percentage of low-level radioactive waste from commercial sources such as Canadian hospitals and universities will also be accepted. It is important to note that CNL has well-established waste processes to ensure that only the waste appropriate for the NSDF is accepted for disposal.

As a prerequisite to the licence amendment decision, the Commission must also make an environmental assessment decision to determine whether the proposed activities are likely to cause significant adverse environmental effects. In accordance with the *Canadian Environmental Assessment Act (2012)*, careful consideration was given to environmental, technical, and economic factors during the assessment of alternative means to carry out the project, including the site selection process. The CRL site was determined to be the most suitable location for the facility because of its geological characteristics, its location well above the floodplain, and its proximity to current waste storage areas, alleviating the need to transport the waste material along public roadways. The chosen location within the Perch Lake Watershed has been well studied and is located along a bedrock ridge that naturally forces water directly away from the Ottawa River. Overall, it is CNL's conclusion that with the identified mitigation measures, the implementation of the NSDF Project is not likely to result in significant residual adverse effects.

Both the EA and licensing decisions trigger the Crown's duty to consult, and where appropriate, to accommodate Indigenous peoples whose potential or established Indigenous and/or treaty rights, under section 35 of the *Constitution Act, 1982,* have the potential to be impacted by the proposed NSDF project. The CNSC is responsible for discharging the Crown's duty to consult in this case. CNL has sought to build meaningful relationships with Indigenous Communities while gaining an understanding of the cultural knowledge of Indigenous Peoples. CNL acknowledges that Indigenous Peoples have been taking care of this land for many generations, and we remain committed to advancing Reconciliation through meaningful actions. On an ongoing basis, CNL provides information to Indigenous Communities about the potential effects of Project activities on Indigenous and/or treaty rights, including rights to hunt, trap, fish, and

conduct cultural ceremonies. Indigenous engagement is ongoing and is conducted in accordance with CNSC REGDOC 3.2.2 *Indigenous Engagement*.

Public engagement is another key element of the environmental assessment process. CNL has conducted public engagement activities related to the NSDF Project since 2016 in accordance with the requirements of *Canadian Environmental Assessment Act (2012)*. The core principles of CNL's engagement strategy include the provision of numerous and varied opportunities for meaningful dialogue about the NSDF Project, soliciting public feedback and incorporating public input, where feasible, during the planning phase.

As a key aspect of the NSDF Project, CNL will expand its already extensive environmental monitoring of the CRL site – sampling of air, surface water, and groundwater – to include the NSDF Project. The Environmental Assessment for the NSDF Project does not predict any significant adverse impacts to people, animals or the environment, with the implementation of the proposed mitigation measures. Ongoing monitoring will confirm these predictions, and the proposed facility will be subject to regulatory oversight of the CNSC.

To demonstrate that the NSDF Project will not pose a risk to human health and safety during the entire life cycle of the facility, CNL conducted scientific evaluations that included a number of different scenarios and their predicted effects on workers, Indigenous Peoples and the public. Safety assessments conducted for the project show no unacceptable risk during construction, operation, closure, or post-closure.

CNL has demonstrated that the NSDF Project is the appropriate solution for the permanent disposal of low-level radioactive waste at the CRL site. The engineering features of the NSDF Project represent an increase in safeguards to protect the Ottawa River and the environment. The preferred location of the NSDF within the licensed CRL site boundary enables CNL to manage and control all aspects of the NSDF Project for the protection of its workers, contractors, Indigenous People, members of the public, and the environment.

CNL submits this document for consideration to support the amendment of the Nuclear Research and Test Establishment Operating Licence of CRL to include a new Class IB nuclear facility, the NSDF, thereby enabling CNL to proceed with construction of the disposal facility.

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1. Introduction

The purpose of this document is to present information in support of the application from Canadian Nuclear Laboratories (CNL) [1] to amend the current Chalk River Laboratories (CRL) Nuclear Research and Test Establishment Operating Licence [2], authorizing CNL to proceed with construction of the Near Surface Disposal Facility (NSDF). The NSDF will be a Class IB nuclear facility for the disposal of solid radioactive low-level radioactive waste located at the CRL site in Deep River, Ontario (Figure 1 and Figure 2).

Low-level radioactive waste is suitable for disposal in engineered near surface facilities that provide robust isolation and containment for periods of up to a few hundred years in alignment with guidance from Canadian Nuclear Safety Commission (CNSC) REGDOC-2.11.1, *Framework for Radioactive Waste Management and Decommissioning in Canada* [3] and International Atomic Energy Agency (IAEA) GSG-1, *Classification of Radioactive Waste* [4].

CNL respectfully acknowledges that the CRL site is located on the unceded and unsurrendered territory of the Algonquin Anishnaabe Nation. CNL recognizes and appreciates their historical connection to this land, and as the customary keepers and defenders of the Ottawa River Watershed and its tributaries. CNL also recognizes and appreciates 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 the unique Indigenous history, rights, and title on the lands where we work.

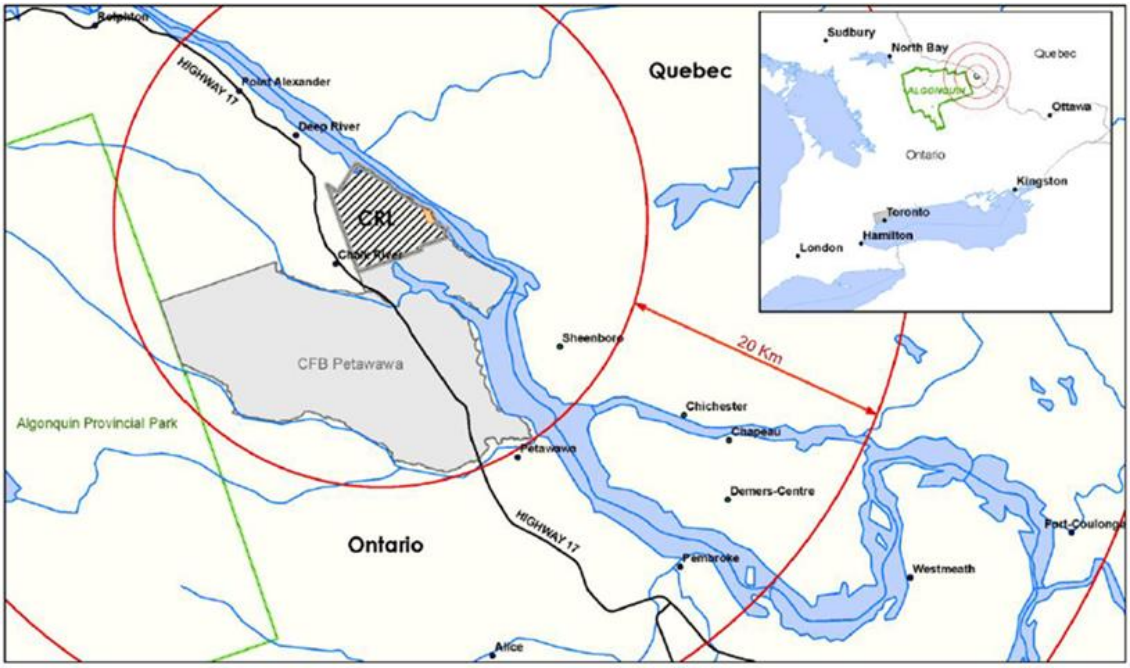


Figure 1: Location of Chalk River Laboratories

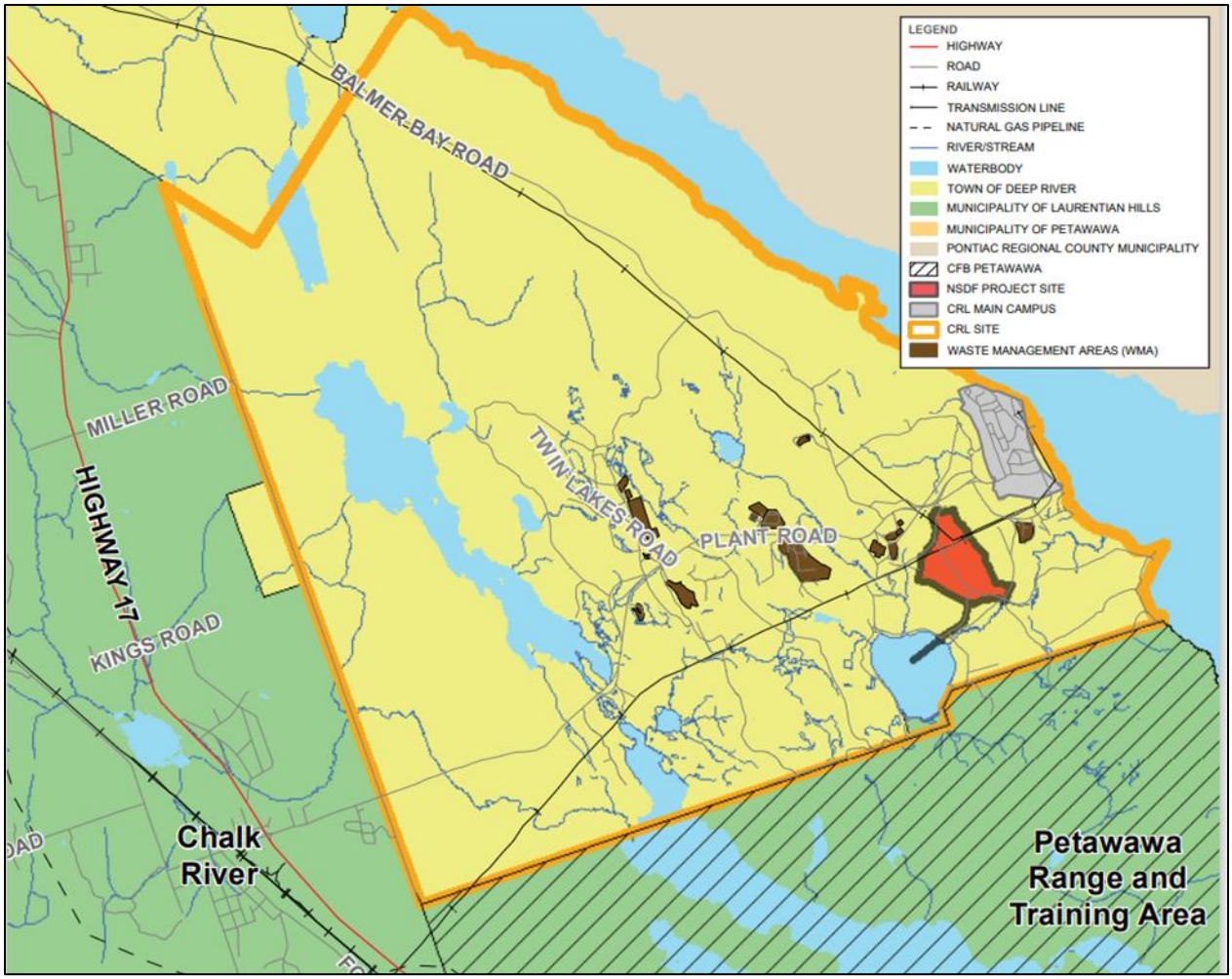
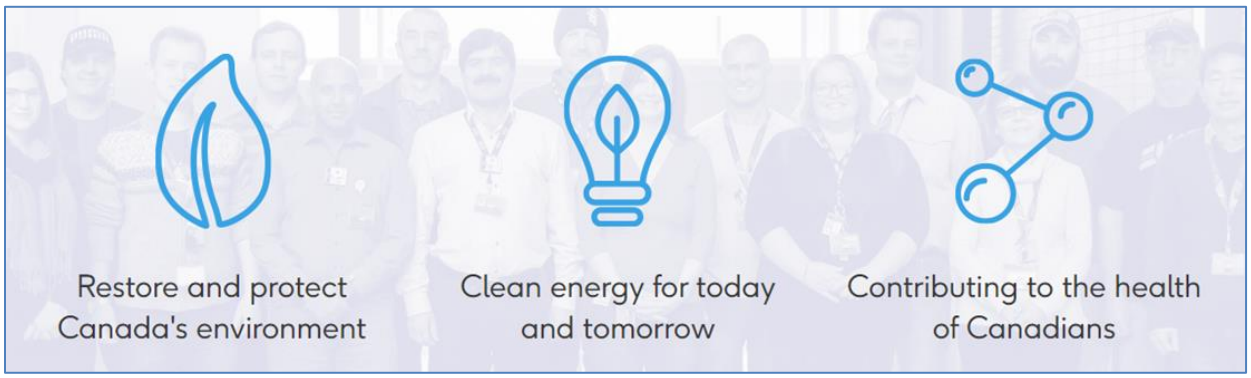


Figure 2: Location of Near Surface Disposal Facility within Chalk River Laboratories Site

1.1 Canadian Nuclear Laboratories Strategic Priorities

CNL is Canada's leading nuclear science and technology organization and a world leader in developing innovative applications for nuclear technology. Services offered through CNL include research and development, design and engineering of specialized technology, waste management, 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.

The following are CNL's strategic priorities:



The NSDF is for the disposal of solid low-level radioactive waste at the CRL site and (the NSDF Project) is a key enabling project for CNL to move forward with its strategic priority to restore and protect Canada's environment, as detailed in Section 1.2.

1.1.1 Management Structure

Atomic Energy of Canada Limited (AECL) has contracted CNL to manage and operate its sites and facilities across Canada. CNL is also contracted to carry out AECL's mandate to enable nuclear science and technology and to protect the environment by fulfilling the government of Canada's radioactive waste and decommissioning responsibilities. In turn, AECL sets the direction and oversees the contract.

AECL delivers its mandate through a government-owned, contractor-operated model, whereby a private-sector organization, CNL, is responsible for managing and operating AECL's sites (Figure 3). 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.

CNL is the licensee responsible for the CRL Nuclear Research and Test Establishment Operating Licence [2] that has proposed to carry out the designated NSDF Project. As such, CNL is the proponent for the development of the NSDF Project and associated infrastructure.

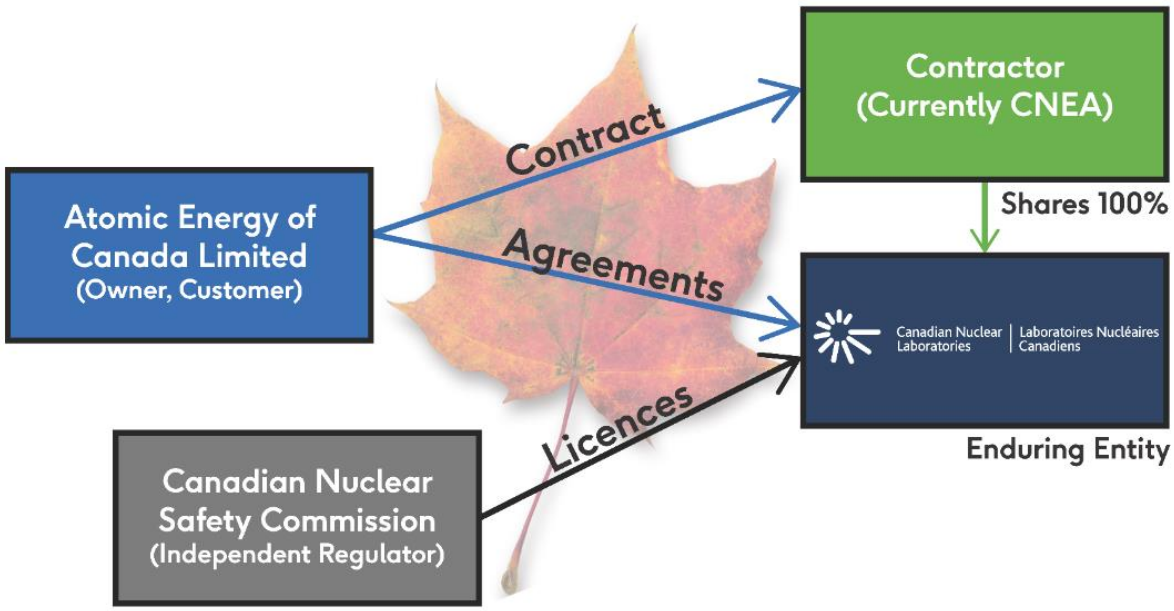


Figure 3: Canadian Nuclear Laboratories and Atomic Energy of Canada Limited Government-Owned Contractor-Operated Model

1.1.2 NSDF Project Organization

CNL is led by an Executive Team and a Board of Directors. The President and Chief Executive Officer, along with a Chief Operating Officer and Vice Presidents, are responsible for different aspects of the business (Section 6.1). A complete list of CNL's Board of Directors and Executive Team is available online at www.cnl.ca. Four Vice Presidents are directly associated with the execution of the NSDF Project.

The Vice President, Environmental Remediation Management and Stewardship and Renewal Group, has overall responsibility for the development of the NSDF Project. This Vice President also has responsibility for the operation of the existing waste services as well as the Waste Management and Cleanup Functions. The Vice President, Central Technical Authority and Chief Nuclear Officer, is the CRL Site Licence Holder and is responsible for the safe and compliant construction and future operation of the facility. This Vice President has the overall responsibility for CNL programs such as Conduct of Operations, Maintenance (Fitness for Service), Design Authority and Design Engineering, Configuration Management, Pressure Boundary, Electrical Safety, Safety Analysis, Training and Development, Commissioning, Quality, Performance Assurance, Compliance, Nuclear Criticality Safety, and Nuclear Materials and Safeguards Management.

The Vice President, Health, Safety, Security, Environmental and Quality, has the overall responsibility for compliance programs for Health, Safety, Security and Environment

Compliance programs, with Directors, such as Radiation Protection, Environmental Protection, Occupational Health and Safety, and Emergency Preparedness supporting these programs. The NSDF Project has been designed and will be operated in accordance with compliance program requirements.

The Vice President, Corporate Affairs, has the overall responsibility for the facilitation of engagement activities with the public and Indigenous Peoples to support the NSDF Project development. Reporting to this Vice President is the Director of Indigenous Relations, who is responsible for leading Indigenous consultation and engagement activities and oversees CNL's efforts to grow its relationships with Indigenous Peoples.

Organization charts for the construction and operations phases of the NSDF Project can be found in Appendix A.

1.2 The Importance of the NSDF Project

CNL proposes to construct and operate the NSDF at the CRL site. AECL owns CRL and the radioactive waste that is located there. As a federal Crown corporation, AECL has a responsibility to take care of its radioactive waste in order to protect the environment and the interests of Canadians in the long term.

Restoring and Protecting Canada's Environment

For more than 75 years, AECL (and now CNL) has been making advances in nuclear science and technology in the interest of Canadians. These include producing medical isotopes that have improved the lives of millions of people in Canada and worldwide, and the CANDU reactors that continue to generate more than 60 percent of Ontario's electricity – clean, emission-free energy. Through investments in the revitalization of the CRL site, that mission and innovative science will continue into the future. However, this proud history has created nuclear liabilities in the form of radioactive waste.

Various modern regulatory guidance documents and CSA standards, such as REGDOC-2.11, *Framework for Radioactive Waste Management* [3] and CSA N292.0-19, *General Principles for the management of radioactive waste and irradiated fuel* [5], provide specifics regarding the design and selection of waste management facilities. The legacy waste management areas at the CRL site were designed and built prior to development of modern standards thus, do not meet all aspects of modern design requirements. Specifically, the legacy waste management areas lack robust containment, which has affected the surrounding environment. Figure 4 shows an example of old waste practices. In this case, an unlined trench (i.e., no engineered barriers) is being filled with waste material in one of the legacy waste management areas on the CRL site.

Figure 4: An Unlined Trench in a Legacy Waste Management Area, circa Late 1960s.

CNL ensures that its workers, the public, and the environment continue to be protected through adherence to existing safety analysis, routine monitoring and taking mitigating actions when appropriate. CNL is actively implementing solutions to retrieve wastes from these legacy waste management areas to place waste in modern and compliant engineered waste management facilities. The NSDF is required to facilitate these activities and has been designed and will be built to modern standards.

The practice of continuing to build additional temporary storage systems at the CRL site for -low-level radioactive waste is also not consistent with modern waste management principles. In accordance with Canada's Radioactive Waste Policy Framework [3], the waste producers and owners of radioactive waste are responsible for the funding, organization, management and operation of disposal and other facilities required for their wastes. Responsible radioactive waste management includes full life cycle management from generation to disposal. As such, AECL, as the waste owner, has asked CNL to identify solutions for waste management of the entire life cycle of all radioactive waste classifications including low-level radioactive waste, intermediate-level radioactive waste, high-level radioactive waste, hazardous waste, and clean (non-radiological) waste.

Aligned with this, CNL has developed an Integrated Waste Strategy [6] that concisely details a cradle to grave approach for all CNL-managed waste classifications, from generation to disposal. The Integrated Waste Strategy [6] is based on CNL's waste inventory and forecast data and built on the fundamental principles of waste avoidance, minimization, and reuse. High- level waste managed by CNL is currently in safe, secure, and suitable storage facilities until a national deep geological repository designed for used fuel becomes available. The current strategy for storing intermediate-level radioactive waste from all CNL-managed sites is safe, secure, and suitable temporary storage facilities at the CRL site until a suitable permanent disposal facility is available. The exceptions to this are the Nuclear Power Demonstration reactor and the Whiteshell Reactor-1 reactor for which the proposed decommissioning approach will be in situ waste disposal.

The purpose of the NSDF Project is to provide the permanent disposal of current and future low-level radioactive waste at the CRL site in a manner that is protective of both human health and the environment. Further, the NSDF Project would enable the remediation of historically contaminated lands and legacy waste management areas, as well as the decommissioning of outdated infrastructure to facilitate the CRL site revitalization.

The NSDF is designed to be a permanent solution that will reduce the liabilities associated with temporary waste storage at the CRL site because the facility has the appropriate design life to contain and isolate the inventory until it is sufficiently decayed. More specifically the facility has been designed for long-term waste management without the need for retrieval. However, CNL will also continue to use the waste hierarchy concepts as application of waste minimization practices ensures an optimized approach to managing the volume of low-level radioactive waste that requires disposal within the NSDF.

1.3 NSDF Project Description

The NSDF Project is a proposed waste disposal facility using an Engineered Containment Mound design built at ground surface that will hold up to 1 million cubic metres (m^3) of solid radioactive low-level radioactive waste. The facility will feature ten waste disposal cells built in two phases. The Engineered Containment Mound includes a multilayer base liner and cover system, where waste will be placed in between. The waste in each cell is covered after the cell is full. It is similar to an engineered municipal landfill but with much more robust engineering features. Included within the proposed Project are other physical components for the collection and treatment of wastewater, support facilities that enable operation, and site infrastructure. The proposed facility would be licensed under the *Nuclear and Safety Control Act* [7] and thus, subject to the associated regulations and independent regulatory oversight from the CNSC.

The proposed location of the NSDF Project is the CRL site in Renfrew County, Ontario, approximately 200 kilometers northwest of Ottawa. The CRL site has an existing Nuclear Research and Test Establishment Operating Licence [2] under the *Nuclear and Safety Control Act* [7] and already contains several nuclear and non-nuclear facilities such as research laboratories and waste management facilities. The CRL site has a total area of approximately 4,000 hectares (ha) and is within the boundaries of the Corporation of the Town of Deep River. The NSDF Project is located entirely within the CRL site and the footprint of the NSDF Project site is approximately 37 hectares, which is less than 1% of the total area of the CRL site. The NSDF Project has also been sloped to minimize visibility from the Ottawa River and the nearest village, Chalk River.

The NSDF will hold only low-level radioactive waste, which contains primarily short-lived radionuclides, and limits the number of long-lived radionuclides. This material will require isolation and containment for up to a few hundred years. The Engineered Containment Mound design life of 550 years has been established to meet the required time period to allow for radiologic decay of the waste inventory.

The types of waste destined for the NSDF include contaminated soils from remediation activities, demolition debris from decommissioning work, and general waste such as used personal protection clothing or equipment. These items are considered low-level radioactive waste as they can be safely handled with limited precautions.

The NSDF will primarily contain low-level radioactive waste currently in storage at the CRL site, waste generated during environmental remediation and decommissioning activities now underway, and expected future waste resulting from ongoing nuclear science and technology activities. A small percentage of the waste volume (approximately 10%) will come from other AECL-owned sites (e.g., Whiteshell Laboratories) or from commercial sources such as Canadian hospitals and universities.

Development of the NSDF Project is planned to occur in several phases. The construction phase, which includes site preparation, is anticipated to start in 2022 or as soon as the relevant regulatory permits and approvals are received. The operations phase is anticipated to begin in 2025 and will last at least 50 years. The operations phase will be completed in two phases as described in Section 1.3. The closure phase primarily includes activities needed to complete the installation of the final cover of the Engineered Containment Mound, continue the treatment of residual leachate, and decommission supporting infrastructure. Closure activities are expected to last 30 years, after which the NSDF Project will transfer into the post-closure phase. The post-closure phase includes implementation of institutional controls for at least 300 years; however, this phase will continue as long as determined necessary by regulatory agencies. During this timeframe, environmental monitoring will continue to demonstrate compliance with the environmental assessment predictions.

The estimated cost to build (i.e., capital expenditures) the NSDF is $475 million and includes site preparation and construction of the Engineered Containment Mound, supporting facilities and buildings, and access roads. Operating costs associated with a 50-year operating life, site closure costs, and surveillance and long-term maintenance for a 30-year period following the end of operations are estimated at $275 million. This results in a total life cycle cost of $750 million for the NSDF Project.

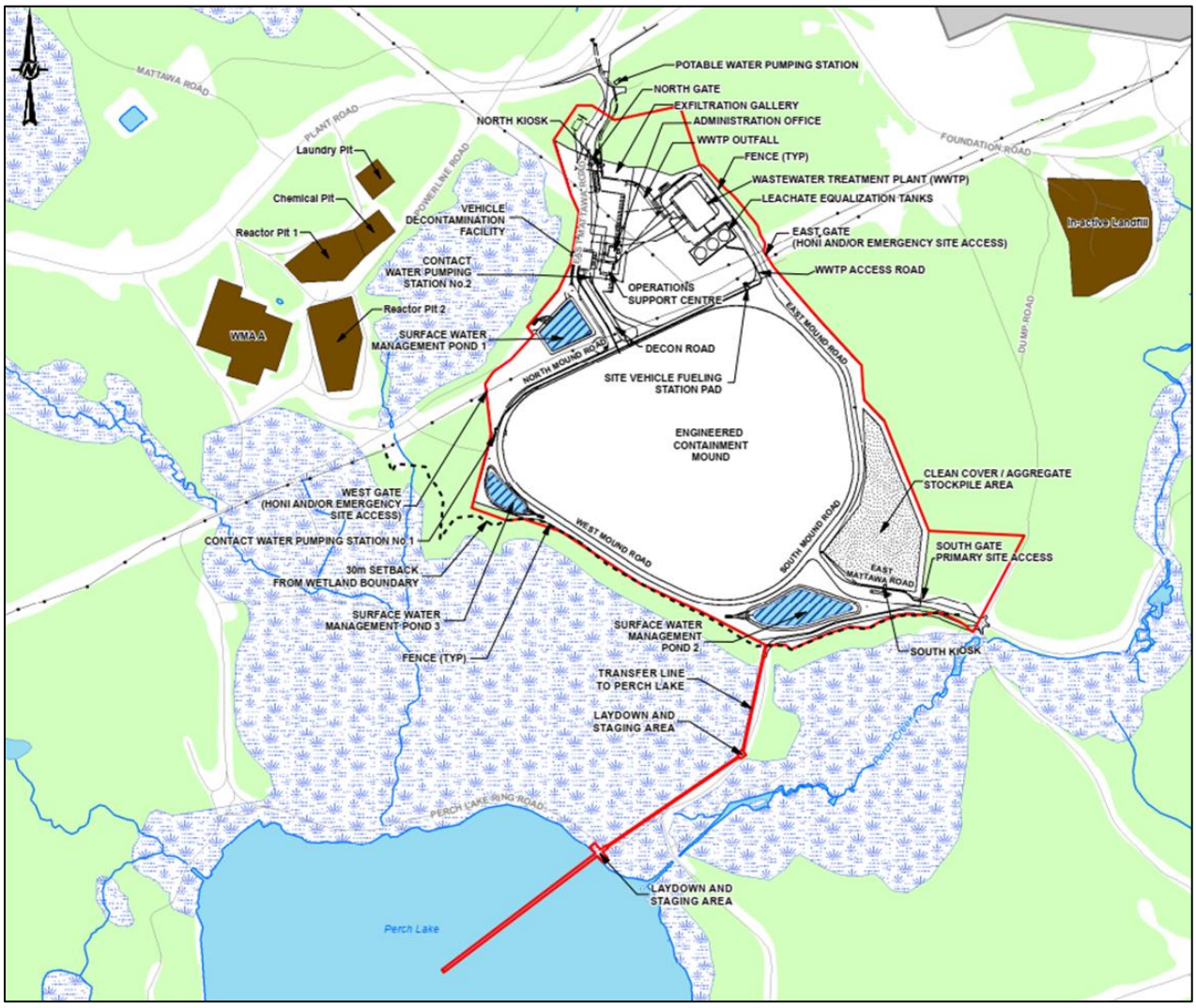


Figure 5: Physical Components within the Near Surface Disposal Facility Project Site

1.4 NSDF Project Phases and Execution

The NSDF Project activities are planned to occur in the following phases: construction and commissioning, operations, closure and decommissioning, and post-closure. Regulatory approval may be required for the NSDF Project to progress from one phase to the next.

1.4.1 Construction

The construction phase including site preparation is anticipated to start in 2022 pending the receipt of positive environmental assessment and licensing decisions. Construction activities are expected to take approximately 3 years to complete (i.e., complete by 2025) and will be performed in accordance with the CNL construction program (Section 6.3.2). The construction season is expected to have a duration of approximately nine months per year.

Site preparation will take approximately four months to complete. Site preparation involves activities required to prepare the NSDF Project site for construction. This includes vegetation clearing (e.g., removal of trees), mobilization of the necessary construction equipment and completing large-scale earth-moving activities (e.g., excavation, blasting, hauling of materials, and grading) using conventional earth-moving equipment such as bulldozers and excavators.

The proposed layout of the planned facilities is shown in Figure 5. The main components and activities associated with the construction phase include the following:

- vehicle traffic on site including transportation of construction materials and haulage of soil spoils to a soil storage area
- construction of the Engineered Containment Mound base liner system (see Section 4.2 of this document), including construction of the perimeter berm that will form the outer boundary for most of the perimeter of the Engineered Containment Mound and will function as a containment system
- construction of the surface water management infrastructure (i.e., drainage ditches, culverts, ponds)
- management of surface water during construction
- management of construction wastes (e.g., building materials, domestic wastes, cleaners, and aerosol cans)
- construction of onsite roads and access development
- construction and commissioning of the Wastewater Treatment Plant, including construction of Wastewater Treatment Plant treated effluent transfer and discharge system as well as an exfiltration gallery and transfer line to Perch Lake
- construction of support facilities (i.e., kiosks and vehicle weigh scales, Administration Building, Operations Support Centre, Vehicle Decontamination Facility, Site Vehicle Refuelling Station, and Potable Water Pump Station)
- construction of site infrastructure (i.e., service elements [sanitary sewage disposal system, surface water management and utilities] and support elements [access roads, parking lots, site security, temporary storage area, and stockpile areas])

A dedicated CNL Director, reporting to the Vice President Environmental Remediation Management and Stewardship and Renewal Group, will oversee the construction of the NSDF (construction organization chart in Appendix A). Construction will be executed by a qualified construction contractor. In late 2016, a public procurement was undertaken, resulting in a notice of preferred construction contractor in 2018. CNL and the preferred construction contractor have been developing plans for construction execution should the NSDF Project be approved. Construction activities will be performed in accordance with the approved licensing basis conditions and restrictions. The CNL Construction Program (Section 6.3.2) provides the framework for external contractors performing construction and installation activities at CNL

sites to ensure they are being adequately controlled and documented within approved safety margins and regulatory or statutory requirements. The Construction Process at CNL is controlled by various procedures, which provide the necessary guidelines to ensure that construction work is compliant with CSA N286-12, *Management System Requirements for Nuclear Facilities* [8].

The NSDF construction will be completed in accordance with the construction drawings and specifications which are also reflective of ISO 9001:2015, *Quality management systems – Requirements* [9]. Specifically the construction work will be inspected and tested in accordance with the construction specifications to ensure that the work/materials meets specification acceptance criteria. The Engineered Containment Mound construction and construction quality control are important to ensure that the performance of the Engineered Containment Mound meets the long-term safety criteria. Comprehensive construction specifications and a Construction Quality Assurance Plan have been developed and will be adhered to in order to minimize uncertainties associated with the Engineered Containment Mound construction and materials.

1.4.2 Commissioning

Pre-commissioning, facility commissioning, related operations, and maintenance training will be conducted toward the end of the construction period and will be performed in accordance with CNL's commissioning program (Section 6.3.3).

Pre-commissioning of the NSDF is carried out through ongoing visual inspections during construction and the testing of systems and components during or prior to installation. Each system or component installed within the NSDF is to be inspected and documented.

The construction of the Engineered Containment Mound has inspection and testing requirements, and the testing results support the Engineered Containment Mound commissioning. The following Engineered Containment Mound systems and components require inspection and testing:

- compacted clay liner
- geomembrane
- geosynthetic clay liner
- geogrid
- geotextile
- leachate collection and removal system

Commissioning of the NSDF will be carried out by the commissioning team following approved commissioning procedures (Section 6.3.3). The commissioning team is made up of the CNL commissioning and engineering representatives, CNL operations representatives,

commissioning representative, Engineer of Record, and construction contractor personnel. The commissioning procedures will be specific to the system or equipment being commissioned.

There are two distinct NSDF areas for the NSDF commissioning:

- Engineered Containment Mound and support facilities
- Wastewater Treatment Plant and support buildings

The commissioning process is separated into inactive commissioning and active commissioning. The following are inactive commissioning phases:

- equipment level commissioning activities using clean water as a medium
- system level commissioning activities using clean water as a medium
- facility level commissioning activities using a representative simulated contaminated wastewater (brine solution) to simulate the expected leachate

The Engineered Containment Mound active commissioning uses low-level radioactive waste to confirm that systems are fully operational and is a prerequisite to active commissioning of the Wastewater Treatment Plant.

The Wastewater Treatment Plant active commissioning uses radioactive wastewater or leachate; once a sufficient volume of wastewater or leachate is available in the equalization tanks, the produced wastewater or leachate is used for final commissioning.

1.4.3 Operations and Closure

Following construction, the operations phase is anticipated to begin in 2025 and the NSDF will operate for at least 50 years during which it will adhere to the requirements of CNL's management system (Section 6.1), including the Conduct of Operations (Section 6.3.1).

The main components and activities associated with the operations phase include the following:

- phased development of disposal cells
- verification and acceptance of wastes that meet the Waste Acceptance Criteria
- placement of low-level radioactive waste that meet the Waste Acceptance Criteria in the Engineered Containment Mound
- progressive closure of disposal cells and installation of temporary (i.e., daily and interim) and final cover systems
- supplementing CRL's existing Environmental Monitoring Program to include the follow-up monitoring program for the NSDF Project
- operation of the Wastewater Treatment Plant and discharge of treated effluent
- surface water management and erosion control

- domestic waste management
- petroleum storage and hazardous materials handling
- maintenance of infrastructure, facilities, and site services.

The NSDF Project has been designed to operate year-round. Subject to acceptable weather conditions, waste placement in the Engineered Containment Mound may cease during periods of inclement weather such as high winds, major precipitation events, extreme cold periods, or inability to compact waste due to frozen conditions. Even if waste placement operations cease, other parts of the NSDF may still operate (e.g., the Wastewater Treatment Plant).

The organization and the lines of authority for the NSDF are shown in Appendix A. The responsibility for overall safe operation of the NSDF rests with the Facility Authority. The responsibility for day-to-day operations rests with the Manager Waste Management Operations with some responsibilities delegated to the Operations Section Leader as will be specified in the facility-specific conduct of operations procedures.

The closure phase activities include installation of the final cover system, and the decommissioning of redundant facilities after the Engineered Containment Mound closure.

1.4.4 Post-closure

Closure activities are anticipated to take approximately 30 years, after which the NSDF will enter into the post-closure phase. In accordance with REGDOC-2.11.1 *Waste Management, Volume III, Version 2: Safety Case for the Disposal of Radioactive Waste* [10], the NSDF design incorporates passive safety features which will ensure the protection of future generations. These features are complemented by the active measures that will be taken by CNL, such as maintenance, security, and surveillance activities during the post-closure phase. During this phase of the project, monitoring and surveillance activities continue to verify the integrity of the facility, while environmental monitoring activities will verify that the performance continues to demonstrate compliance with the environmental assessment predictions.

The post-closure phase is not synonymous with “abandonment”. Rather this phase of the waste management facility’s life cycle continues with the implementation of institutional controls. Institutional controls include methods to restrict public access and preserve knowledge of the facility. Upon closure, controls will be established to limit land usage, including recognition on the property title or deed to ensure the appropriate zoning restrictions and the creation of a buffer or attenuation zones. Such administrative or legal controls help to reduce the potential for inadvertent human exposure.

As the enduring federal entity and owner of the assets and liabilities of CNL, AECL is committed to controlling and restricting the land use of the NSDF footprint for as long as necessary. While other areas of the CRL site may be re-used, the NSDF Project site will continue to be restricted as a waste disposal facility.

1.5 Regulatory Requirements

The Canadian nuclear regulatory framework consists of laws passed by parliament that govern the regulation of Canada's nuclear industry. Pursuant to these laws, the CNSC regulates the nuclear industry through the issuance and enforcement of licences. There are two main regulatory aspects for NSDF authorization, namely the *Canadian Environmental Assessment Act (2012)* [11] and the *Nuclear Safety and Control Act* (NSCA) [7]; the CNSC is the Responsible Authority for the NSDF Project for both these legislations.

Both the EA and licensing decisions trigger the Crown's duty to consult, and where appropriate, to accommodate Indigenous peoples whose potential or established Indigenous and/or treaty rights, under section 35 of the *Constitution Act, 1982,* have the potential to be impacted by the proposed NSDF project.

Therefore, the Commission has three decisions to make with respect to the proposed NSDF project: an EA decision under CEAA 2012, a licensing decision under the NSCA, and a decision on whether the honour of the Crown has been met in fulfilling the CNSC's duty to consult.

1.5.1 Nuclear Safety and Control Act

The *Nuclear Safety and Control Act* [7] and its regulations, are the primary legislation of the main Responsible Authority, the CNSC, for the CRL site. Several regulations fall under the NSCA and those that are considered directly applicable to the NSDF are listed below. The laws, regulations, and guidance that are directly applicable to the NSDF Project form the drivers of the overall licensing framework. Therefore, the Safety Case [12] and its supporting evidence focus on the following key drivers for the NSDF Project licensing:

- *Nuclear Safety and Control Act* [7]
- *General Nuclear Safety and Control Regulations* [13]
- *Radiation Protection Regulations* [14]
- *Class I Nuclear Facility Regulations* [15]
- *Nuclear Substances and Radiation Devices Regulations* [16]

The proposed location of the NSDF is the CRL site, an existing licenced nuclear facility with decades of site characterization activities already performed. More specifically, the NSDF Project would be constructed on a site within the Perch Lake Basin. CNL already has an understanding of the site characteristics present on the Perch Lake basin. The site characterization activities undertaken in support of the application to construct the NSDF are supplemental to this existing data and are comprehensive. The technical studies and documents prepared and submitted to the CNSC staff in support of the application to construct also meet the intent of the requirements to apply for a licence to prepare a site. Therefore, CNL made the decision to apply directly for a licence to construct the NSDF.

In 2017, CNL submitted a construction application for the NSDF as a modification to an existing Class IB nuclear facility (the Waste Management Areas) [17]. The 2017 application was updated in a follow-up application letter in 2021 [1]. The application letter [1] includes clause-by-clause concordance of the NSDF Project to relevant excerpts from the *Nuclear Safety and Control Act* [7] and applicable CNSC regulations. This letter also describes how CNL meets these requirements as per the compliance verification criteria prescribed by the CNSC in the Licence Condition Handbook [18]. The application letter was updated for the following reasons:

- The original application was submitted under the previous CNL Site Licence and Licence Condition Handbook. The updated application was revised to reflect the current licence [2] and CRL's Licence Condition Handbook [18].
- Many of the CNL documents supporting the initial application have been updated or superseded through technical evaluation by CNSC staff.
- In 2019, CNL submitted a letter [19] notifying the CNSC staff of a change in licencing strategy where the NSDF would be a stand-alone Class IB nuclear facility rather than part of the existing Waste Management Areas of the CRL site.

The CNSC issues regulatory guidance documents that present general CNSC requirements and expectations, along with recommended approaches that can be followed to meet them. The regulatory documents applicable to the CRL site are listed in CRL's Licence Conditions Handbook [18].

The CNSC has recently issued new regulatory documents relevant to the NSDF Project:

- REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada* [3]
- REGDOC-2.11.1 *Waste Management, Volume I: Management of Radioactive Waste* [20]
- REGDOC-2.11.1 *Waste Management, Volume III, Version 2: Safety Case for the Disposal of Radioactive Waste* [10]
- REGDOC-2.11.2, *Decommissioning* [21]

CNL has completed a gap analysis on these requirements with NSDF Project documentation, as requested by CNSC staff [22]. One gap was identified related to decommissioning requirements in REGDOC-2.11.2 [21]. Although the NSDF Project does have a preliminary decommissioning plan, it requires revision to meet the requirements. CNL has identified this as an action and is being tracked as a regulatory commitment to the CNSC.

Domestic and international standards, in particular consensus standards produced by the Canadian Standards Association (CSA) Group, are an important component of the CNSC's regulatory framework. Standards support the regulatory requirements established through the *Nuclear Safety and Control Act* [7] and its regulations and licences by setting out the necessary elements for acceptable design and performance at a regulated facility or for a regulated

activity. Standards are one of the tools used by the CNSC to evaluate whether licensees are qualified to carry out licensed activities.

1.5.2 Canadian Environmental Assessment Act (2012)

In 2016, CNL submitted the NSDF Project Description to the CNSC, leading to the initiation of the environmental assessment process under the *Canadian Environmental Assessment Act, 2012* [11].

In 2017, the Commission released a *Record of Decision. Decision on the Scope of Environmental Assessments for Three Proposed Projects at Existing Canadian Nuclear Laboratories' Facilities* [23] addressing expectations on the scope of factors to be assessed in the environmental assessment of the NSDF Project as a designated project under *Canadian Environmental Assessment Act*, 2012 [11]. Pursuant to Section 19 of the *Canadian Environmental Assessment Act*, 2012 [11], the Commission determined the Project scope for the environmental assessment must include the factors mandated in paragraphs 19(1) (a) to (h) of *Canadian Environmental Assessment Act*, 2012 [11] with no additional factors. The Record of Decision also set out that the environmental assessment must consider the *Generic Guidelines for the Preparation of an Environmental lmpact Statement pursuant to the Canadian Environmental Assessment Act, 2012* [24] with respect to information and requirements for identifying valued components and spatial and temporal boundaries as well as engaging Indigenous Peoples and the public on these key points.

The CNSC delegated preparation of the technical studies (i.e., the Environmental Impact Statement) to CNL. Guidance on the preparation of the Environmental Impact Statement is provided in REGDOC-2.9.1, *Environmental Protection – Environmental Principles, Assessments and Protection Measures* [25] and the document Generic Guidelines for the Preparation of an Environmental lmpact Statement pursuant to the *Canadian Environmental Assessment Act, 2012* [24]. All revisions of the NSDF Environmental Impact Statement were prepared by CNL in accordance with this guidance. Concordance tables demonstrating alignment with the CNSC Generic Environmental Impact Statement guidelines and REGDOC-2.9.1 can be found in Appendix 1.0 of the NSDF Environmental Impact Statement.

In August, 2019, the *Impact Assessment Act* [27] came into force, repealing the *Canadian Environmental Assessment Act, 2012* [11]. The *Impact Assessment Act* contains transitional provisions for environmental assessments of designated projects commenced under *Canadian Environmental Assessment Act, 2012* and for which the CNSC is the Responsible Authority. The CNSC informed CNL that the environmental assessment for the NSDF Project will continue under the *Canadian Environmental Assessment Act, 2012* [11]. The CNSC notes that as per the transition provision described in subsection 182 of the Impact Assessment Act: *"Any environmental assessment of a designated project by the Canadian Nuclear Safety Commission or the National Energy Board commenced under the 2012 Act, in respect of which a decision statement has not been issued under Section 54 of the 2012 Act before the day on which this Act comes into force, is continued under the 2012 Act as if that Act had not been repealed."* As outlined in subsection 182, given that the NSDF Project was commenced under *Canadian*

Environmental Assessment Act, 2012 and a decision statement has not yet been issued, it therefore will continue to be completed under its current process.

The 2017 NSDF Environmental Impact Statement was submitted to the CNSC for review in March 2017 [28]. In addition to CNSC staff review, the Environmental Impact Statement was made available for review by expert Federal and Provincial departments, Indigenous Peoples and the public. Subsequent drafts of the Environmental Impact Statement were submitted by CNL to CNSC in 2019 [29] and 2020 [30] but were not deemed complete. The final NSDF Environmental Impact Statement [31] was submitted to the CNSC along with dispositions to all comments received on the 2017 draft Environmental Impact Statement in May 2021 [32]. In July 2021, CNSC staff determined that the information provided in CNL's submission was complete and, as such, the final Environmental Impact Statement was deemed acceptable [31].

CNSC staff have prepared an Environmental Assessment Report on the basis of the final NSDF Environmental Impact Statement [31]. The CNSC Commission Member Document and Environmental Assessment Report include staff recommendations to the Commission.

1.5.3 Other Regulatory Obligations

In addition to the NSCA and Canadian Environmental Assessment Act, 2012 [11], the NSDF Project is also regulated by other legislation, including (but not limited to) the following:

- *Migratory Birds Convention Act*, 1994 [33]
- *Species at Risk Act*, 2002 [34]. A permit from Environment and Climate Change Canada will be required under Section 73 of the Act prior to construction
- *Polychlorinated Biphenyls Regulations*, 2008 [35]
- *Fisheries Act*, 1985 [36]
- *Canada Labour Cod*e and *Canada Occupational Health and Safety Regulations* [37]

Federal permits, licences, and authorizations that may be required for the NSDF Project include the following:

- Petroleum storage tank permit(s) may be required, depending on the size of fuel tanks installed on the site
- Natural Resources Canada: a licence under the *Explosives Act* [38] may be required if explosives are to be stored at the CRL site
- A project review may be required for the discharge of treated effluent to Perch Lake under section 35 the *Fisheries* Act [36]

The NSDF Project is located on federal lands and is regulated under the CNSC; therefore, it is anticipated that provincial permits, licences, or other authorizations are not required.

1.6 International Guidance

The IAEA has published IAEA SSR-5 *Disposal of Radioactive Waste* [39] which specifies safety requirements relating to the disposal of radioactive waste of all types. Design principles and concepts to ensure safety in the disposal of radioactive waste shall include the following:

- multiple safety functions
- containment of radioactive waste
- isolation of radioactive waste
- surveillance and control of passive safety features

Furthermore, the disposal facility and its engineered barriers shall be designed to contain the waste with its associated hazards, to be physically and chemically compatible with the host geological formation and/or surface environment, and to provide safety features after closure that complement those features afforded by the host environment. The facility and its engineered barriers shall be designed to provide safety during the operational period.

Additional international guidance considered for the NSDF Project include (but not limited to) the following:

- IAEA GSG-1 *Classification of Radioactive Waste*[4]
- IAEA SSG-23 *Safety Case and Safety Assessment for the Disposal of Radioactive Waste* [40]
- IAEA SSG-29 *Near Surface Disposal Facilities for Radioactive Waste* [41]
- IAEA SSG-31 *Monitoring and Surveillance of Radioactive Waste Disposal Facilities* [42]
- IAEA *Safety Assessment Methodologies for Near Surface Disposal Facilities* [43]
- IAEA SF-1 *Fundamental Safety Principles* [44]

The above guidance documents are used primarily in the design and safety assessments for the NSDF, which are broadly described in Sections 4 and 5, as well as in the discussion of the Safety and Control Areas located in Sections 6.4 and 6.5.

2. Engagement Activities

2.1 Indigenous Engagement

As part of its corporate, environmental, and social responsibility, CNL recognizes the importance of meaningful engagement to build strong working relationships with Indigenous communities and organizations. Engagement with Indigenous communities and organizations on the NSDF Project started in October 2015 and is documented in the NSDF Project Indigenous Engagement Report [45]. A proposed list of Indigenous communities and organizations was identified by CNL and the CNSC based on potential or established Indigenous or treaty rights of Indigenous communities in the vicinity of the NSDF Project. See Figure 6 for a map that shows the location of the identified Indigenous communities in relation to the NSDF Project.

CNL sent formal notifications to all identified Indigenous communities and organizations in July 2016, which included a description of the NSDF Project, information on how to submit comments and/or questions on the Project, and a request for the communities to indicate their preferred method(s) of communication.

CNL is committed to working in collaboration with local and interested Indigenous Peoples through meaningful and ongoing engagement during all phases of the NSDF Project (Figure 7). CNL shares information with Indigenous leadership, consultation staff and Indigenous community members in relation to the potential effects of NSDF Project activities on the environment, and on Indigenous Peoples and/or treaty rights, including rights to trap, hunt, fish, gather, or conduct cultural ceremonies.

In addition, CNL communicates information about the NSDF Project licensing process and seeks feedback from Indigenous communities and organizations about any concerns or questions relating to the Project or licensing process. CNL will also continue to invite, respond to, and incorporate feedback throughout the different phases of the Project. It is CNL's ongoing commitment to develop strong relationships with First Nations and Métis communities by providing meaningful avenues for participation, developing contribution and long-term agreements that include appropriate support for capacity, and by seeking to understand and incorporate the perspectives and traditional knowledge of Indigenous Peoples in project documentation and reports.

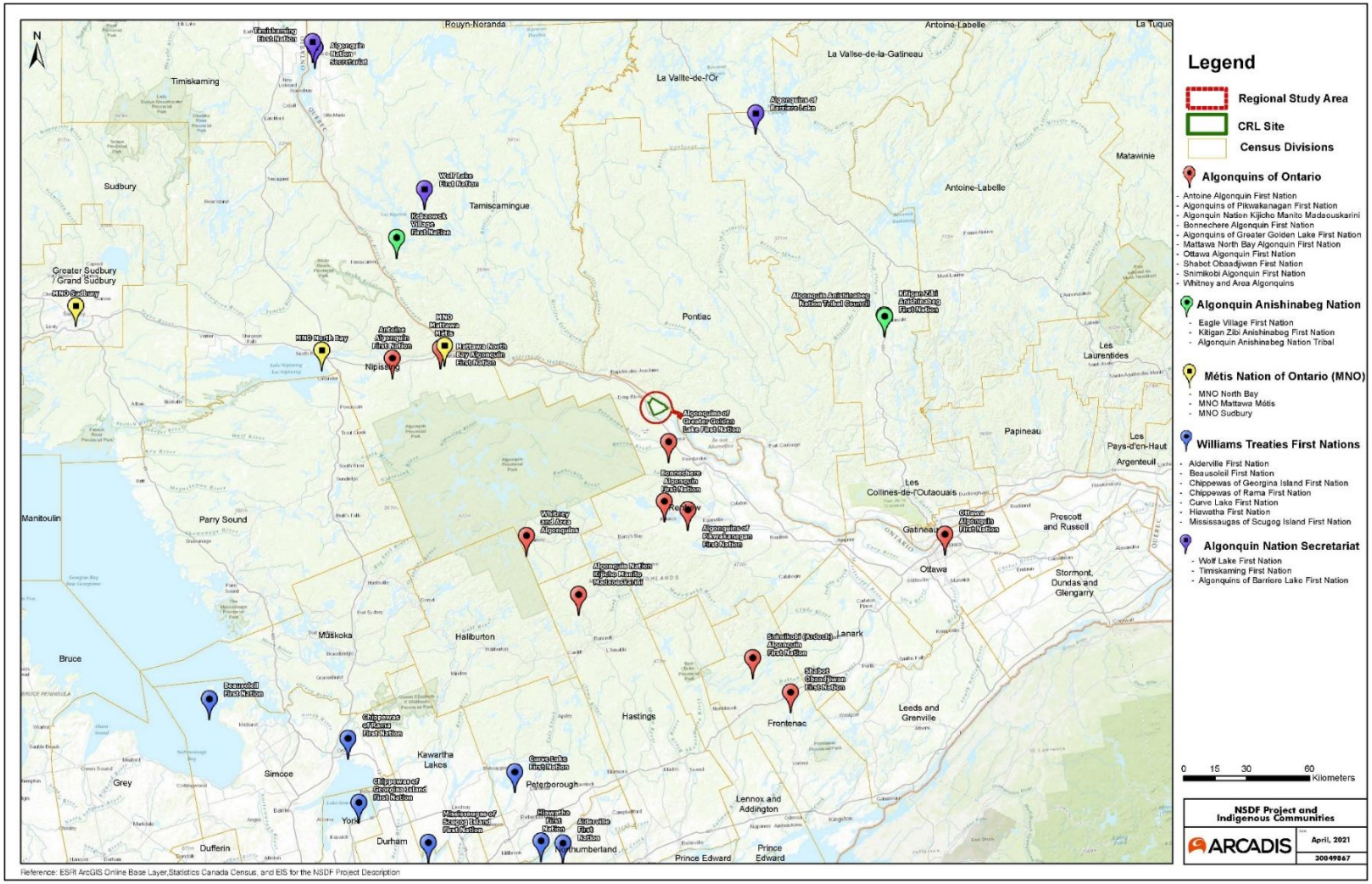


Figure 6: Identified Indigenous Communities and Organizations in Relation to the NSDF Project Location

Figure 7: Algonquins of Pikwakanagan First Nation Cultural Exchange for the Renfrew County and District School Boards (2018) to which CNL Staff Were Invited as Guests

In 2019, CNL was honoured to host a cultural ceremony at Pointe au Baptême with delegates from a radioactive waste management conference (Figure 8). With the COVID-19 pandemic affecting in-person engagement activities since March 2020, CNL has adapted by providing online platforms for virtual meetings, workshops, webinars, Project updates, and open houses. CNL remains committed to ensuring that engagement activities continue during the pandemic where communities are willing and able, and to protect the health and safety of participants and staff by following public health recommendations and protocols.

While some Indigenous communities and organizations chose to become actively engaged with CNL early in the NSDF Project, other communities have only done so more recently as interest and/or capacity (funding) have allowed. Thereby, CNL has had significant discourse and formal exchange of comments and responses with certain communities, the results of which have been incorporated in the final NSDF Environmental Impact Statement [31], while engagement with other communities is not as advanced. In addition to seeking information about Indigenous interests as required by the *Nuclear Safety and Control Act* [7] and *Canadian Environmental Assessment Act*, 2012 [11], CNL has adapted its engagement activities according to the unique interests, concerns, and information needs of Indigenous communities and organizations.

Figure 8: Cultural Ceremony at Pointe au Baptême (2019)

2.1.1 Algonquins of Ontario (AOO) Engagement

The Algonquins of Ontario (AOO) is an organized collective of Algonquin communities assembled to enable a unified approach to reaching a settlement over a comprehensive land claim including an area of over 3.6 million hectares (ha) within the Ottawa River and Mattawa River watersheds in eastern Ontario. The area that is the subject of the Algonquin Land Claim in Ontario includes the National Capital Region, all of Renfrew County, and most of Algonquin Park. The AOO is comprised of ten Algonquin communities located within the Ottawa Valley: Antoine Algonquin First Nation; Algonquins of Pikwakanagan First Nation; Algonquin Nation Kijicho-Manito Madaouskarini; Bonnechere Algonquin First Nation; Algonquins of Greater Golden Lake First Nation; Mattawa/North Bay Algonquin First Nation; Ottawa Algonquin First Nation; Shabot Obaadjiwan First Nation; Snimikobi (Ardoch) (Beaver Creek) Algonquin First Nation; and Whitney Area Algonquins.

In 2018, the AOO, AECL, and CNL signed a tri-partite Memorandum of Understanding (MOU) to guide dialogue between the parties on matters of mutual interest. More specifically, the MOU is intended to be a vehicle to work towards the development of a Long-Term Relationship Agreement between the parties. The MOU identifies the need for a group that will examine and communicate the technical details of the NSDF environmental assessment and another group that will advance a Long-Term Relationship Agreement between the parties. The MOU broadly identifies potential topic areas for the Long-Term Relationship Agreement. The AOO and CNL have been deeply engaged since the signing of the MOU to work through each commitment. From 2019 to 2021, the AOO, AECL, and CNL developed a Terms of Reference and work plan for the Long-Term Relationship Agreement. The Long-Term Relationship Agreement is intended to cover the interests of all three parties with respect to both the CRL and NPD sites, as well as other projects and/or initiatives across the unceded AOO Settlement Area. The Long-Term Relationship Agreement discussions are relevant to NSDF as it is expected that certain project-specific initiatives and commitments will be implemented or realized under the agreement. The AOO initially focused its interests on the Long-Term Relationship Agreement and the NPD Closure Project; however, in late 2020, the AOO indicated an interest in the NSDF

Project. Funding was provided by CNL to the AOO for their continued participation in the environmental assessment process.

The AOO submitted written comments on the 2016 Project Description. CNL has addressed and verified these comments through the AOO's review of the 2020 NSDF Environmental Impact Statement [30]. The AOO also submitted written comments on the final NSDF Environmental Impact Statement [31]. CNL has responded in detail to each of the AOO comments and received written feedback from the AOO on CNL's responses. Many of the comments have been addressed but some remain unresolved. CNL and the AOO have agreed on a path forward and are working together to address the remaining unresolved comments. CNL has incorporated feedback from the AOO regarding the final NSDF Environmental Impact Statement [31]. Unresolved comments are related to the Rights Impact Assessment being conducted by the CNSC or to requests outside the scope of *Canadian Environmental Assessment Act* 2012 [11].

CNL has also received and incorporated the AOO Algonquin Knowledge and Land Use Study into the environmental assessment process, as summarized in Section 6.4 of the final NSDF Environmental Impact Statement [31]. The AOO have reviewed and provided input into this Section to verify that the findings of the study have been appropriately represented. The Algonquin Knowledge and Land Use Study confirmed the previous assumptions embedded into the Environmental Impact Statement as well as the conservative approach which assumed that traditional activities were occurring in proximity to the CRL site.

As part of the NSDF environmental assessment process, a list of 29 commitments was developed based on the feedback that CNL received from the AOO. This feedback is based on comments and recommendations from the AOO's technical review of the 2020 NSDF Environmental Impact Statement [30] and the AOO Algonquin Knowledge and Land Use Study. In May 2021, CNL provided a list of commitments to the AOO which reflect the next steps that had been agreed to by both CNL and AOO during workshops. The commitment list will evolve as collaboration between the AOO and CNL continues during the NSDF environmental assessment process. The commitment list is considered the master list of next steps agreed to between AOO and CNL. In late May 2021, the AOO commitment list was reviewed in a meeting with AOO, CNL, CNSC, and AECL during which the list was verified by the AOO. CNL acknowledges that, from the AOO's perspective, there are outstanding requests for information and incomplete reviews. CNL anticipates that the AOO will communicate their acceptance of CNL's response to these remaining concerns or if additional commitments are required to sufficiently address AOO concerns.

CNL is committed to working with Algonquin harvesters to better understand and address their concerns related to traditional uses of lands adjacent to the CRL site. To achieve this, CNL is committed to involving the AOO in the development of the NSDF Environmental Assessment Follow-up Monitoring Program and the CRL site-wide environmental monitoring programs will be a key area of focus with CNL and the AOO.

CNL and the AOO are currently working together to establish a budget and workplan to fulfill the 29 commitments. Monthly touch point meetings began in November 2021. The prioritized activities in the workplan for 2022 focus on pre-construction commitments.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as progress on these outstanding commitments.

2.1.2 Algonquins of Pikwakanagan First Nation (AOPFN) Engagement

The primary residential reserve of the Algonquins of Pikwakanagan First Nation (AOPFN) is located in the Ottawa Valley on the southeast shore of Golden Lake where it flows into the Bonnechere River, in Renfrew County, Ontario. The Reserve was established through a Crown patent in 1873 following several petitions from the community, formerly known as Golden Lake Indian Reserve No. 39. The AOPFN is a sovereign entity that retains title to the land and resources of the AOO claim area. Although the Algonquin Land Claim is currently being negotiated through the AOO, the AOPFN upholds the sacred responsibility to the land and is an independently-governed First Nation with Aboriginal rights associated with that standing.

CNL and AECL had been engaging with the AOPFN through the AOO until, in March 2020, the AOPFN identified that the proper channel of engagement with them on the NSDF Project was through the AOPFN Consultation Coordinator. The AOPFN expressed the need to be engaged as an independent First Nation from the AOO regarding CNL-related projects and activities. In order to facilitate a meaningful engagement with the AOPFN directly, CNL initiated discussions with the AOPFN on establishing an NSDF Project-specific contribution agreement to ensure support of AOPFN's participation in the environmental assessment process.

Contribution agreement meetings started in early June 2020 and a contribution agreement was signed in September 2020. The contribution agreement includes funding for AOPFN-led studies and support for meetings on the AOPFN's review of the Algonquin Knowledge and Land Use Study, their review of NSDF Project documents, and engagements with CNL leading up to the CNSC Commission Hearing on the NSDF Project. Upon signing of the contribution agreement, monthly Working Group meetings started in September 2020. Since the September 2020 signing, amendments have been made to the contribution agreement for high priority actions that require capacity support moving forward in developing project-specific relationship policies, plans, and programs between the AOPFN and CNL. CNL is committed to continuing the Working Group with the AOPFN and to providing funding for the AOPFN's involvement in the planning, pre-construction, construction, and operations phase of the NSDF Project.

In early 2021, CNL and AECL commenced discussions with AOPFN on establishing a tri-partite MOU to guide dialogue between the parties on matters of mutual interest for the CRL site, not specific just to the NSDF Project. The MOU was signed in May 2021. The MOU is a step towards the establishment of a longer-term co-operation or relationship agreement between the AOPFN, CNL, and AECL.

The AOPFN and CNL have been deeply engaged since the signing of the contribution agreement in 2020. The AOPFN submitted written comments on the 2019 NSDF Environmental Impact

Statement [29]. CNL has responded in detail to each of the AOPFN comments. CNL has since received written feedback from the AOPFN on these responses.

The AOPFN have reviewed and provided input on Section 6.4 of the final NSDF Environmental Impact Statement [31] to verify that the AOPFN Algonquin Knowledge and Land Use Study findings were accurately integrated into the description of environment. The AOPFN has noted that other aspects of the study are not adequately reflected in Section 6.4, especially CNL's assessment of the NSDF Project effects on traditional land and resource use. Issues of remaining concern for the AOPFN regarding Section 6.4 include the lack of integration of risk perception and sensory changes on harvesters as impact pathways, the use of a biophysical proxy approach to assessing impacts on traditional use by AOPFN harvesters, and disagreement with the overall finding by CNL of no anticipated residual impacts on traditional land and resource use from the project. CNL has encouraged the AOPFN to identify these remaining issues in its written submission to the Commission, and has committed to ongoing dialogue on AOPFN's concerns about the effects of the project, should it proceed.

The findings of the AOPFN Algonquin Knowledge and Land Use Study confirmed CNL's previous assumptions and conservative approach that traditional activities were occurring within proximity to the CRL site, but not on the CRL site due to existing access restrictions.

CNL developed a commitments list within the structure of the AOPFN/CNL Working Group. In March 2021, CNL sent the AOPFN a summary of 53 commitments with the resolution status that included next steps that had been agreed to by both CNL and the AOPFN. The commitments list will evolve as collaboration between the AOPFN and CNL continued during the environmental assessment process. In April 2021, the AOPFN provided a letter of acknowledgement that the list of commitments provided by CNL was accurate. While CNL does not assume that this acknowledgement constitutes AOPFN support for the NSDF Project, it does indicate that there is a reasonable path forward, with both parties having agreed to the next steps.

CNL recognizes that the AOPFN have outstanding concerns including, but not limited to: differences of opinion on the likelihood of adverse project effects on culture, traditional use, and the AOPFN rights, whether or not CNL will respect "Willing Host" or other free, prior, and informed consent decisions by the AOPFN, and the inclusion of off-site radioactive materials for disposal at NSDF, should the project proceed.

CNL also recognizes that the AOPFN involvement in the development of the NSDF Environmental Assessment Follow-up Monitoring Program and CRL site-wide monitoring programs is a key area of ongoing interest. As such, CNL is committed to working with AOPFN members and harvesters to understand and further address their concerns about traditional uses on lands adjacent to the CRL site. CNL and the AOPFN have agreed to amend the contribution agreement to include an updated budget and workplan to fulfill pre-construction commitments.

CNL and the AOPFN have worked together to establish a budget and workplan for 2021/22 related to the NSDF Project pre-construction commitments. Activities to date have included

AOPFN knowledge keepers conducting a survey on the proposed NSDF Project site (Figure 9), a technical review of the draft NSDF Environmental Assessment Follow-Up Monitoring Program, a workshop being planned to further discuss the AOPFN Guardian Program and integration of traditional knowledge into future monitoring for the NSDF Project, and support for the AOPFN to hire a communications specialist.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as progress on these commitments.

Figure 9: Algonquins of Pikwakanagan First Nation Knowledge Keepers Survey of the Proposed NSDF Project Site (October 2021)

2.1.3 Métis Nation of Ontario (MNO) Engagement

The Métis Nation of Ontario (MNO) was formed in 1993 to represent communities and individuals recognized by the Métis Nation within Ontario and works to represent the rights, interests, and collective aspirations of Métis People and communities throughout the province. CNL engages with members of the MNO Mattawa/Lake Nipissing Métis Traditional Territory Consultation Committee and MNO Lands, Resources, and Consultation Branch.

In 2018, the MNO and CNL signed an MOU along with a Reciprocal Funding Agreement for the NSDF and NPD Projects that has enabled the MNO to participate in the NSDF Project environmental assessment. The MOU was reached with the MNO and, more specifically, the Mattawa/Lake Nipissing Traditional Territory Consultation Committee, which includes the Sudbury Métis Council, the North Bay Métis Council, and the Mattawa Métis Council, which represent the regional rights-bearing Métis community. A representative of the Mattawa MNO has been a member of CNL's Environmental Stewardship Council since March 2012.

The summarized objectives of the MOU include: to establish, in relation to the NSDF Project, a mutually beneficial, cooperative, productive, and ongoing working relationship; to provide a

process for CNL to engage with the local and regional Métis communities, address any potential effects, and discuss necessary mitigation measures; and to enable the ability of the MNO to participate in the NSDF environmental assessment processes. The MOU also indicates their intention to pursue a longer-term relationship with CNL. CNL provided funding to the MNO to assist their engagement, undertake technical studies, participate in a valued components workshop, and allow staff to co-ordinate activities and work with CNL. The MNO also carried out a comprehensive traditional knowledge and land study funded by the CNSC.

The MNO, CNL and AECL are currently working together to establish a longer-term co-operation or relationship agreement, more broadly related to the CRL site.

The MNO and CNL have been deeply engaged since the signing of a MOU in 2018 (Figure 10). The MNO have focused their technical reviews on three specific topics: Métis rights and interests, archaeology, and protection of water.

CNL has extensively communicated with the MNO to address their comments on the 2017 draft Environmental Impact Statement. CNL had also explained how the 2019 revised draft Environmental Impact Statement incorporated feedback directly communicated by the MNO, input from the MNO Traditional Knowledge and Land Use Study, and feedback from the valued components workshop. The MNO's consultants have reviewed additional information and documents responding to their concerns and comments. The MNO provided a letter in 2020 accepting the majority of CNL's responses. While this letter did not communicate full acceptance of all of CNL's responses, it does indicate that the MNO has reviewed and acknowledged them.

CNL notes that additional technical comments about the NSDF Environmental Impact Statement were received from the MNO in 2019, 2020, and 2021. Responses to these comments were provided by CNL; CNL has not received feedback from the MNO on these responses. The MNO has acknowledged CNL's effort to incorporate concerns into the 2019 NSDF Environmental Impact Statement [29] (received February and August 2020) but they also provided additional comments for consideration. In March 2021, CNL received feedback from MNO on the incorporation of MNO input into the 2020 NSDF Environmental Impact Statement [30]. Many comments were closed with no further comment, some were considered partially addressed, and some were considered unresolved. CNL notes that a number of the comments partially addressed or unresolved were related to the Rights Impact Assessment being conducted by the CNSC. CNL responded in March 2021 to all comments on the final NSDF Environmental Impact Statement [31], indicating proposed next steps and commitments where necessary.

In February 2021, CNL sent a letter to the MNO providing an update on the status of the NSDF environmental assessment as well as a list of commitments CNL has made to the MNO to address any outstanding interests or concerns. The commitments list is a living document that may evolve as collaboration between the MNO and CNL continues during the environmental assessment process. In late March 2021, the MNO commitment list was reviewed and verified in a meeting with the MNO, CNL, CNSC, and AECL.

CNL recognizes that MNO involvement in the development of the NSDF Environmental Assessment Follow-up Monitoring Program and the CRL site-wide monitoring programs are an area of ongoing interest. As such, CNL is committed to working with MNO citizens and harvesters on understanding and addressing their concerns about traditional uses on lands adjacent to the CRL site. CNL and the MNO are currently working together to extend the current MOU which will include a budget and workplan to fulfil the 20 commitments.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as progress on these commitments.

Figure 10: Presentation of the Métis Sash to CNL Staff at a Métis Nation of Ontario Community Information Session (2019)

2.1.4 Algonquin Anishinabeg Nation Tribal Council (AANTC) Engagement

The Algonquin Anishinabeg Nation (AAN) – also referred to as the Algonquins of Western Quebec or Algonquin Anishinabeg Nation Tribal Council (AANTC) – was voluntarily established in 1992. Its purpose was to provide representation in land claim development and negotiation for member nations. Traditional territories claimed include the Ottawa River valley. At its inception, it comprised five member nations: Kebaowek First Nation (formerly known as Eagle Village) First Nation, Lac Simon First Nation, Abitibiwinni First Nation, Kitigan Zibi Anishinabeg First Nation, and Long Point First Nation (Winneway). Later, two other communities joined the AANTC.

CNL initiated discussions with AANTC in late May 2020 to establish an NSDF Project-specific contribution agreement to ensure support of AANTC's participation in the environmental assessment process. The contribution agreement was to include meetings and discussions on

AANTC comments received regarding the 2017 Draft Environmental Impact Statement as well as engagement leading up to the CNSC Commission Hearing on the NSDF Project. One contribution agreement meeting was held in June 2020 and in September 2020, the AANTC informed CNL that they would not be willing to meet again until their requests made to the Minister of Natural Resources on the Chalk River nuclear assessment projects are addressed.

CNL provided draft responses to the AANTC's formal comments on the 2017 NSDF Environmental Impact Statement [28] in May 2019 and in April 2020. CNL attempted to engage with the AANTC to discuss CNL's responses on multiple occasions through a variety of means (i.e., emails, letters, telephone calls, and invitations to webinars and meetings). In May 2020, CNL sent a letter to AANTC which included requests for specific information to assist in validating assumptions CNL made in the Environmental Impact Statement with respect to traditional activities occurring within proximity to the NSDF Project. CNL did not receive a response from the AANTC regarding this letter. CNL made several efforts to co-ordinate a meeting with the AANTC in 2019 and 2020 but was unable to have a meeting date confirmed.

The AANTC consultant reviewed the 2019 NSDF Environmental Impact Statement [29] and acknowledged positive improvements since the 2017 NSDF Environmental Impact Statement [28]. The AANTC consultant indicated that the review was complete and a report was with the AANTC for review and approval. To date, CNL has not received this report or any responses to letters; therefore, CNL cannot verify that the AANTC's concerns from the 2017 NSDF Environmental Impact Statement have been addressed.

In 2020, AANTC consultants submitted additional technical comments and information requests to CNL on the 2019 NSDF Environmental Impact Statement to which CNL has responded and offered to meet and discuss. It is CNL's opinion that these comments do not change the conclusions of the final NSDF Environmental Impact Statement and are not new concerns or interests. Many of the comments are related to the NSDF Environmental Assessment Follow-up Monitoring Program, which will not be finalized until an environmental assessment decision is rendered, thus there remains opportunity for involvement.

CNL has provided the AANTC with a list of seven commitments made during NSDF Project engagements and a request for a response with any concerns regarding the commitment list. AANTC has not provided a response.

Although a number of correspondence exchanges with AANTC consultants have occurred, the AANTC has not responded directly to any of CNL's engagement attempts since September 2020.

In May 2020, the AANTC and Kebaowek First Nation submitted a letter to the Government of Canada outlining interests and concerns that included the NSDF Project: Letter from AANTC May 14 2020. In August 2020, the AANTC and Kebaowek First Nation submitted a second letter to the Minister of Natural Resources outlining similar concerns: Letter from AANTC August 26 2020. In September 2020, the AANTC informed CNL that they would refrain from future meetings with CNL until a response from the Minister of Natural Resources addressing their requests was received. In November 2020, the Minister of Natural Resources responded to AANTC and Kebaowek First Nation acknowledging the Chalk River environmental assessment

projects: Letter from Minister November 5 2020. The CNSC also responded to the AANTC and Kebaowek First Nation: Letter from CNSC November 25 2020. In January 2021, Kebaowek First Nation and AANTC submitted a third letter to the Minister of Natural Resources indicating the need to meet to discuss Indigenous consultation and engagement for the Chalk River nuclear assessment projects. While many of these concerns are related to the Government of Canada, CNL is nevertheless interested in meaningful engagement with AANTC and Kebaowek First Nation on the NSDF Project.

Although CNL attempted further communication with the AANTC, the AANTC has informed CNL that they would not be willing to meet again until their January 2021 letter sent to the Minister of Natural Resources receives a response and theequests are met.

CNL remains committed to ongoing engagement with the AANTC. CNL is also willing to involve the AANTC in the NSDF Environmental Assessment Follow-up Monitoring Program and would be pleased to engage with AANTC further.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as any progress on commitments.

2.1.5 Kitigan Zibi Anishinabeg First Nation Engagement

The Kitigan Zibi Anishinabeg First Nation (also known as the River Desert Band or Maniwaki) is one of the nine currently federally recognized Algonquin communities in Quebec. The community resides on reserve lands that were founded in 1851. The main Reserve is situated to the south-west of the borders of Maniwaki in the Outaouais region of Quebec, on the west bank of the Gatineau River.

Kitigan Zibi Anishinabeg First Nation is a member of the AANTC. Kitigan Zibi Anishinabeg First Nation was represented at the June 2020 contribution agreement meeting.

Kitigan Zibi Anishinabeg First Nation submitted written comments on the 2016 NSDF Project Description and the 2017 NSDF Environmental Impact Statement [28].

In December 2019, CNL sent Kitigan Zibi Anishinabeg First Nation notification of the online posting of the 2019 NSDF Environmental Impact Statement [29] and the updated Indigenous Engagement Report for review. CNL offered to meet with the Kitigan Zibi Anishinabeg First Nation to provide updates and discuss how their comments were incorporated. Kitigan Zibi Anishinabeg First Nation did not provide a response.

CNL has attempted to engage with Kitigan Zibi Anishinabeg First Nation to discuss draft dispositions to their comments on the 2017 NSDF Environmental Impact Statement [28] on multiple occasions through a variety of means (i.e., emails, letters, telephone calls, invitations and to webinars and meetings); however, Kitigan Zibi Anishinabeg First Nation has not provided a response to CNL.

A list of CNL's commitments made during NSDF Project engagements was provided to Kitigan Zibi Anishinabeg First Nation. CNL requested a response if there were any concern regarding the commitment list. Kitigan Zibi Anishinabeg First Nation has not provided a response.

In November 2021, the Environmental Remediation Management Stakeholder Relations team met with two newly identified contacts with Kitigan Zibi Anishinabeg First Nation. An NSDF Project overview was provided. CNL acknowledges that Kitigan Zibi Anishinabeg First Nation may have more comments on the NSDF Project going forward and will continue to offer engagement opportunities and provide notifications of NSDF Project activities.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as any progress on commitments.

2.1.6 Kebaowek First Nation Engagement

Kebaowek First Nation is one of the nine currently federally recognized Algonquin communities in Quebec. The reserve is situated on the shore of Lake Kipawa to the northeast of Témiscaming, Quebec.

Kebaowek First Nation is a member of the AANTC. Kebaowek First Nation was represented at the June 2020 contribution agreement meeting.

Kebaowek First Nation has not submitted any written comments on the NSDF Project Description or the Environmental Impact Statement ([28], [29], [30]). The only feedback received to date on the NSDF Project has been in a letter directed to the Government of Canada. CNL has offered the Kebaowek First Nation opportunities for engagement and kept them informed about the NSDF Project status.

CNL has sought to validate assumptions made in the final NSDF Environmental Impact Statement [31] with Kebaowek First Nation, including those on traditional activities that may be occurring within proximity to the NSDF Project site; however, the Kebaowek First Nation has not provided a response.

CNL has provided Kebaowek First Nation with a list of CNL commitments made and requested a response if there were any concerns regarding the commitment list. Kebaowek First Nation has not provided a response.

CNL will continue to offer Kebaowek First Nation engagement opportunities and to follow up on any outstanding interests and concerns.

In September 2021, Kebaowek First Nation sent CNL a Letter of Intent for review. CNL provided feedback, and a meeting was held in December 2021 to further discuss.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as progress on commitments.

2.1.7 Williams Treaties First Nations (WTFN) Engagement

The Williams Treaties First Nations (WTFN) are the Chippewas of Beausoleil, Georgina Island and Rama, and the Mississaugas of Alderville, Curve Lake, Hiawatha and Scugog Island. These seven First Nations are signatories to various 18th and 19th century treaties that covered lands in different parts of south central Ontario. In 1923, the Chippewas and Mississaugas signed the

Williams Treaties, which included one large tract of land between Lake Huron and the Ottawa River bounded on the north by the Mattawa River-Lake Nipissing and French Line and on the south by earlier concluded treaties.

Based on WTFN interest in the NSDF Project and in CNL's broader activities such as the Port Hope Area Initiative, a monthly information sharing meeting between CNL and WTFN was established in March 2020. These meetings provide all WTFN communities with monthly updates as well as an opportunity to ask questions and share feedback on CNL activities.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as any progress on commitments.

Further information on engagement with the individual First Nation members of the WTFN is in the following sections.

2.1.8 Alderville First Nation

The Alderville First Nation has not submitted any written comments on the NSDF Project Description or the Environmental Impact Statement ([28], [29] and [30]). The only feedback received from Alderville First Nation was verbal, for which CNL provided additional information in the form of webinars and technical documents. CNL reached out to Alderville First Nation to determine if their concern was addressed; however, CNL received no written response. CNL has provided opportunities for engagement to Alderville First Nation and kept them informed about the NSDF Project status.

CNL has provided Alderville First Nation with a list of CNL commitments made during NSDF Project engagement activities. CNL requested a response indicating if there were any concerns regarding the commitment list; however, Alderville First Nation has not provided a response.

CNL will continue to offer Alderville First Nation engagement opportunities and follow up on any emerging interests and concerns unless otherwise instructed by representatives of Alderville First Nation.

2.1.9 Beausoleil First Nation

Beausoleil First Nation has not submitted any written comments or provided any verbal feedback on the NSDF Project. CNL has provided opportunities for engagement to Beausoleil First Nation and kept them informed about the NSDF Project status.

CNL has sought to validate assumptions made in the final NSDF Environmental Impact Statement [31], including those with respect to traditional activities that may be occurring within proximity to the NSDF Project; however, Beausoleil First Nation has not provided a response.

CNL provided Beausoleil First Nation a list of CNL commitments made and requested a response if there were any concerns regarding the commitment list; however, Beausoleil First Nation has not provided a response.

CNL will continue to offer Beausoleil First Nation engagement opportunities and follow up on any emerging interests and concerns unless otherwise instructed by representatives of Beausoleil First Nation.

2.1.10 Georgina Island First Nation

Georgina Island First Nation has not submitted any written comment nor provided any verbal feedback on the NSDF Project.

CNL has provided opportunities for engagement to the Georgina Island First Nation and kept them informed about the NSDF Project status.

CNL has sought to validate assumptions made in the final NSDF Environmental Impact Statement [31], including those with respect to traditional activities that may be occurring within proximity to the NSDF Project; however, the Georgina Island First Nation has not provided a response.

CNL provided the Georgina Island First Nation a list of CNL commitments made and requested a response if there were any concerns regarding the commitment list but the Georgina Island First Nation has not provided a response.

CNL will continue to offer engagement opportunities to the Georgina Island First Nation and follow up on any emerging interests and concerns unless otherwise instructed by representatives of the Georgina Island First Nation.

2.1.11 Chippewas of Rama First Nation

The Chippewas of Rama First Nation has not submitted written comments nor provided verbal feedback on the NSDF Project.

CNL has provided opportunities for engagement to the Chippewas of Rama First Nation and kept them informed about the NSDF Project status.

CNL has sought to validate assumptions made in the final NSDF Environmental Impact Statement [31] with the Chippewas of Rama First Nation, including those regarding traditional activities that may be occurring within proximity to the NSDF Project; however, the Chippewas of Rama First Nation has not provided a response.

CNL has provided the Chippewas of Rama First Nation with a list of CNL commitments made during NSDF Project engagement activities. CNL requested a response if there were any concerns regarding the commitment list but the Chippewas of Rama First Nation has not provided a response.

CNL will continue to offer engagement opportunities to the Chippewas of Rama First Nation and follow-up on any emerging interests and concerns unless otherwise instructed by representatives of the Chippewas of Rama First Nation.

2.1.12 Curve Lake First Nation

Curve Lake First Nation's comments on the 2016 Project Description have been incorporated in the Environmental Impact Statement and no further comments were submitted on the Environmental Impact Statement ([28], [29] and [30]).

CNL has sought to validate assumptions made in the final NSDF Environmental Impact Statement [31] with the Curve Lake First Nation, including those that discuss traditional activities that may be occurring within proximity to the NSDF Project; however, the Curve Lake First Nation has not provided a direct response to the questions.

In October 2020, CNL sent a letter highlighting the remaining opportunities to provide further input or feedback on the NSDF Project within the formal context of the environmental assessment. Curve Lake First Nation responded to this letter indicating their interest in capacity to support meaningful consultation, engagement, and participation in the NSDF Project. In November 2020, contribution agreement discussions began and in November 2021, CNL and Curve Lake First Nation signed a contribution agreement that supports the Curve Lake First Nation's participation in the environmental assessment process for the NSDF Project.

CNL has provided the Curve Lake First Nation with a list of CNL commitments made during NSDF Project engagements.

CNL will continue to build a meaningful relationship with Curve Lake First Nation and follow-up with any emerging interests and concerns on the NSDF Project.

The NSDF Indigenous Engagement Report [45] will include engagement updates as well as any progress on commitments.

2.1.13 Hiawatha First Nation

Hiawatha First Nation submitted written comments on the 2017 NSDF Environmental Impact Statement [28].

In December 2019, CNL sent Hiawatha First Nation notification of the online posting of the revised 2019 NSDF Environmental Impact Statement [29] and the updated NSDF Indigenous Engagement Report [45]. CNL requested the Hiawatha First Nation to review the Indigenous Engagement Report. CNL also offered to meet to provide updates and discuss how the Hiawatha First Nation's comments were incorporated. In May 2020, CNL sent a letter to the Hiawatha First Nation that included draft dispositions of their comment on the 2017 NSDF Environmental Impact Statement [28]. Hiawatha First Nation did not provide a written response to either of these engagement attempts. Nevertheless, through a series of webinars with the W T F N in 2020, this topic was addressed and additional information was provided as a follow-up to the webinars. The Hiawatha First Nation representative at the webinar indicated verbally their general satisfaction with what was presented.

CNL has sought to validate assumptions made in the final NSDF Environmental Impact Statement [31] with the Hiawatha First Nation, including those about traditional activities that may be occurring within proximity to the NSDF Project. Hiawatha First Nation provided verbal

feedback that members of this community practice harvesting in the Ottawa Valley, but did not provide any details on the proximity to the CRL site.

CNL has provided Hiawatha First Nation a list of CNL commitments made during NSDF Project engagement activities. CNL requested a response if there were any concerns regarding the commitment list; however, Hiawatha First Nation has not provided a response.

CNL will continue to offer engagement opportunities to the Hiawatha First Nation and follow up on any outstanding interests and concerns unless otherwise instructed by representatives of the Hiawatha First Nation.

2.1.14 Mississaugas of Scugog Island First Nation

Mississaugas of Scugog Island First Nation has not submitted any written comments or provided any verbal feedback on the NSDF Project.

CNL has provided opportunities for engagement to Mississaugas of Scugog Island First Nation and kept them informed about the NSDF Project status.

CNL has sought to validate assumptions made in the final NSDF Environmental Impact Statement [31] with the Mississaugas of Scugog Island First Nation, including those regarding traditional activities that may be occurring within proximity to the NSDF Project site. However, the Mississaugas of Scugog Island First Nation has not provided a response.

CNL has provided the Mississaugas of Scugog Island First Nation a list of CNL commitments made during NSDF Project engagements. CNL requested a response if there were any concerns regarding the commitment list; however, the Mississaugas of Scugog Island First Nation has not provided a response.

CNL will continue to offer engagement opportunities to the Mississaugas of Scugog Island First Nation and follow up on any emerging interests and concerns unless otherwise instructed by representatives of the Mississaugas of Scugog Island First Nation.

2.1.15 Anishinabek Nation Engagement

The Anishinabek Nation (formerly known as Union of Ontario Indians) is a political organization that advocates for forty member First Nations within Ontario, seven of which are included and noted in the preceding sections (Alderville First Nation, Beausoleil First Nation, Chippewas of Georgina Island First Nation, Chippewas of Rama First Nation, Curve Lake First Nation, Mississaugas of Scugog Island First Nation and AOPFN).

The Anisinabek Nation submitted written comments on the 2017 NSDF Environmental Impact Statement [28].

In December 2019, CNL sent the Anishinabek Nation a notification of the online posting of the revised 2019 NSDF Environmental Impact Statement [29] and the updated NSDF Indigenous Engagement Report [45]. CNL invited the Anishinabek Nation to review these documents and

offered to meet to provide updates and discuss how their comments were incorporated in the Environmental Impact Statement. The Anishinabek Nation did not provide a response.

In May 2020, CNL sent a letter to the Anishinabek Nation that included draft dispositions to their comments on the 2017 NSDF Environmental Impact Statement [28]. The Anishinabek Nation did not provide a response to this letter.

CNL has attempted to engage with the Anishinabek Nation to discuss CNL's responses on multiple occasions through a variety of means (i.e., emails, letters, telephone calls, invitations to webinars and meetings). CNL has also sought to validate assumptions made in the final NSDF Environmental Impact Statement [31] with the Anishinabek Nation but has not received a response.

CNL has provided the Anishinabek Nation with a list of CNL three CNL commitments made and requested a response if there were any concerns regarding the commitment list. Anishinabek Nation has not provided a response.

To date CNL has been unable to arrange a meeting with the Anishinabek Nation to discuss their comments on the 2017 NSDF Environmental Impact Statement [28]. Nevertheless, CNL will continue to provide engagement opportunities to the Anishinabek Nation and follow-up on any outstanding interests and concerns unless otherwise instructed by representatives of the Anishinabek Nation.

2.1.16 Algonquin Nation Secretariat Engagement

The Algonquin Nation Secretariat is a tribal council encompassing three federally recognized Algonquin Communities within Quebec: the Timiskaming First Nation, the Algonquins of Barriere Lake, and the Wolf Lake First Nation.

Algonquin Nation Secretariat has not submitted any written comments or provided any verbal feedback on the NSDF Project.

On multiple occasions and using various means (i.e., emails, letters, telephone calls, and invitations to webinars, and meetings), CNL has attempted to engage with the Algonquin Nation Secretariat to discuss the NSDF Project and to validate CNL's assumptions in the final NSDF Environmental Impact Statement [31]; however, the Algonquin Nation Secretariat has not provided a response. CNL has provided the Algonquin Nation Secretariat with a list of three CNL commitments made and requested a response if there were any concerns regarding the commitment list. The Algonquin Nation Secretariat has not provided a response.

CNL will continue to offer engagement opportunities to the Algonquin Nation Secretariat and follow-up on any emerging interests and concerns unless otherwise instructed by representatives of the Algonquin Nation Secretariat.

2.1.17 Mohawks of Bay of Quinte Engagement

The Mohawks of the Bay of Quinte are a First Nation within Hastings County, Ontario. They control the Tyendinaga Mohawk Territory, which is a 7,362.5-ha reserve on the shores of Bay of Quinte in south-eastern Ontario, east of Belleville.

Although the Mohawks of Bay Quinte are not listed as one of CNL's identified communities to engage, the Mohawks of Bay of Quinte did provide comments on the 2017 NSDF Environmental Impact Statement [28] through the formal environmental assessment process.

In January 2020, CNL sent the Mohawks of Bay of Quinte notification of the online posting of the revised 2019 NSDF Environmental Impact Statement [29] and the updated NSDF Indigenous Engagement Report [45]. CNL invited the Mohawks of Bay of Quinte to review the revised Environmental Impact Statement. CNL offered to provide updates and discuss how the comments of the Mohawks of the Bay of Quinte were incorporated into the revised Environmental Impact Statement. The Mohawks of Bay of Quinte did not provide a response to these invitations.

In May 2020, CNL sent a letter to the Mohawks of Bay of Quinte that included draft dispositions to their comments on the 2017 NSDF Environmental Impact Statement [28]. The Mohawks of Bay of Quinte acknowledged their receipt of the letter and responses and indicated an interest in meeting. In late May 2020, CNL followed up on the request to meet and were informed by the Mohawks of Bay of Quinte that the next steps on the NSDF Project engagement was currently with the Tyendinaga Mohawk Council. Once a decision has been made, the Mohawks of Bay of Quinte will contact CNL.

CNL has provided the Mohawks of Bay of Quinte with a list of three CNL commitments made. CNL requested a response if there were any concerns regarding the commitment list; however, the Mohawks of Bay of Quinte has not provided a response.

CNL will continue to provide engagement opportunities to the Mohawks of Bay of Quinte and follow-up on any outstanding interests and concerns unless otherwise instructed by representatives of the Mohawks of Bay of Quinte.

2.1.18 Future Indigenous Engagement Activities

CNL has established a path forward and next steps with identified Indigenous communities and organizations, including formulating commitments to address outstanding interests and concerns and in some cases, co-developing detailed work plans and schedules to execute pre-construction commitments. CNL is also working directly with Indigenous communities and organizations to provide opportunities for involvement in future environmental monitoring.

The NSDF Indigenous Engagement Report [45] will continue to document ongoing engagement, discussions and negotiations with Indigenous Peoples relevant to CNL as a whole and specifically about the NSDF Project. The Indigenous Engagement Report will also continue to document outstanding concerns or disparities in views following submission of the final NSDF Environmental Impact Statement [31] and will provide updates on the progress and completion

of the consolidated lists of NSDF Project commitments made in response to interest and concerns from Indigenous communities and organizations.

CNL recognizes a mutual desire to establish long-term relationship agreements to help facilitate many aspects both related and unrelated to projects such as the NSDF (Figure 11). It is important to CNL that relationships with Indigenous communities and organizations endure, grow, and respond to future activities.

Figure 11: Summary Infographic of CNL's Agreements and Commitments with Indigenous Peoples

2.2 Public and Stakeholder Engagement

Transparency is important to build public confidence in the safety of the NSDF design and in CNL's ability to construct and operate the NSDF. In accordance with its Public Information Program requirements as outlined in the CRL Nuclear Research and Test Establishment Operating Licence [2], CNL will continue to employ a variety of methods to inform, educate, and discuss the project with stakeholders and to enable the public to provide valuable feedback on the project.

The NSDF Project was introduced to CNL's Environmental Stewardship Council on 29 October, 2015 and engagement activities commenced in early 2016. CNL will continue to engage, seek, and record feedback, respond to questions, and support meaningful discussion on topics of public interest and concern related to the NSDF Project as the NSDF progresses through the construction, operations, closure, and the post-closure period.

Table 1 summarizes the NSDF public engagement activities. The complete list of engagements is presented in Section 4 of the final NSDF Environmental Impact Statement [31].

In March 2020, the COVID-19 pandemic impacted in-person engagement activities. CNL has adapted to the restrictions by providing online platforms for virtual meetings, workshops, webinars, Project updates, and open houses. CNL remains committed to ensure engagement activities continue and are in alignment with current public health guidelines.

Table 1: Type and Frequency of Public and Stakeholder Engagements

Description of Engagement Method	**Year**						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Public information sessions	14	8	1	-	-	-	**23**
Presentations and site tours	12	25	12	11	10	1	71
Community events	2	4	5	6	2	-	19
Employee updates	4	1	1	2	7	5	20
Environmental Stewardship Council meetings	3	3	3	3	2	3	17
Breakfast briefings	0	0	1	2	1	-	4
Webinars	-	-	1	4	3	5	13
Focus groups & technical discussions	-	-	-	1	1	3	5
NSDF intervenor meetings	-	-	-	3	4	-	7
Virtual open houses	-	-	-	-	1	1	2
Other Engagement Methods and Activities							
Social media – Facebook, Twitter, You Tube, Instagram and Linked In							
Internal & external newsletters							
Media relations – media tracking and “detect & correct”							
Stakeholder email distribution lists							
CNL.ca and NSDF Project webpages							
Fact sheets and infographics							
Poster boards							
NSDF 3D scale models							
Advertising – newspaper and radio stations							
Community Advisory Panel							

The engagement activities provided CNL with an opportunity for dialogue with members of the public. The majority of public concerns with the NSDF Project are typically be associated with one or more of the following themes:

- waste inventory
- design/engineering details
- long-term accountability
- alternative means assessment (including site selection)
- environmental events (e.g., flooding and earthquakes)
- protection of the Ottawa River

This feedback identified areas where CNL could improve elements of the project, leading the project team to conduct the following:

- increase the robustness of the facility through design changes
- analyze additional alternative means (e.g., facility types, effluent discharge locations, final grade of the facility)
- conduct additional baseline studies
- expand the regional study areas, such to include 8 km of the Ottawa river downstream from Perch Creek, including both the Ontario and Quebec shorelines
- reduce the radiological waste inventory
- conduct assessment of more far-reaching scenarios that reflect areas of public interest
- improve communication methods

Public and stakeholder feedback is addressed through continuing engagements and/or in the changes that have been made to the final NSDF Environmental Impact Statement [31]. Some comments from the public are considered outstanding. These are largely related to follow-up environmental monitoring and verification of mitigation measures proposed for the project. These topics are addressed as part of the development of the NSDF Environmental Assessment Follow-up Monitoring Program, which will not be finalized until after an environmental assessment decision, and thus there remain opportunities for public input and engagement.

A consolidated list of CNL's Public and Indigenous Groups' comments on the draft Environmental Impact Statement [28] can be found on the NSDF Project Impact Assessment Agency webpage (Reference Number 80122).

2.2.1 Future Engagement Activities

The NSDF Project will continue public and stakeholder engagement efforts to support growth in awareness and understanding of the Project. Methods employed to date have helped to

inform, educate, and discuss the NSDF Project with the public and stakeholders, and have enabled the public to provide valuable feedback to the NSDF Project. CNL will continue engagement efforts as the Project moves into construction and throughout the life cycle of the Project, demonstrating transparency and access to information.

CNL will continue to promote all milestones and significant events through the CNL website, webinars, public information sessions, updates to municipal councils, annual conferences, site tours, and meetings of the Environmental Stewardship Council and Community Advisory Panel. Online communications platforms, such as CNL's social media feeds, will continue to be used to engage the public on the NSDF Project as they offer access to the largest audience (followers), which continues to grow, and the widest geographic reach (location). Reflective of the anticipated increase in media interest during the Commission hearing, CNL will adapt its approach to engagement with media to ensure clear communication of the benefits of the project and to correct misinformation.

In order to continue engagement with the public beyond the NSDF licence application phase, CNL will maintain open channels of communication and address project-specific concerns through CNL's Public Information Program. CNL will continue to evaluate to what extent stakeholders understand and trust CNL's communication with respect to the NSDF Project. Through the analysis of multiple forms of feedback CNL will verify, and pivot if necessary, the public and stakeholder engagement strategy as the NSDF Project progresses through the construction, operations, closure, and post-closure period.

2.3 Federal and Provincial Regulatory Agencies

2.3.1 Licence Application Review by CNSC Staff

Since 2016, CNL has prepared over 100 technical documents to support CNL's application to add the NSDF to the existing CRL Nuclear Research and Test Establishment Operating Licence [2] in alignment with the Safety and Control Areas (Section 6). Appendix C lists many of the most significant technical documents that have been submitted for CNSC staff review and comment from the beginning of the Project up to November 2021.

CNSC staff have carefully considered all of the NSDF design and safety documents to ensure they are in alignment with the requirements of the *Nuclear Safety and Control Act* [7] and its regulations, CNSC regulatory documents, the requirements of the CRL Nuclear Research and Test Establishment Operating Licence and international guidance. The CNSC staff review resulted in numerous comments for CNL disposition, additional technical analysis and revisions of documents to address these comments to CNSC staff satisfaction.

CNL and CNSC staff met (and continue to meet) when necessary to clarify intentions and to facilitate mutual understandings. For particularly important topics theme meetings often preceded the submissions to present one or more of the following:

- the management process followed, or modelling codes used for conducting a technical study

- a summary of technical information contained in the document
- how CNL incorporated CNSC comments on previous document submissions

2.3.2 Federal-Provincial Review of the NSDF Environmental Impact Statement

In March 2017, CNL submitted to CNSC staff the 2017 NSDF Environmental Impact Statement [28] for the NSDF Project at the CRL site. A Federal and Provincial Review Team consisting of the following agencies completed a technical evaluation:

- Canadian Nuclear Safety Commission
- Environment and Climate Change Canada
- Natural Resources Canada
- Health Canada
- Parks Canada
- Ontario Ministry of Environment, Conservation and Parks
- Québec Ministère de l'Environnement et de la Lutte contre les changements climatiques

CNL submitted the revised 2019 NSDF Environmental Impact Statement to CNSC staff in November 2019 [29] along with dispositions to the 257 Federal and Provincial Review Team information requests on the 2017 draft Environmental Impact Statement. In April 2020, the Federal and Provincial Review Team completed their technical review of the 2019 revised draft Environmental Impact Statement, its updated supporting documents, and responses to all federal and provincial comments and information requests. This Federal and Provincial Review Team technical review resulted in 37 additional information requests in total; several of these follow-up comments on existing information requests and several were new information requests resulting from the review of new information. CNL responded to the 37 information requests, followed by additional clarification being required on five of these information requests. Response to the five information requests resulted in clarification on two of the information requests. The two outstanding information requests were deemed acceptable by the Federal and Provincial Review Team in October 2020. As such, CNL proceeded with finalizing the Environmental Impact Statement.

In December 2020, CNL submitted the 2020 NSDF Environmental Impact Statement [30] for acceptance by the Federal Provincial Review Team. In January 2021, CNL was informed by CNSC staff [46] that outstanding information was required to be included in the Environmental Impact Statement. CNL revised the Environmental Impact Statement and resubmitted the document in May 2021. In July 2021, CNSC staff completed their review of the final Environmental Impact Statement. **CNSC staff determined that the information provided in CNL's submission was complete** and, as such, the final NSDF Environmental Impact Statement was **deemed acceptable** [31].

A table of all Federal-Provincial Review Team comments can be found on the NSDF Project Impact Assessment Agency webpage (Reference Number 80122).

3. Evaluation of Alternatives

The *Canadian Environmental Assessment Act, 2012* [11], requires that federal environmental assessments evaluate alternative means of carrying out a project that are technically and economically feasible and the environmental effects of any such alternative means. In Section 2.5 of the final NSDF Environmental Impact Statement [31], following Canadian Environmental Assessment Agency guidance [47], CNL undertook a comprehensive evaluation of alternatives for the location of the facility, the type of facility, the design of facility, and the approach taken to treat wastewater and manage treated effluent to meet the needs of the Project. Consideration was given to technical, economic, and environmental factors. The alternative means evaluated are presented in Table 2 and the criteria for evaluating the alternatives are presented in Table 3. Of the alternatives considered, the **construction of a near surface disposal facility for the disposal of low-level radioactive waste at the CRL site was the preferred alternative** in terms of both technical and economic feasibility. The environmental effects of the construction and operation of the NSDF are either comparable or more favourable to most of the alternatives studied. International nuclear industry guidance notes that this model has been found to be suitable for the disposal of low-level radioactive waste. The Engineered Containment Mound design is the best available technology when taking into consideration the proposed waste, which consists mostly of contaminated soils and demolition debris.

A summary of the alternative means assessment was made available to the public and Indigenous Peoples and input received was taken into consideration for the final NSDF Project design. Based on this input, additional alternative means were assessed in the final NSDF Environmental Impact Statement [31] including the “do nothing” approach (on-going waste storage), a very low-level radioactive waste facility, a shallow cavern, and a number of alternative effluent discharge options.

Table 2: Alternative Means Evaluated for the NSDF Project

Aspect of the Disposal Facility	Alternatives Considered
Facility type	• No disposal facility (on-going waste storage) • Very low-level radioactive waste disposal facility • Near surface • Geologic waste management facility
Facility design of near surface options	• Engineered Containment Mound • Shallow cavern • Above-ground concrete vault
Facility location	• On site (at the CRL site) • Off site (at Whiteshell Laboratories or Nuclear Power Demonstration site)
Site selection	• 15 potential sites at the CRL site
Leachate treatment and management	• Existing wastewater treatment facility • New wastewater treatment facility • No discharge option (leachate evaporation ponds)

Aspect of the Disposal Facility	Alternatives Considered
Effluent discharge options	• Discharge to ground • Discharge to surface water (Perch Creek, Perch Lake and Ottawa River) • Co-discharge with the NSDF stormwater system and discharge to ground • Discharge to ground and discharge to surface water. • No liquid discharge (i.e., thermal evaporator)
Discharge type	• Discharge by surface spray onto Perch Lake • Piped outfall to Perch Lake (submerged outlet in Perch Lake) • Piped outfall to Perch Lake (above-water discharge) • Submerged diffuser in Perch Lake (alignment along lakebed) • Submerged diffuser in Perch Lake (diffuser suspended in water column)
Final grade of the facility	• Engineered Containment Mound below existing grade • Engineered Containment Mound above existing grade • Engineered containment mid-grade range

Table 3: Criteria for Evaluating Alternatives for the NSDF Project

Category		Criteria
Technical feasibility		• Does the alternative meet the project purpose? • Does the alternative meet the required storage capacity? • Is the alternative an example of best available technology? • Does the design incorporate compatible construction materials for the radioactive wastes planned for disposal to provide sufficient design robustness to protect the environment? • What is the complexity of monitoring requirements for the alternative?
Economic feasibility		• How does the life cycle cost of each alternative compare in relation to each other?
Environmental effects	Biophysical	• Environmental setting - does the alternative result in new disturbance (i.e., greenfield site) or is it located within a previously disturbed area (i.e., brownfield site)? • How do the likely effects on biophysical valued components compare (e.g., atmospheric environment, aquatic biodiversity, and terrestrial biodiversity)? • Can the alternative be constructed, operated, and decommissioned in a manner that provides long-term protection of ecological health?
	Social	• How do the effects on socio-economic valued components compare (e.g., land and resource use, heritage resources, socio-economic)? • How the alternatives are perceived by the public and Indigenous Peoples and is one alternative preferred over another?
	Human health	• Can the alternative be constructed/operated in a manner that

Category		Criteria
	and safety	provides protection of public health and safety? • How does the long-term protection of public health and safety compare? • Can the alternative be constructed/operated in a manner that provides protection of worker health and safety?

3.1 Alternative Facility Types

The alternative facility types were assessed and **a near surface facility was selected as the preferred option for the disposal of CNL's low-level radioactive waste**. The following is a summary of the evaluation of alternative facility types:

- **No disposal facility** – As previously referenced, the legacy waste management areas at the CRL site were designed and built prior to development of modern standards thus do not meet all aspects of current regulatory guidance and expectations. Furthermore, continued use of ongoing or interim waste storage for low-level radioactive waste is not in alignment with *Canada's Radioactive Waste Policy Framework* [3] where waste producers and owners of radioactive waste are responsible for a life cycle management approach.
- **Very low-level radioactive waste disposal facility** – The fraction of the total low-level radioactive waste that could be segregated as very low-level radioactive waste is disproportionate to the time, effort and waste storage requirements that would be expended to realize any net benefit from the work. In addition, the low-level radioactive waste segregated from the very low-level radioactive waste will still require a separate low-level radioactive waste disposal facility.
- **NSDF** – Of the alternatives considered, the construction of a near surface disposal facility for the disposal of low-level radioactive waste at the CRL site was the preferred alternative. International nuclear industry guidance notes that this model has been found to be suitable for the disposal of low-level radioactive waste.
- **Geologic waste management facility** – This facility type would provide increased barriers for potential releases to the environment in the long term; however, the nature or hazards associated with low-level radioactive waste does not warrant this level of safeguard (i.e., the design would not be commensurate with the hazards associated with the inventory). A geologic waste management facility is typically proposed for high- or intermediate-level radioactive wastes, which are not within the scope of the NSDF Project.

3.2 Alternative Facility Designs

The alternative designs of a near surface facility were assessed and **the Engineered Containment Mound design was selected as the preferred option for the disposal of CNL's**

low-level radioactive waste. The following is a summary of the evaluation of alternative facility designs:

- **Engineered Containment Mound** – The Engineered Containment Mound design is the best available technology when considering the proposed waste which consists mostly of contaminated soils and demolition debris.
- **Above ground concrete vaults** – This design option is technically feasible, but is subject to deterioration from wind, rain, and freeze-thaw cycles and is expected to be more vulnerable to seismic events. The above-ground concrete vaults option is estimated to cost about 4.5 times more than the cost of the Engineered Containment Mound design option.
- **Shallow caverns** – Shallow caverns were not considered feasible for the 1 million m^3 of low-level radioactive waste, as this would require multiple caverns. More importantly, the average groundwater level on the CRL site means that there is a high likelihood that the hydrogeological characteristics of a shallow cavern would not meet IAEA guidance with respect to groundwater flow paths and the migration of radionuclides.

3.3 Alternative Facility Locations

Alternative facility locations were considered and **the CRL site was selected as the preferred option for the disposal of CNL's low-level radioactive waste**. AECL and CNL's preference for a low-level radioactive waste disposal option was a technically feasible site on lands currently under AECL ownership and CNL control, ideally close to the location of generation and/or storage of the waste and in an area that is already covered by a nuclear licence. The following is a summary of the evaluation of alternative facility locations:

- **Whiteshell Laboratories and Nuclear Power Demonstration sites** – The physical location of both sites meet most technical requirements for the siting of the disposal facility. However, both sites are subject to closure, and will therefore lose many services in the next decade and most of the low-level radioactive waste already exists, or will be generated, at the CRL site. Transporting nearly 900,000 m^3 of low-level radioactive waste from the CRL site to Whiteshell Laboratories or the Nuclear Power Demonstration site would result in approximately 45,000 shipments. The nuclear industry has a good safety record with respect to the transportation of radioactive materials, however the potential environmental effects (greenhouse gas emissions) of transporting this large volume of waste on public roads will be greater than the potential environmental effects of a disposal facility located at the CRL site.
- **CRL Site** – More than 90% of the waste to be managed by the NSDF Project is already located at the CRL site (Figure 12). Furthermore, the CRL site has an enduring mission to be Canada's premier nuclear science and technology organization. There are currently no plans for closure of the CRL site; it will thus have infrastructure and programs such as environmental protection in place for the long-term. Locating the NSDF at the CRL site also eliminates the additional time and cost of transporting the waste to another

location, reducing the generation of greenhouse gas emissions due to waste transportation.

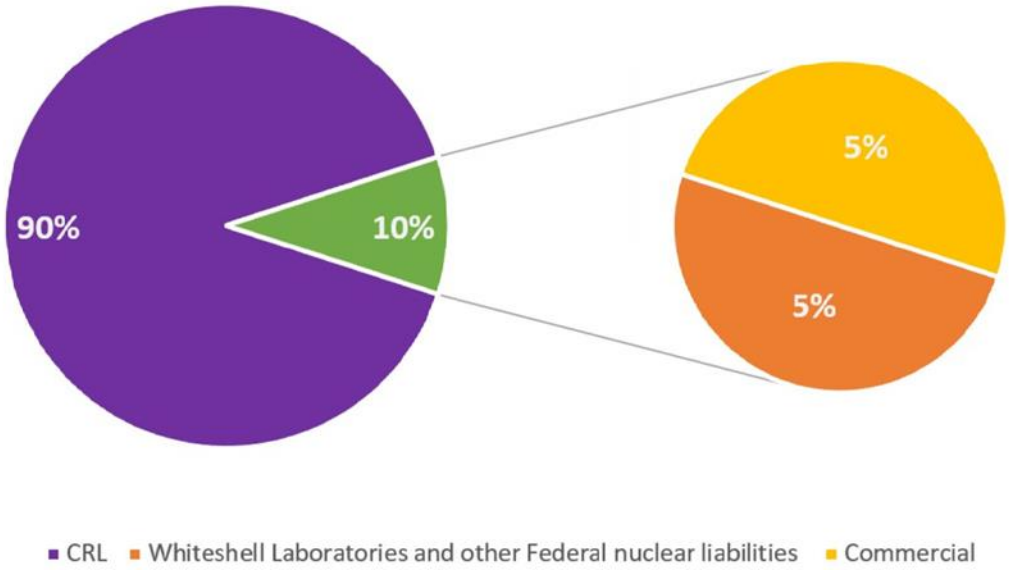


Figure 12: Source of Wastes by Volume to be Included in the NSDF

3.4 Site Selection

The site selection process for the proposed NSDF on the CRL site included the evaluation of 15 potential sites. The 15 potential sites within the CRL site were initially screened to see how the sites met mandatory criteria for the NSDF, such as the minimum space required. Sites that passed this initial screening were then evaluated to see if the site met other criteria such as location in relation to the floodplain, geological characteristics, and the presence of species at risk. Based on this initial screening and evaluation, two sites were identified for further evaluation: the East Mattawa Road site (within the Perch Lake Basin) and the Alternate Site (site 11A) (within the Chalk Lake Basin) (Figure 13). Both sites were technically feasible; however, their interactions with the environment differed.

The **East Mattawa Road site was selected as the preferred site** based on the following:

- The East Mattawa Road site is located on a **bedrock ridge that naturally forces water away from the Ottawa River**. The proposed East Mattawa Road site is 1.1 km from the main channel of the Ottawa River, but groundwater passing below it, discharges to Perch Creek before draining to the Ottawa River, providing a flow path distance of about 2.6 km.
- The groundwater transit time from the East Mattawa Road site to the nearest surface waterbody is estimated to be 5 to 15 years with an average transit time of approximately 7 years compared to approximately 2 years for the Alternate site. Direct evidence of slow migration of releases is provided by several decades of contaminant

migration monitoring at legacy waste management areas in the Perch Lake Basin, which do not have the benefit of engineered containment.

- The East Mattawa Road site is located closer to services (e.g., power and water), the decommissioning and demolition waste that will be generated on the CRL main campus and the existing low-level radioactive waste in storage at the CRL site.
- Biodiversity studies to date by CNL do not indicate that Blanding's turtles are making extensive overland movement in the area of the East Mattawa Road site during their migration as no individuals have been sighted on the road in this location.

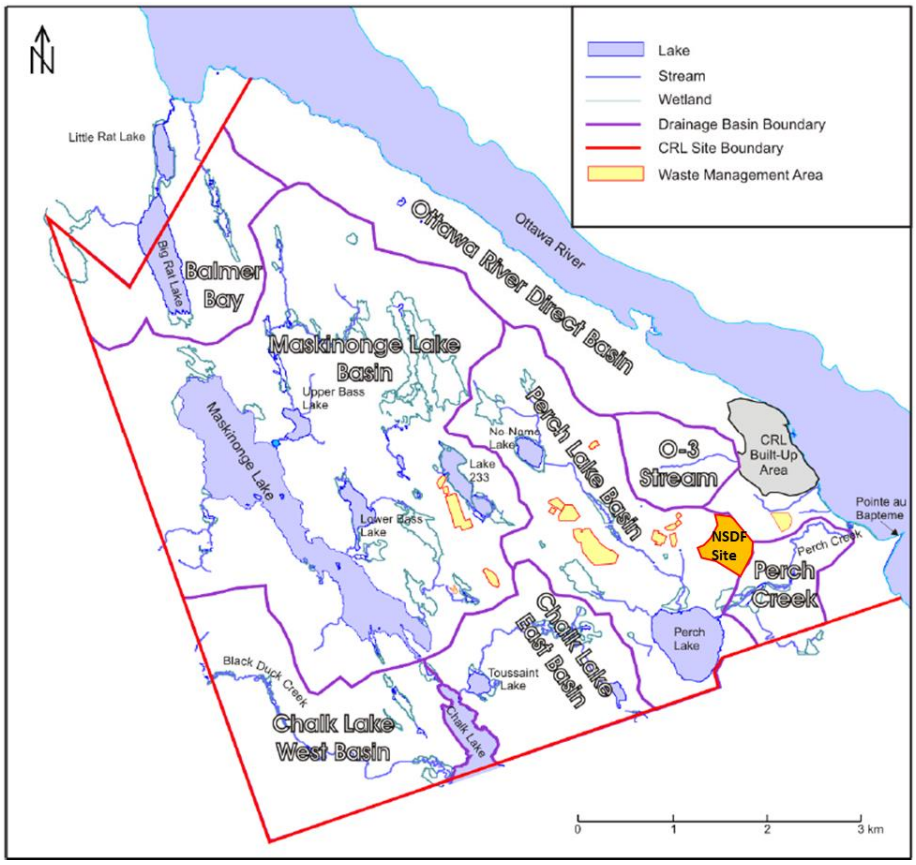


Figure 13: Chalk River Laboratories Site Drainage Basins showing the NSDF Site in the Perch Lake Basin

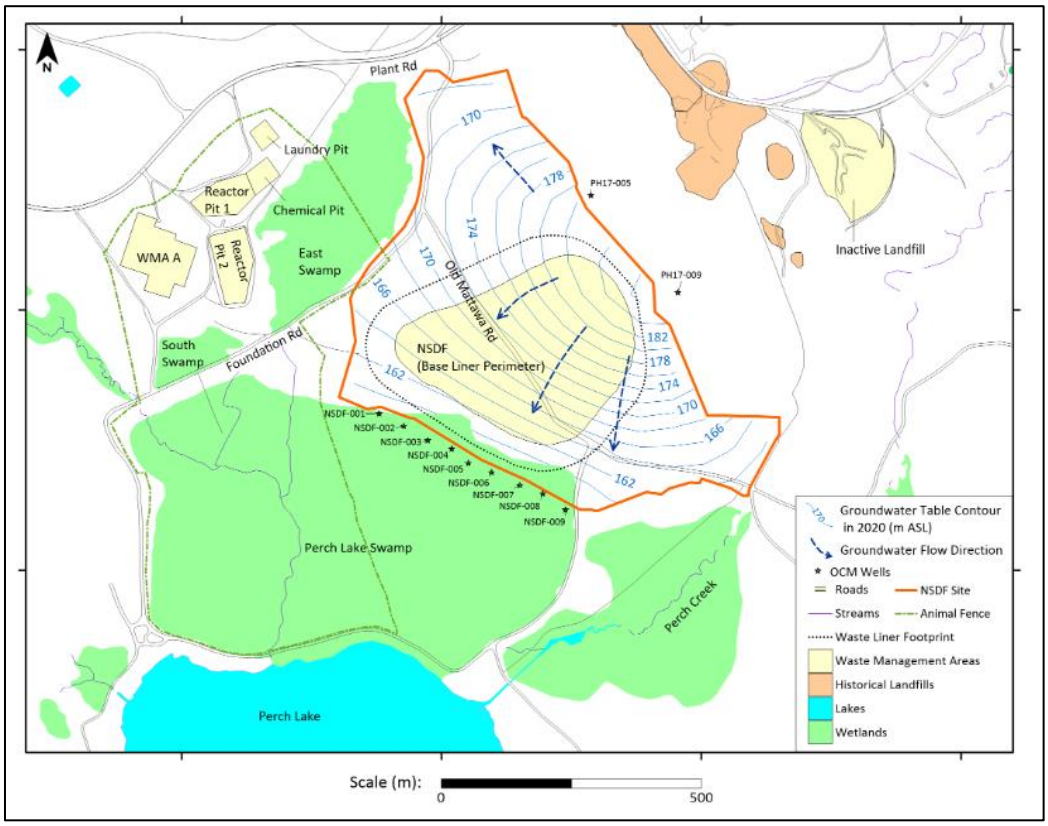


Figure 14: Near Surface Disposal Facility local water flow gradients

3.5 Alternatives Leachate Treatment and Management Options

Leachate is generated as water infiltrates through the waste in the disposal cell during operations and to a much lesser extent during the post-closure phase. A comparison of projected leachate concentrations and effluent discharge targets show that several radionuclides and non-radiological constituents may be present in the wastewater at concentrations that exceed discharge targets, and treatment for these designated contaminants of potential concern will be required. Wastewater is the product of three streams: leachate, water that comes into contact with contaminated material (known as contact water), and operational wastewater. The Wastewater Treatment Plant must therefore be designed for removal of radionuclides and selected non-radiological constituents. Alternatives for leachate treatment and management were considered, and **a dedicated wastewater treatment plant on the NSDF site was selected as the preferred option**. The following is a summary of the evaluation of alternatives leachate treatment and management options:

- **Use of the existing Waste Treatment Centre** – The existing Waste Treatment Centre is over 40 years old, and there are significant uncertainties in its ability to treat the additional volume and content from the NSDF. In addition, this option would require

2 km of pipeline to be constructed on the CRL site, along with significant re-investment and upgrades to existing infrastructure. For these reasons, use of the existing Waste Treatment Centre was deemed not technically or economically feasible.

- **Building a new and dedicated wastewater treatment plant** – The proposal to build a new, standalone treatment plant would meet the NSDF Project purpose and would use the best demonstrated available technology that is economically achievable for removal of the radiological and non-radiological contaminants of potential concern from the NSDF wastewater. Further, this alternative would have the capacity to treat the volume of leachate and wastewater predicted to be generated over the operating life of the NSDF Project and not limit the Engineered Containment Mound's storage capacity over the long-term. Effluent monitoring will be required at the wastewater treatment plant to ensure treated water meets effluent discharge targets.
- **No discharge option** – Leachate evaporation ponds are artificial ponds with very large surface areas that are designed to efficiently evaporate water by sunlight and exposure to the ambient temperatures. Leachate evaporation ponds are used in hot dry climates and are not effective in the mid-continental climate of central Canada with no distinct dry season. Therefore, a leachate evaporation pond is not considered a technically feasible alternative.

3.6 Alternative Effluent Discharge Options

Following treatment in the Wastewater Treatment Plant, the treated effluent will need to be managed on-site or be discharged to the natural receiving environment. Several effluent discharge option alternatives were considered, and **a combination of discharge to the ground and discharge to Perch Lake was selected as the preferred option**. The following is a summary of the evaluation of alternative effluent discharge options:

- **Discharge to the ground** – Discharge of treated effluent to the ground would involve the construction of an exfiltration gallery, which would promote the exfiltration of treated effluent into the local groundwater regime. This effluent discharge option uses the ground for retention capabilities allowing for radionuclide decay. The treated effluent, once discharged to the ground, would be returned to the adjacent wetlands and eventually to Perch Lake and the Ottawa River. Discharge to ground provides the added benefit of enabling the control of recharging water to the wetlands. The average Wastewater Treatment Plant discharge rate is higher than the infiltration capacity of the hosting soils; therefore, the current design of the exfiltration gallery cannot support the required discharge flow rate and is not technically feasible.
- **Discharge to surface water, Perch Creek** – Perch Creek does not have a sufficient flow rate to accept the effluent discharge and was not deemed technically feasible.
- **Discharge to surface water, Perch Lake** – The use of a transfer line to discharge treated effluent is widely used and effective, and standard mitigations are available to limit adverse effects and provide adequate provisions to protect the environment. CNL

currently monitors water quality within Perch Lake and any additional monitoring requirements would be incorporated into the existing monitoring program. Construction of a transfer line to Perch Lake is technically feasible.

- **Discharge to surface water, Ottawa River** – This alternative considers sending the treated effluent from the Wastewater Treatment Plant to one of CNL's three existing discharge points along the Ottawa River. Any options would require the construction of a transfer line to transport the treated effluent from the Wastewater Treatment Plant to the Ottawa River discharge point. Although existing underground infrastructure along the perimeter of the developed site adds complexity to construction, construction of a transfer line to the Ottawa River is technically feasible. However, protection of the Ottawa River is a high priority for Indigenous Peoples and the public. Discharge directly to Ottawa River is expected to be perceived unfavourably by Indigenous Peoples and the public.
- **Co-discharge with the NSDF Project stormwater system and discharge to the ground** – This option considered using one or more of the three surface water management ponds in combination with the exfiltration gallery. The surface water management ponds manage all non-contaminated surface water within the NSDF Project site, and discharge to adjacent wetlands. There is insufficient space on the NSDF Project site to accommodate a new pond or enlarge the existing ponds in order to meet capacity requirements, therefore this option was considered not technically feasible.
- **Discharge to the ground and discharge to surface water** – This alternative involves the combination of discharge to the ground with the direct discharge to the Perch Lake via a pipeline. The combination of discharge to ground with direct discharge to surface water provides an additional discharge option when there is insufficient infiltration capacity at the exfiltration gallery. Discharge to ground provides the added benefit of enabling control of recharging water to the wetlands. Discharge to Perch Lake is considered technically feasible. Therefore, discharge to the ground combined with discharge to surface water (i.e., Perch Lake) is technically feasible and is the preferred option for keeping the water balance in the ecosystem.
- **No liquid discharge (i.e., thermal evaporator)** – Because of public concerns about liquid emissions, options to reduce or eliminate liquid emissions were considered. A thermal evaporator could be installed to evaporate and release the treated effluent to the atmosphere. The evaporator would be technically feasible for normal flow conditions but would not have the capacity to manage the flow from back-to-back storm events. This option was considered not technically feasible. Furthermore, this option would introduce additional emissions to air through evaporation (e.g., tritium and other volatiles) and produce a visible steam plume, which is expected to be a concern to the public.

3.7 Alternative Discharge Types

The total annual volume of wastewater to be treated and discharged to the Perch Creek and Perch Lake Watershed is approximately 11,000 m^3, which represents less than 1% of the annual average total outflow from Perch Lake of approximately 1,700,000 m^3. Two alternative discharge types were considered technically and economically feasible for the discharge of treated effluent to Perch Lake, and **the submerged diffuser (alignment along lakebed) was selected as the preferred option**. The following is a summary of the evaluation of alternative discharge types:

- **Discharge by surface spray onto Perch Lake** – This alternative would involve spraying treated effluent over the lake surface through a series of above-water on-lake or lake-periphery discharge units. This discharge type would only be possible in open water conditions (i.e., year-round operation is not possible). Therefore, this alternative discharge type is considered not technically feasible.
- **Piped outfall to Perch Lake (submerged outlet in Perch Lake)** – Treated effluent would be discharged into the lake below the water line through a single piped outlet, and could therefore be expected to operate year-round. This discharge type is considered technically feasible.
- **Piped outfall to Perch Lake (above-water discharge)** – Treated effluent would be discharged onto the lake surface through a pipe outfall, limiting the discharge to open water conditions (i.e., year-round operation is not possible). Therefore, this alternative discharge type is considered not technically feasible.
- **Submerged diffuser in Perch Lake (alignment along lakebed)** – A submerged diffuser would be located along the lakebed and anchored to the bed at various points along the submerged pipeline. This option allows for year-round discharge, as the submerged diffuser would be located in a zone within Perch Lake that is deep enough for the diffuser ports to be below ice and with sufficient water column height to allow maximized mixing within Perch Lake. This alternative discharge type is considered technically feasible.
- **Submerged diffuser in Perch Lake (diffuser suspended in water column)** – This submerged diffuser option extends into the lake with buoyancy support, which would limit the application for this option to open water conditions. Therefore, this alternative discharge type is considered not technically feasible.

3.8 Final Grade of the Facility

Three alternatives were assessed for the Engineered Containment Mound floor elevation and final grade of the facility. Two of the alternatives (i.e., maintaining the existing grade and above grade alternatives) cannot meet the NSDF design requirements as well as accommodate the 1 million m^3 of low-level radioactive waste storage capacity within the NSDF footprint which reflects the required wetland setbacks. **The mid-range grade alternative was selected as the**

preferred Engineered Containment Mound design, because this alternative is compliant with design requirements and can meet the required storage capacity. The following is a summary of the evaluation of final grade of the facility:

- **Engineered Containment Mound below existing grade** – The base of the Engineered Containment Mound cannot extend into the groundwater table. For this alternative, the areal extent of the Engineered Containment Mound would need to increase to meet the required storage capacity. However, additional space at the NSDF Project site is constrained and the Engineered Containment Mound cannot be expanded further without encroaching on adjacent wetlands. Therefore, an Engineered Containment Mound that maintains the existing grade of the surrounding area cannot meet the required storage capacity for the NSDF Project and is not technically feasible.
- **Engineered Containment Mound above existing grade** – A design requirement for the NSDF is that the Engineered Containment Mound is not visible from the Ottawa River, Plant Road, or the CRL campus. If the Engineered Containment Mound floor was situated on top of the bedrock at the NSDF Project site, the areal extent of the Engineered Containment Mound would also need to increase to meet the required storage capacity. However, additional space at the NSDF Project site is constrained and the Engineered Containment Mound cannot be expanded further without encroaching on adjacent wetlands. Therefore, the above-grade alternative cannot meet the required storage capacity for the NSDF Project and is not technically feasible.
- **Mid-range grade** – This alternative would require excavation and blasting of bedrock to keep the berm heights lower and the elevation of the top of the Engineered Containment Mound near the ridgeline at an elevation approximately 3 m below the sight line from the CRL campus. This design accommodates all NSDF design requirements and satisfies the storage capacity required and thus has been deemed technically feasible.

3.9 Similar Disposal Facilities and Operating Experiences

The design of the NSDF Project used the operating experiences from similar facilities, including international facilities and CNL's Port Hope Long-Term Waste Management Facility and Port Granby Long-Term Waste Management Facility. Benchmarking site visits were conducted as part of the design development. Table 4 provides a list of similar near surface facilities in Canada and the USA.

Within Canada, CNL is implementing the Port Hope and Port Granby projects, on behalf of AECL, in eastern Ontario for the safe, long-term management of historical low-level radioactive waste arising from the operations of the former Crown corporation Eldorado Nuclear Ltd. and its private-sector predecessors. These projects also include the construction and operation of facilities for the long-term storage of low-level radioactive waste that are similar in design to the NSDF Project (Figure 15). The design of the Engineered Containment Mound for the NSDF Project is fundamentally consistent with those for the Port Granby and Port Hope project. The

thickness of 0.75 m for a compacted clay liner in the base liner system is consistent with the standard practice for waste containment facilities. The thickness of the compacted clay liner meets the requirements of *Ontario Regulation 232/98, Landfilling Sites* [48] for non-hazardous waste facilities and is the same as that used for the Port Granby and Port Hope facilities.

Figure 15: Installation of Liner (left) and Capped and Closed Facility (right) in Port Granby, Ontario

Table 4: Similar Near Surface Facilities in Canada and the USA

Facility	Location	Year Built	Status	Capacity (m^3)	Facility Design	Waste Type	Climate	Annual Precipitation	Terrain	Distance to Nearest Surface Waterbody
Proposed CNL NSDF	Ontario, Canada	Proposed	Proposed	1,000,000	Engineered containment mound	low-level radioactive waste from past operations, environmental remediation, and decommissioning	Wet	87 cm	On a ridge	~0.35 km to Perch Creek, 1.2 km to Ottawa River
CNL Port Granby Long-Term Waste Management Facility	Ontario, Canada	2017	Facility capped and closed, treatment of leachate continues	774,000	Engineered containment mound	Low-level radioactive waste, hazardous and mixed waste from uranium processing, and environmental remediation	Wet	83 cm	Flat	0.7 km to Lake Ontario
CNL Port Hope Long-Term Waste Management Facility	Ontario, Canada	2017	In operation	1,200,000	Engineered containment mound	Low-level radioactive waste, hazardous and mixed waste from uranium processing, and environmental remediation	Wet	83 cm	Flat	0.1 km to Brand Creek, 3 km to Lake Ontario
Oakridge National Laboratories, Environmental Management Waste Management Facility	Tennessee, USA	2002	In operation	1,300,000	Engineered containment mound	Low-level radioactive waste, hazardous waste from environmental remediation, and decommissioning	Wet	140 cm	On a ridge	0.5 km to Bear Creek and Clinch River
Clive Disposal Facility	Utah, USA	1988	In operation	1,000,000	Engineered containment mound	Low-level radioactive waste, mixed waste, polychlorinated biphenyl waste	Arid	42 cm	Flat	42 km to Stansbury Bay
Barnwell Disposal Facility	South Carolina, USA	1971	In operation	1,000,000	Engineered containment mound	Low-level radioactive waste	Arid	117 cm	Flat	5 km to Par Pond
Texas Compact Waste Facility	Texas, USA	2012	In operation	255,000	Engineered containment mound	Low-level radioactive waste	Arid	40 cm	Flat	60 km to Laguna Gatuna
Hanford Environmental Restoration Disposal Facility	Washington, USA	1996	In operation	16,800,000	Engineered containment mound	Low-level radioactive waste, hazardous and mixed waste from environmental remediation, and decommissioning	Arid	16 cm	Flat	12 km to Columbia River
Portsmouth On-site Waste Disposal Facility	Ohio, USA	Under construction	Under construction	1,000,000	Engineered containment mound	Low-level radioactive waste, hazardous and mixed waste from uranium processing	Wet	102 cm	On a ridge	2.4 km to Scioto River
Fernald On-site Disposal Facility	Ohio, USA	1996	Closed	2,250,000	Engineered containment mound	Low-level radioactive waste and mixed waste from uranium processing	Wet	105 cm	Flat	~1 km to Great Miami River

4. The NSDF is Protective of the Ottawa River and the Environment

As previously discussed in Section 1.2, past waste management practices, which met the standards of the day, are no longer acceptable. Specifically, the legacy waste management areas lack robust containment, which in some instances has led to contamination of the surrounding environment. CNL is committed to the cleanup mission at the CRL site, which requires removal of the existing sources causing contamination in the environment and placing the waste in modern engineered containment; thus the NSDF Project is a critical part of that mission as an enabling facility. **The main engineering features of the NSDF Project represent an increase in safeguards to protect the Ottawa River and the environment**. These safeguards include the following:

- The main containment features of the proposed facility are the natural and synthetic barriers – in both the base liner and cover systems – which are designed to work together to isolate the waste materials from the environment for hundreds of years after which the radioactivity of the waste will have decayed to levels found naturally in the environment.
- The dedicated wastewater treatment facility will remove contaminants from any leachate or wastewater collected during the operational period. The treatment or removal of contaminants from the wastewater are not novel and are used within the international nuclear industry.
- The discharge to the environment during the operational period is controlled and only occurs after the treated effluent has been confirmed to meet the discharge criteria, which are reflective of the federal and provincial water quality guidelines and ensure protection of the Ottawa River and surrounding environment.

4.1 Description of Wastes

Wastes being disposed in the NSDF are organized into six physical waste types defined by material composition. The vast majority of the waste type proposed for the NSDF Project are soils, soil-like debris, and decommissioning and/or demolition wastes, accounting for approximately 85% of the waste volume. The remaining approximately 15% of the waste volume is wastes that are contained in various types of packages. Figure 16 shows an example of soil or bulk wastes (within an engineered bag) generated from decommissioning activities. Figure 17 shows the type of waste, such as contaminated personal protective clothing, generated from operations at the CRL site.

The sorting and segregation of contaminated wastes into types, such as soils or building debris, is an important part of building the facility. The Engineered Containment Mound is constructed as a relatively solid structure, compacted to specific requirements. Soil and soil-like wastes can be used to fill in the gaps between packaged wastes and large rubble and building debris. This allows for more efficient compaction of the overall facility.

Figure 16: Soil or Bulk Wastes Generated from Decommissioning

Figure 17: Contaminated Waste Generated from Operations

Radiologic Content

The NSDF will contain only low-level radioactive waste. Low-level radioactive waste contains primarily short-lived radionuclides (i.e., half-life ≤30 years) and restricts the number of long lived radionuclides (i.e., half-life > 30 years); thus, isolation and containment are only required for periods of time up to a few hundred years. Long-lived radionuclides are included in the NSDF inventory as they are intrinsically part of the radiological fingerprints of waste streams at CRL and other CNL sites, and are listed in Table 5. It is not practical, technical, or economical to separate the long-lived radionuclides from the waste streams, especially since many of the waste streams are in the form of soil and building debris. However, the concentrations of long-lived radionuclides that are proposed in the NSDF inventory are limited, consistent with CSA

N292.0 *General principles for the management of radioactive waste and irradiated fuel* [49] and IAEA GSG-1 *Classification of Radioactive Waste* [4] guidance.

Table 5: Proposed Radionuclides in CNL's NSDF

Radionuclide	Half-Life[(a)] (years)	Predominant Decay Emission
Silver-108m	438	Gamma
Americium-241	433	alpha/gamma
Americium-243	7,360	Alpha
Carbon-14	5,700	Beta
Chlorine-36	301,000	Beta
Cobalt-60	5	beta/gamma
Cesium-135	2,300,000	Beta
Cesium-137	30	beta/gamma
Hydrogen-3 (tritium)	12	Beta
Iodine-129	15,700,000	beta/gamma/x-ray
Molybdenum-93	4,000	x-ray
Niobium-94	20,300	beta/gamma
Nickel-59	76,000	x-ray
Nickel-63	101	Beta
Neptunium-237	2,140,000	alpha/gamma
Plutonium-239[(b)]	24,100	Alpha
Plutonium-240[(b)]	6,650	Alpha
Plutonium-241	14	Beta
Plutonium-242	375,000	Alpha
Radium-226	1,600	alpha/gamma
Selenium-79	327,000	Beta
Tin-126	230,000	beta/gamma
Strontium-90	29	beta
Technetium-99	211,000	beta
Thorium-230	75,400	alpha
Thorium-232	14,000,000,000	alpha
Uranium-233	159,000	alpha
Uranium-234	246,000	alpha
Uranium-235	704,000,000	alpha/gamma
Uranium-238	4,470,000,000	alpha/gamma
Zirconium-93	1,610,000	beta

(a) Half-lives are from the IAEA Live Chart of Nuclides.
(b) Reported as Pu-239/240 as these radionuclides are generally combined in laboratory analysis.

The Engineered Containment Mound design life of 550 years has been established to meet the required time period to allow for radioactive decay of the waste inventory, as illustrated in Figure 18. The radioactivity concentration in the Engineered Containment Mound decreases by about 2,000 times in the first 100 years and begins to approach background levels of concentration shortly thereafter. After the initial rapid decay of the shorter-lived radionuclides, the radioactivity concentration begins to approach the natural background concentrations of the local soils. By the time the facility begins to experience degradation of barriers, the

radioactivity concentration will have decayed even closer to background levels. In fact, at the time the engineered barriers no longer provide significant physical containment, 99.991% of the disposed inventory will have decayed and only 0.005% is available to be released from the Engineered Containment Mound. This negligible environmental release is the reason the radiological consequences to both human health and the environment are acceptable low, as presented in Section 5.5.

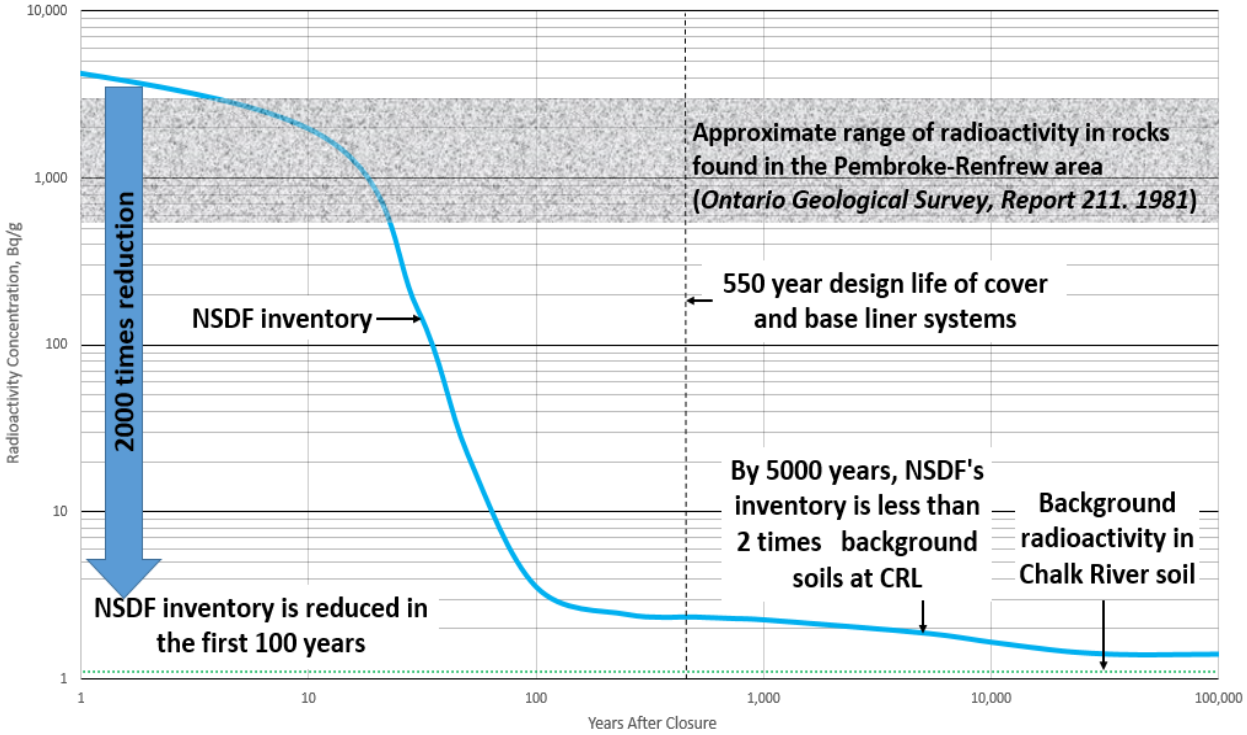


Figure 18: **Radiological Decay of the NSDF Inventory with Time**

Although not all radionuclides proposed in the NSDF inventory are naturally occurring, the purpose of comparing the NSDF total radioactivity concentration to the total natural background concentrations is to build confidence that the long-term hazard is acceptably low. The radioactivity concentration of natural rock formations in the Pembroke-Renfrew area is also plotted on Figure 18. This comparison provides an analogy by recognizing that long-lived radionuclides already exist in the environment without being a hazard. There is no requirement to meet background radioactivity levels in a disposal facility. The radiological inventory proposed for the NSDF, combined with the facility design, ensures that impacts to human health and risk to the environment remain below the regulatory limits, as discussed in Section 1.5.

Non-radiologic Content

The NSDF will only accept radiologically contaminated material; however, these materials are made of a variety of metals, organics, and chemical compounds. As a land disposal facility, the NSDF will follow the guidelines of Ontario's *Regulation 347, General – Waste Management* [50],

for acceptable quantities and concentrations of metals, organics, and chemical compounds to limit the leaching potential of the facility.

Inventory Control

CNL has developed Waste Acceptance Criteria [51] for the proposed NSDF Project to ensure all waste received for disposal is in compliance with the design and licensing basis for the facility. For example, as a near surface disposal facility, the Waste Acceptance Criteria must be established to limit the concentration and potential hazard of the radioactive material, thus limiting the consequence of human intrusion. A limit of 400 Bq/g on average for long-lived alpha emitting radionuclides has been used. Similarly, for long-lived beta and/or gamma emitting radionuclides, the allowable average activity concentration is 10,000 Bq/g. These limits are consistent with the categorization of low-level radioactive waste in both CSA N292.0 *General principles for the management of radioactive waste and irradiated fuel* [49] and IAEA GSG-1 *Classification of Radioactive Waste* [4] guidance. Additionally, due to the impracticality of treating the wastewater to remove tritium, CNL has instead established a total inventory of tritium for the facility as well as tritium concentration thresholds when the waste must be packaged into leachate-controlled packages. By placing stringent controls on the amount of tritium being placed in the NSDF, the inventory is controlled at the source and emissions from the Wastewater Treatment Plant will meet the tritium effluent discharge targets.

Waste shall comply with all of the criteria in the Waste Acceptance Criteria [51] to be considered acceptable for disposal in the NSDF. In addition, there are two upper limits to the amount of waste that the NSDF can accept. Neither the maximum radioactivity of each radionuclide (as per Table 5) nor the total volume of 1 million m^3 may be exceeded.

4.2 Engineered Containment

The NSDF Project has been designed in accordance with regulatory and international design principles for radioactive waste disposal (see Section 1.6). This includes the incorporation of multiple safety functions, containment and isolation of the radioactive waste, and incorporation of surveillance and control of the passive safety features. The long-term safety performance of the NSDF Project depends on many safety features, including the following engineered barriers:

- base liner system, which has a primary and secondary liner to contain the waste and to limit the potential release of contamination to the subsurface and groundwater
- a final cover system, which will isolate the waste, provide radiation shielding and an intrusion barrier, and prevent precipitation from infiltrating the waste
- a perimeter berm, which provides structural stability and is designed to withstand natural physical events, thereby ensuring containment of the waste

The base liner and final cover systems are composed of a combination of natural materials (e.g., a compact clay liner) and synthetic materials (e.g., high-density polyethylene geomembranes) designed to work together to prevent the release of contaminants into the environment. Long-term performance tests demonstrate that the synthetic high-density polyethylene

geomembrane component of the liner systems will meet the 550-year design life, thus complementing the compact clay layer and providing a hydraulic barrier for thousands of years.

Since the perimeter berm is constructed exclusively from natural materials, it is expected to remain intact and performing its function of providing structural integrity for thousands of years. Further, the waste material placement and compaction are part of the design basis to ensure structural stability in order to avoid settling and subsidence. Similar structures, such as human-made mounds built with earthen materials and limited engineering or construction knowledge, have existed for more than 550 years (e.g., Monks Mound in Illinois, USA).

The facility development uses a two-phased approach. Phase 1 development has a capacity of 525,000 m³ and accommodates wastes currently in storage and wastes to be generated over the next 20 to 25 years. Phase 2 development will increase the waste capacity by 475,000 m³ to the total capacity of 1 million m³, thus accommodating the wastes generated until the expected end of NSDF operations. Following its closure, the Engineered Containment Mound will resemble a grassy outcrop build into an existing hillside. Although the Engineered Containment Mound will be approximately 18 m tall, due to the local topography and its design, the Engineered Containment Mound will not be visible from the Ottawa River.

The Engineered Containment Mound elevation ranges from approximately 163 m above sea level to 202 m above sea level, which corresponds to the lowest elevation of the base liner system and highest elevation of the final cover system, respectively. Figure 19 shows a cross-section of the Engineered Containment Mound and includes the elevation in metres above sea level (the figure is not to scale).

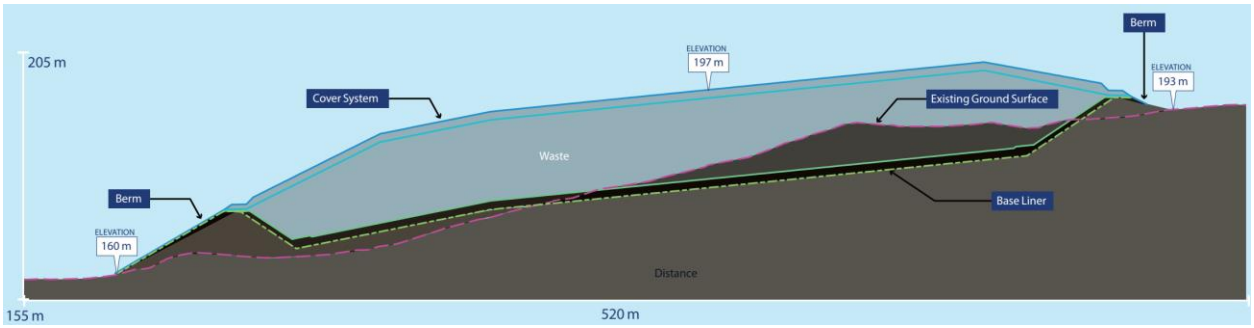


Figure 19: Cross-Section of the Engineered Containment Mound

The Engineered Containment Mound will consist of 10 individual but continuous disposal cells (six cells in Phase 1 and four cells in Phase 2), each designed for progressive construction, filling, and closure in sequence. The cells vary in size and have an average surface area of approximately 12,000 m^2. The disposal cells are designed to hold the structural dead load and progressive weight of the waste and live load from the waste placement equipment operations. Dividing the entire disposal area into 10 cells provides for the preferred operation and closure sequence to support water management as discussed in Section 4.3.

The waste placement process will maximize in-place density and reduce void space, thus reducing the potential for future differential settlement of waste. The handling and placement procedures are developed to ensure safe and secure placement of the waste so that it does not

affect the integrity and long-term performance of the Engineered Containment Mound. Although waste placement is planned on a year-round basis, it will be subject to acceptable weather conditions and may cease during periods of inclement weather.

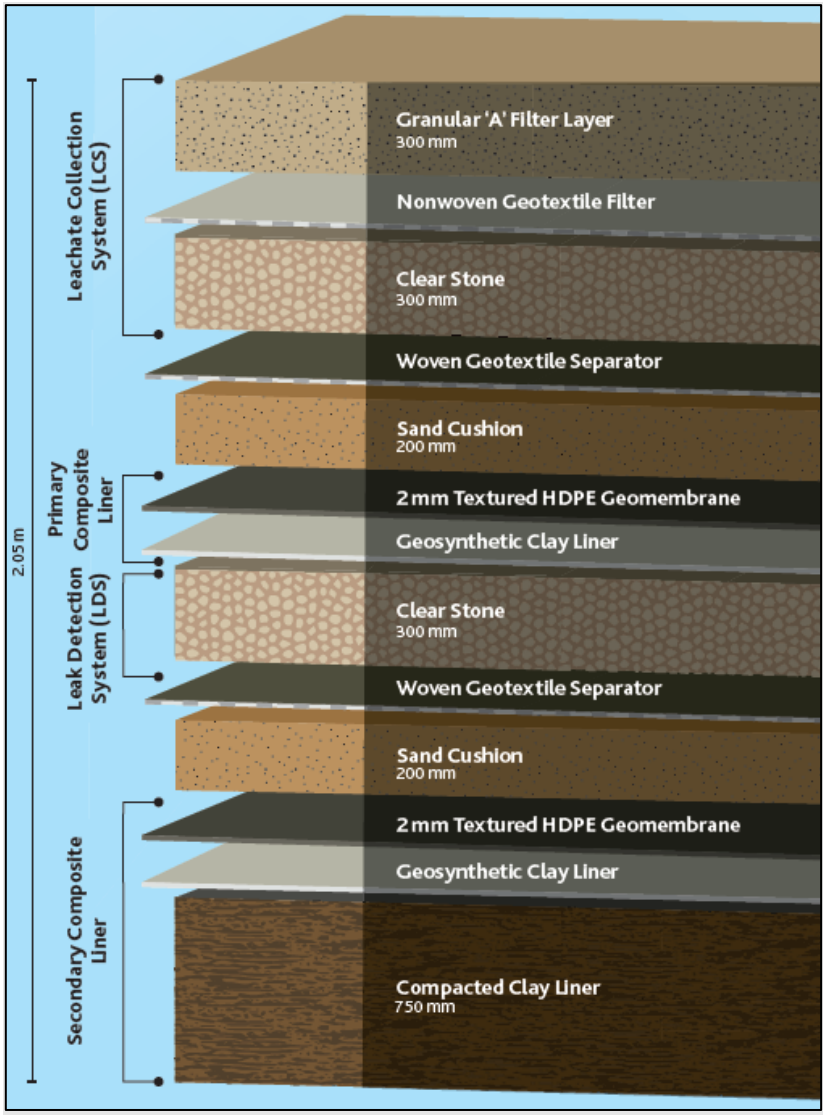


Figure 20: Base Liner System

Figure 20 presents a cross section of the base liner system.

The base liner system is made of multiple layers of natural and synthetic materials. The base liner's primary purpose is to contain and isolate the waste from the geosphere. The secondary purpose of the liner system is to collect leachate and detect leaks in the primary liner during the operations phase of the Project.

The liner system contains multiple layers of natural and synthetic materials designed to maintain the integrity of the primary hydrological barriers, the high-density polyethylene geomembrane. The liner system contains two high-density polyethylene geomembrane liner systems, both supported by geosynthetic clay liners and separated by sand and stone layers. The liner is constructed with this double-layer system to provide additional confidence that the system as a whole will perform as designed over the duration of the design life of the Engineered Containment Mound. In addition to the double- high-density polyethylene geomembrane liner system, the final barrier separating the waste from the environment is 750 mm of compacted clay. Clay is a natural material with no specific "design life" and is expected to perform as a hydraulic (water) barrier for thousands of years.

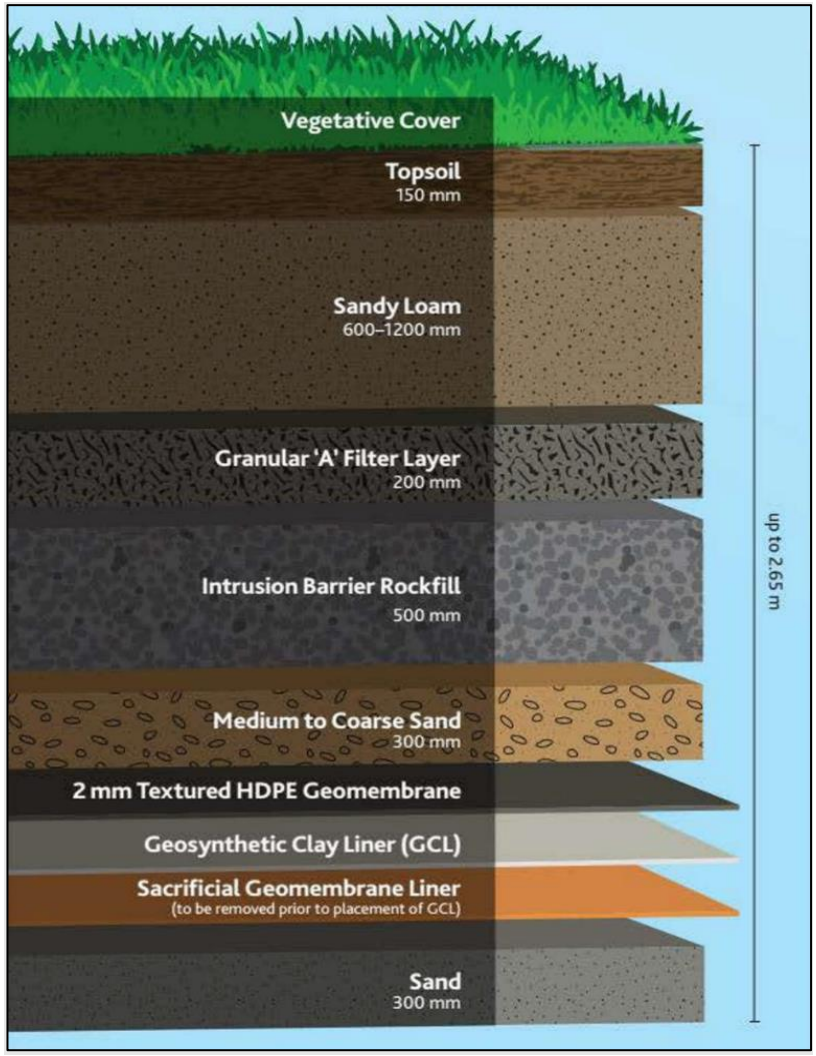


Figure 21: Final Cover System

Figure 21 presents a cross-section of the final cover system.

The final cover system contains multiple layers of independent barriers comprised of both natural and synthetic materials and uses the best available technology and materials available. The final cover is designed to direct precipitation away from the waste and minimize infiltration into the waste. The high-density polyethylene geomembrane is a non-porous material, meaning water cannot penetrate through it. The high-density polyethylene geomembrane is supported by a layer of geosynthetic clay liner. The clay liner serves two purposes: it is a water infiltration barrier and a repairing mechanism for the high-density polyethylene geomembrane. If the high-density polyethylene becomes pierced or degrades to the point where water is able to pass through it, water will then come into contact with the geosynthetic clay liner. The clay in the geosynthetic clay liner expands when in contact with water, thus “sealing” the damage to the geomembrane.

The intrusion barrier is a layer of rock aggregate fill and has several purposes. The primary purpose is to deter wildlife from digging holes into the waste. The intrusion barrier may also deter or even prevent the roots of large trees from penetrating into the waste. By keeping tree roots shallow, the potential damage to the cover system from a felled tree being uprooted is significantly reduced.

The layers of material above the high-density polyethylene geomembrane all contribute to its protection. The approximately 2 m of material create a barrier between the high-density polyethylene and the environment. The cover materials protect the high-density polyethylene from potential forest fire conditions and from potential freeze-thaw cycling in the winter and spring. The barrier layers together form a system designed to mitigate water infiltration into the Engineered Containment Mound for the duration of its design life, but likely for much longer.

4.3 Water Management

The approach for surface water management within the NSDF Project is designed to keep precipitation that has not contacted the waste material (i.e., non-contact water) separate from precipitation that has potentially contacted with the waste material and thus at risk of being contaminated (i.e., contact water). The surface water management system is designed to prevent surface water from uncontaminated areas from discharging into contaminated areas.

Contact and non-contact water ponds will be kept independent from each other by the ridge and valley configuration (herringbone shape) in the base liner and through the use of temporary berms. The cells are oriented so that the ridge and valleys will naturally direct water to ponds located at the low point of each cell. The ponds will be positioned along the south edge of the Engineered Containment Mound for Phase 1, as shown in Figure 22.

Non-contact water is conveyed from the Engineered Containment Mound to the surrounding surface water management system (labeled as SWMP 1 through 3 in Figure 22). The surface water management system consists of collection, conveyance, treatment (i.e., settling ponds), and discharge outlets to receiving waters. The capacity of the surface water management system considers several design storms including a 24-hour, 100-year design storm with climate change and snowmelt considered, to determine the operational high levels and flows of the non-contact conveyance and pond systems. A conservative approach using storms of different magnitude and time to peaks (rainfall distributions) were modelled to determine high water levels and flow rates.

The contact water pond will receive potentially contaminated water from the waste handling area as well as the adjacent waste disposal cell. There are design features to promote flow to the contact water pond such as grading the waste in the active waste cell (minimum 2% slope) towards the contact water pond. The collected wastewater in the contact water ponds is pumped to the Wastewater Treatment Plant for treatment prior to discharge to the environment.

Figure 22: Artist Rendering of the Engineered Containment Mound Disposal Cell Layout

4.3.1 Minimizing Generation of Wastewater

The NSDF Project considered measures to contain and isolate waste during placement, specifically to minimize or prevent contact water and radionuclide migration. The more general objective is to minimize the generation of wastewater from which radiological contaminants need to be removed. The principles of isolation and containment are satisfied in the inventory management, design features, and planned operational practices.

The inventory control of the NSDF Project applies a graded approach to control leachate radionuclide concentrations during placement of waste. A small portion of waste will be required to use robust packaging to isolate the waste from precipitation and prevent the spread of contamination. Specifically, leachate-controlled waste packages are intended to provide short-term barriers for wastes with higher radionuclide concentrations during the time the disposal cell is not covered with the final cover system (approximately 5-10 years). Thus, more mobile radionuclides, such as tritium, are kept isolated from the environment to minimize liquid effluent releases during the operations phase.

The proposed NSDF Project includes the following operational features to minimize the generation of wastewater:

- limiting the operational cell area to 21,000 m^2
- managing contact water and non-contact water within the Engineered Containment Mound separately
- using interim covers over waste areas that will be inactive for greater than 30 days

During waste placement operations, efforts are made to minimize the contact of precipitation with contaminated waste, thus minimizing contact water and leachate generation. The operation of the NSDF is limited to one open cell at a time to limit the surface area of waste that is exposed to the environment (i.e., precipitation) at any given time. As a cell is constructed, interim covers are placed over the waste to limit infiltration of precipitation and promote non-contact surface water run-off. As each disposal cell is completed, the final cover system is installed over the filled disposal cell. Other operational practices to limit contact with precipitation include grading (i.e., minimum 2% slope) and compaction of the waste fill to promote surface water run-off.

During the operations phase, sacrificial liners are used on top of the waste (as part of the interim cover) and the base liner systems to divert storm water into the non-contact water collection areas (ponds). The temporary sacrificial liners on the Engineered Containment Mound floor and as part of the interim cover will be removed, cell by cell, prior to placement of the waste and final cover materials.

Any water run-off that contacts (or is suspected to have contacted) the contaminated waste will be diverted to a contact water pond and conveyed to the Wastewater Treatment Plant for treatment to remove contaminants prior to controlled release into the environment.

Additional measures that could be taken to keep the waste dry during waste handling, placement and storage (operation), and minimize precipitation infiltration into the active disposal cell are being considered including assessing the feasibility of using a conceptual weather cover structure over the open disposal cell to minimize contact water and precipitation infiltration. Minimizing precipitation infiltration into the active disposal cell will reduce the volume of leachate and contact water generated in the Engineered Containment Mound.

4.3.2 Wastewater Treatment

The Wastewater Treatment Plant (Figure 23) for the NSDF Project will be a new, stand-alone facility with a new effluent discharge on the CRL site. The strategy for wastewater treatment is based on protecting human health and the environment by defining an approach to that uses the best available technology that is economically achievable, and capable of meeting regulatory requirements. The design life for the Wastewater Treatment Plant is approximately 50 years. If the Wastewater Treatment Plant is required beyond its design life, the unit would be refurbished to enable continued treatment of leachate or other treatment options would be investigated.

Figure 23: Artist Rendering of the NSDF Wastewater Treatment Plant

The NSDF wastewater (i.e., leachate plus contact water) is conveyed to the equalization tanks by pumping stations for storage prior to processing in the Wastewater Treatment Plant. Wastewater will be collected from the Engineered Containment Mound, the drainage systems of the Vehicle Decontamination Facility, and the Operations Support Centre. The NSDF wastewater treatment process includes chemical precipitation to separate out metals and radionuclides, membrane filtration to remove suspended solids, granular activated carbon to remove organics, and polishing steps including ion exchange and pH adjustments.

CNL has performed pilot testing of the proposed treatment process using simulated NSDF effluent. This pilot testing demonstrated that the effluent target concentrations can be achieved.

The plant is designed for batch release where liquid effluent must be sampled and compared to targets prior to discharge.

The general layout and process flow of the proposed facility is shown in Figure 24.

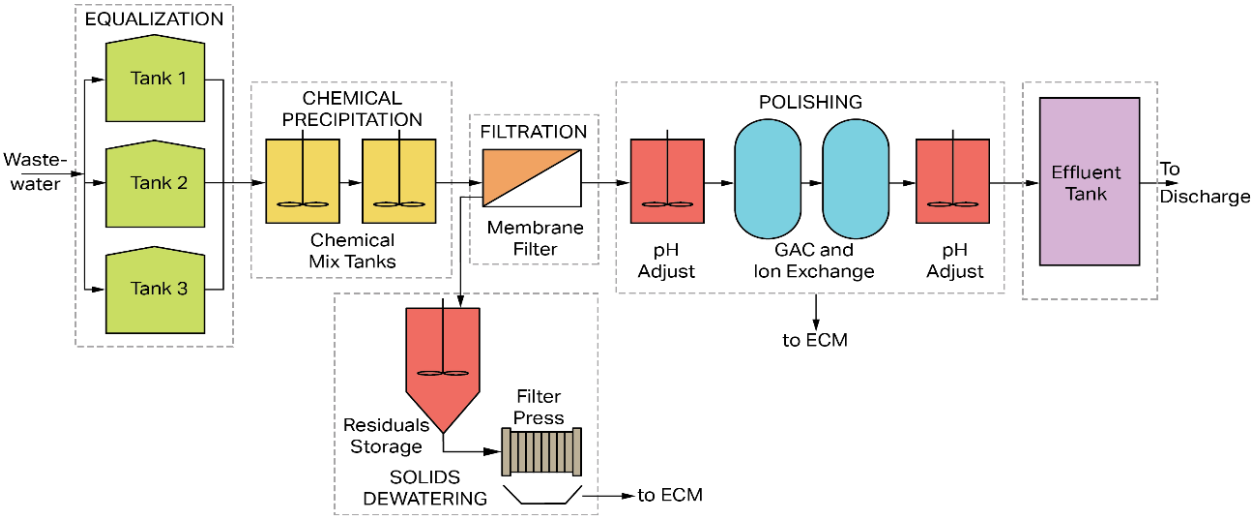


Figure 24: Wastewater Process Flow Diagram

Wastewater Collection

There are three above-grade, covered wastewater collection tanks (equalization tanks), constructed of 316L stainless steel, each with a working capacity of 1,900 m^3, for a total volume of 5,700 m^3. Over 80% of this design volume is designated as reserve capacity in case of an extreme precipitation event. The bounding design basis event is two back-to-back 100-year, 24-hour storm events that would produce a contact water volume of 4,710 m^3.

The wastewater treatment plant has two trains, each identical in process (Figure 24), and a design flow rate of 11.36 m^3/h. Operation of one wastewater treatment process train provides full treatment capacity. The secondary wastewater treatment process train can be used while the primary treatment train is out of service for maintenance or repairs.

Interconnections between the treatment trains also allow flow to be diverted between trains at each major process step. One treatment train can be operated to process average wastewater flow rates and two trains can be brought online when significant storm events occur or when it is desired to process wastewater at a higher rate.

Chemical Precipitation

When sufficient wastewater has accumulated in the collection tanks, samples will be collected for laboratory analysis to determine the chemical treatment needed to achieve effective precipitation.

Metals and radionuclides will be precipitated using the following general reactions for hydroxide and sulphide precipitation:

dissolved metal ion + OH^- metal hydroxide complex (insoluble precipitate)
dissolved metal ion + S^{--} metal sulphide complex (insoluble precipitate)

Addition of an iron salt such as ferric chloride in the presence of elevated pH results in the formation of precipitated ferric hydroxide. The formation of ferric hydroxide precipitate aids in the coagulation and adsorption of some metals and radionuclides to further enhance their removal.

Chemical coagulation using ferric chloride, and addition of both hydroxide and sulphide, was demonstrated to be very effective during laboratory-scale testing and the pilot-scale test for precipitation of metals and radionuclides.

Membrane Filtration

Membrane filtration will provide nearly complete removal of suspended solids from the chemically pre-treated wastewater.

In combination with chemical precipitation, the membrane filtration process was demonstrated during the pilot-scale test to achieve the effluent discharge targets for all heavy metals.

Granular activated carbon adsorption will be used for removal of organic contaminants that may be present in the wastewater.

Polishing

The ion exchange process will provide polishing treatment for removal of low concentrations of metals and radionuclides that remain after chemical precipitation and membrane filtration.

The ion exchange vessels are in a lead-lag arrangement. When the ion exchange resin in the lead vessel reaches its adsorption, the resin will be replaced with fresh resin. The vessel with fresh resin will be placed in the lag position and the former lag vessel will be placed in the lead position.

Residuals Dewatering

Based on the projected wastewater quantity and characteristics and the results of pilot-scale tests, it is estimated that an average of approximately 1 to 2 m^3/day of liquid residuals will be produced from the chemical precipitation and membrane filtration process, with a solids concentration ranging from 15,000 to 50,000 mg/L. The estimated dry mass of residuals is 35 kg per day prior to the addition of body feed and pre-coat chemicals.

A filter press system is used for dewatering. Based on the results of the pilot-scale test, it is expected that the dewatered residuals will have a solids content in excess of 30%, with a density of 1,390 kg/m^3. The liquid from the dewatering is returned to the treatment process (i.e., it is not discharged) and the solid portion of the residuals will be placed in the Engineered Containment Mound.

Final Effluent Controlled Discharge

Treated effluent from the final pH adjustment tanks (which follow the ion exchange stage) will be conveyed by gravity to the final effluent storage tanks, each sized for 8 h of hydraulic detention time. The final effluent storage tanks each provide 91 m^3 of final effluent storage for sampling prior to discharge. Sampling of the treated effluent is to ensure that it meets the effluent discharge targets before release to the environment.

The NSDF's Wastewater Treatment Plant treated effluent discharge systems are designed for the peak flow from the Wastewater Treatment Plant. The preferred option is to discharge the treated effluent from the Wastewater Treatment Plant to the exfiltration gallery as this provides a longer transit time to the Ottawa River as compared to directly discharging to Perch Lake, as well as reduces water losses from the local hydrogeological system. Under high water table conditions (i.e., in the spring), discharge to the exfiltration gallery is not possible and the treated effluent will be routed to Perch Lake.

Both the exfiltration gallery and Perch Lake are within the CRL site, which remains restricted from public use. The CRL site is not a source of drinking water for the public.

4.3.3 Effluent Discharge Targets

Protection of the Ottawa River (Figure 25) is important to CNL and its employees. Protection is achieved by adherence to regulatory limits and guidelines established to protect human health and the environment.

The Wastewater Treatment Plant effluent discharge targets for radionuclides are the maximum acceptable concentrations for drinking water and are derived using Health Canada Guidelines for Canadian Drinking Water Quality [52]. The use of drinking water concentrations for radionuclides is considered conservative as there is no public access to the Perch Creek and Perch Lake Watershed where Wastewater Treatment Plant effluent discharges will occur. The method for calculation of the maximum acceptable concentrations is provided in Health Canada Guidelines for Canadian Drinking Water Quality [52].

As tritium is a special-case radionuclide that cannot be removed via available wastewater treatment technologies, the effluent discharge criteria for tritium will be based on the requirement that tritium concentrations in Perch Creek remain below 7,000 Bq/L, which represents the Health Canada Drinking Water Quality guideline for tritium [52]. By placing stringent controls on the amount of tritium being placed in the NSDF, emissions from the Wastewater Treatment Plant will meet the tritium effluent discharge targets.

The effluent discharge targets for non-radioactive constituents are based on the protection of aquatic life and may be lower or higher than drinking water criteria. The effluent discharge targets are gathered from a variety of sources including the Canadian Council of Ministers of the Environment and Ontario Provincial Water Quality Objectives. If both federal and provincial criteria were available, the lower value was used to define the discharge target. The Canadian Council of Ministers of the Environment guideline values are for the protection of aquatic life;

the Ontario Provincial Water Quality Objectives were developed to ensure that water quality is satisfactory for aquatic life and recreation. Other reference documents were used when Canadian Council of Ministers of the Environment or Ontario Provincial Water Quality Objectives were not available.

It is CNL's commitment to demonstrate that the NSDF design can achieve these guidelines and limits now as well as for future generations. The NSDF effluent discharge targets are described in Section 3.4.2.5 of the final NSDF Environmental Impact Statement [31].

Figure 25: The Ottawa River, Downstream of CRL (the tip of Pointe au Baptême – a culturally significant site - is shown in the photo)

4.4 The Site is Appropriate

The design of the NSDF Project has taken into consideration the physical site characteristics of the CRL site to protect human health and the environment with features that will contain and isolate the waste. Furthermore, the protection of human health and environment is not solely reliant on the engineered safety barriers but complemented by the natural features of the selected site. The NSDF Project has performed extensive site characterization work to support the design and environmental assessment.

The Engineered Containment Mound will be located approximately 1.1 km from the Ottawa River. However, the facility has been sited on a bedrock ridge that slopes away from the Ottawa River, and the ridge acts as a groundwater divide with groundwater flowing towards the Perch Lake Basin. The groundwater passing below the Engineered Containment Mound has a longer flow path distance than the overland distance, resulting in an average transit time of 7 years. In comparison, the groundwater residence time from the Alternate Site (discussed in Section 3.4) is 2 years even though the overland distance to the Ottawa River is further. Regardless of the location, protection of the surface water and groundwater is the highest priority to CNL. As

discussed in Section 4.2, the engineered containment of the NSDF Project has been designed to prevent the release of contaminants into the environment, including groundwater, to protect local waterbodies until the radioactivity has sufficiently decayed such that it does not pose an unacceptable consequence to human health or the environment.

The siting of the Engineered Containment Mound on the bedrock ridge also locates it far above the maximum calculated Ottawa River flood levels for the area. Specifically, the lower point of the Engineered Containment Mound is at 163 m above sea level, while the maximum flood level due to upstream dam breaks is calculated to be about 122 m above sea level. Therefore, flooding of the Ottawa River cannot adversely affect the integrity of the NSDF or its barriers.

The Engineered Containment Mound will be built on the late Precambrian and/or early Paleozoic age granitic gneisses of the Ottawa-Bonnechere Graben underlying the CRL site. The CRL site is in a region characterized as a low to moderate seismic zone but overall this region has been tectonically stable for over 100 million years, as the last major block faulting occurred over about 120 million years ago. This adds confidence regarding long-term stability of the rock formation. The proposed Engineered Containment Mound is to be constructed on or near the bedrock. Structures founded on bedrock are generally seismically resistant because the motion is not amplified as much as the ones founded on overburden. As a result of the seismic assessment, optimizations were made during the design phase to mitigate the potential for liquefaction. A process known as “remove and replace” will be used during construction of the Engineered Containment Mound to stabilize the base of the perimeter berm. The native sandy soil is being removed and replaced by compacted engineered granular fill material, which allows water to drain more effectively.

CNL has conservatively chosen a once-in-10,000-year earthquake as the design basis earthquake for the Engineered Containment Mound and its 550-year design life. This design basis earthquake is equivalent to a peak ground acceleration of 0.55 g, which means the Engineered Containment Mound is designed to withstand a magnitude of earthquake that is not expected to occur because Ontario is not on a major tectonic plate border. The adoption of this size of earthquake is considered conservative because the inventory of radioactive material in the NSDF is low hazard and experiences significant decay in the first 100 years.

The NSDF Project is to be located in the Perch Creek and Perch Lake Watershed, which has well-understood hydrogeological properties. Due to early waste management practices, portions of the Perch Lake Basin have been impacted by groundwater plumes of radioactivity. Thus, the area has been used to study the mobility of radionuclides in groundwater and the overburden for over 60 years. This has led to a good understanding of how any radionuclides released from the Engineered Containment Mound after the design life will move in the environment. Following the eventual degradation of the base liner system, hundreds of years in the future, the low release rate of contaminants exiting the facility leads to negligible environmental concentrations and thus acceptably low radiological consequence to both human health and the environment. The release rates are low due to the natural and synthetic barriers coupled with the natural attenuation of the geosphere and surrounding environment.

The CRL site does not have a closure date. In fact, the CRL site is currently undergoing a site revitalization, a process that is generating low-level radioactive waste and driving the need for the NSDF Project. CRL's enduring mission means that qualified technical personnel will continue to work and develop skills related to radiation protection, nuclear safety, decommissioning, and waste management. By extension, the expertise required to continue the safe management and development of the NSDF over several decades will remain at CNL. Furthermore, the siting of the NSDF Project on federally owned lands and the enforcement of land-use restrictions increases confidence that the waste will be undisturbed for hundreds of years after closure.

The location of the NSDF Project is appropriate for its function as a low-level radioactive waste disposal site.

4.5 Consideration of Environmental Events

The NSDF Project has considered how changes to the environment could adversely affect the facility. This included an evaluation of how climate change, severe weather, and other environmental events may interact with and potentially alter the condition and function of the NSDF Project, resulting in effects on the environment or human health. Due to the recognized long timeframe of the NSDF Project as a permanent disposal facility for low-level radioactive waste, the potential magnitude and severity of future environmental events were considered. For example, natural hazards such as extreme weather caused by climate change, flooding, tornadoes, forest fires, seismic events, and glaciation were all assessed.

To ensure the effects of the NSDF Project are minimized, the design basis of the NSDF accounts for expected and extreme environmental conditions of the site. Some of the events considered and the design features that mitigate against their consequences include the following:

- Extreme rainfall events are considered in the design of the wastewater collection and treatment systems. The storage capacity and maximum flow rate of the Wastewater Treatment Plant was based on back-to-back, 100-year, 24-hour storm events. Within the Engineered Containment Mound, stormwater features such as drainage, ditches, culverts, and surface water management ponds have been designed appropriately for peak flows that accounted for climate change.
- Flooding of the Ottawa River as well as nearby creeks and wetlands has been taken into consideration in the siting of the NSDF Project. The base of the proposed NSDF is located approximately 163 m above sea level, which is approximately 50 m above the current water levels of the Ottawa River. Other design features provide additional mitigation to flooding including the topographical slopes of the Engineered Containment Mound.
- Significant seismic events and the potential for damage to the safety features are considered in the design of the Engineered Containment Mound. The design of the Engineered Containment Mound is robust enough to withstand significant seismic events beyond what have been recorded for the Ottawa Valley (i.e., once in 10,000 years). The use of earthen materials and specifications for waste material

placement and compaction are part of the design basis of the Engineered Containment Mound that provide the necessary structural stability. The Wastewater Treatment Plant and other infrastructure required only for the operations phase have followed current national building codes and will withstand typical seismic events for the Ottawa Valley (i.e., once in 2,475 years).

- Tornadoes are recognized as a hazard to the facilities on the CRL site, including the NSDF Project. It is acknowledged that the NSDF Project is in a geographical area that could reasonably expect a tornado strike; because of this, the design of the Wastewater Treatment Plant and other infrastructure will be robust and built to withstand potential tornadoes and high winds. The effects of tornadoes or extreme winds on the Engineered Containment Mound are expected to have negligible consequences.

Since the next predicted glaciation event may not occur until 100,000 years into the future, far beyond the hazardous lifetime of the NSDF inventory, an assessment of the consequences as the result of glaciation was not warranted. The NSDF Project incorporates design features to minimize the facility's effect on the environment during facility operation as well as into the post-closure phase; thus, residual effects on the environment from the NSDF Project are not significant.

If an extreme environmental event occurs, CNL already has procedures in place for an immediate response and post-event cleanup or remediation.

4.6 Environmental Assessment

The environmental assessment approach for the NSDF Project was developed to meet the requirements of the *Canadian Environmental Assessment Act*, 2012 [11] and the generic Environmental Impact Statement guidelines developed by the CNSC [24], which provide an outline of the information to be included, along with a high-level description of the methods to be implemented for the environmental assessment. Section 5.1 of the final NSDF Environmental Impact Statement [31] details the scope and environmental assessment approach implemented for the NSDF Project.

The assessment started with defining the overall scope of the assessment including identifying the valued components for each environmental discipline, such as atmospheric environment, hydrogeology, terrestrial biodiversity, human health, and the socio-economic environment. Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Indigenous Peoples, the scientific community, or the public. Examples of valued components identified include air quality, groundwater quality, migratory birds, and human health.

The next step for the assessment was to define the physical boundaries and the time-related phases of the Project during which the NSDF Project effects should be assessed. Three spatial boundaries were considered: the site study area, the local study area, and the regional study area. The site study area includes the area where NSDF Project activities would be undertaken, which includes the NSDF Project's proposed facilities, buildings, and infrastructure. A local

study area was selected for each environmental component to represent where the NSDF Project would have a direct affect. This most often includes the land and water immediately surrounding the site study area and portions of the downstream environment (e.g., Perch Lake). The largest section is the regional study area where the NSDF Project may interact with other existing infrastructure. The regional study area includes the full CRL site and in some cases extends beyond the site boundary (e.g., 8 km downstream into the Ottawa River). The expansion of the regional study area was in response to concerns raised by the public.

The assessment phases align with those of the NSDF Project: construction phase (approximately 3 years), operations phase (at least 50 years), closure phase (approximately 30 years), and post-closure phase (into the future).

The next step was to describe the existing conditions. A description of the environment subsection was developed for each environmental component and includes a description of the baseline conditions. The potential effects of the NSDF Project on the environment were then identified and mitigation was developed to reduce adverse effects on the environment. Residual effects (i.e., effects that remain after the application of mitigation) were classified (e.g., low to high magnitude and short-term duration) so that it could be determined if each residual effect was significant or not. Cumulative effects (i.e., the combined effect of the NSDF Project with other reasonably foreseeable developments) were also evaluated to determine the significance of these effects. Any uncertainty in the assessment and the general confidence in the predictions from the assessment were also evaluated.

Finally, monitoring programs were proposed to verify the predictions and assumptions from the environmental assessment and to confirm that the proposed mitigation is effective.

An interactive executive summary [53] of the Environmental Impact Statement can be found on CNL's website. This document that was created to assist with engagement on the NSDF in communicating technical information to a general audience.

4.6.1 Atmospheric Assessment Results

The climate in the region surrounding the NSDF Project site is classified as humid continental, with warm summers, cold winters, and no distinct dry season. The overall average daily temperature is 5.6°C, the daily average temperature in the winter is -9.3°C, and the daily average temperature in the summer is 19.1°C. Annual precipitation of 859 millimetres equivalent (mm[eq]) is calculated for the region, with the highest precipitation typically occurring in the summer. The wind conditions at the CRL site are considered to travel predominantly along the Ottawa River. When air quality is measured, contaminants are well below provincial and federal criteria, suggesting that the region has generally good air quality.

Section 5.2 of the final NSDF Environmental Impact Statement [31] seeks to understand and characterize potential residual effects of the NSDF Project and other previous, existing, and reasonably foreseeable developments on the atmospheric environment.

The NSDF Project activities have the potential to release air emissions that could contribute to changes in air quality and incrementally to climate change. During the construction and operations phases, NSDF Project activities will result in emissions, including dust associated with construction activities such as the operation of vehicles and equipment. Examples of the mitigation implemented to limit potential effects on air quality and climate change include the following:

- Implementing the Dust Management Plan developed for the NSDF Project, which includes appropriate management techniques to control dust generated by the NSDF Project.
- Maintaining on-site vehicles and equipment.
- Limiting idling of vehicles and equipment on site.

With the implementation of these measures, the predicted changes to air quality as a result of the NSDF Project during both construction and operations phases do not exceed air quality guidelines and/or standards with one exception: the 1-h nitrogen dioxide Canadian Ambient Air Quality Standard. However, exceedance of the 1-h nitrogen dioxide standard is not likely to occur given the conservative nature of the air quality assessment modelling. For example, in the model, heavy equipment is assumed to run simultaneously and continuously during working hours, which is unlikely to be the case. With the implementation of CNL's robust environmental protection program, including the Dust Management Plan for the NSDF Project, **residual effects from the NSDF Project on air quality are not significant.**

A slight residual effect to greenhouse gas emissions was identified because of the NSDF Project. The change is estimated to be less than a 0.02% increase in total provincial greenhouse gas emissions and a 0.005% increase in total national greenhouse gas emissions. Consequently, the **residual effect from the NSDF Project on greenhouse gases is not significant.**

4.6.2 Geological and Hydrogeological Assessment Results

The CRL site is located within the Canadian Shield. Bedrock outcrops in several locations in the region, and a widespread but thin deposit of glacial sediment covers the bedrock in most areas where soil is present. Soil layers in the area generally consist of well-drained sandy soils. Groundwater table depth varies significantly throughout the NSDF Project site and changes with the seasons. The average groundwater depths range from approximately 0.06 m in the vicinity of the wetlands to 15.95 m in the northern section of the study area, which corresponds to the thickest overburden. Groundwater flow from the NSDF Project site is to the adjacent wetlands and ultimately discharges to the Ottawa River via Perch Lake and Perch Creek. However, as mentioned previously the NSDF Project has been designed to prevent the release of contaminants into the environment, including groundwater, to protect local waterbodies.

Section 5.3 of the final Environmental Impact Statement [31] seeks to understand and characterize potential residual effects of the NSDF Project and other past, present, and reasonably foreseeable developments on the physical aspects of the environment.

Without mitigation, NSDF Project activities have the potential to alter soil quantity, quality, and distribution as well as geomorphology as a result of construction and closure activities. Blasting activities, site grading, excavating, and emissions of air contaminants could change soil quality during construction. The construction of the NSDF Project will physically alter groundwater levels and flows and surface drainage. During operations, discharge of treated effluent could cause changes to groundwater quality, levels, and flows. During the post-closure phase, without mitigation, leakage of leachate could cause changes to groundwater quality. Examples of design features and mitigation implemented to limit these potential effects to geology and hydrogeology include the following:

- Physical changes to the bedrock from blasting will be limited to the local area within the Engineered Containment Mound footprint.
- The base liner design includes both primary and secondary liner systems that are designed to have redundancy in case of premature failure and are designed to be suitable for the disposal of low-level radioactive waste.
- The Surface Water Management Plan developed for the NSDF Project, which includes appropriate management techniques for erosion and sediment control, will be implemented.

The residual effects of the NSDF Project on geology are related to changes in soil quantity, soil quality, and geomorphology as a result of construction of the NSDF Project and changes to soil quality from blasting activities and air emissions. Mitigation and environmental design features implemented for the NSDF Project include existing practices at the CRL site and those used at similar facilities. Consequently, **changes in geology are not expected to result in significant adverse effects to other valued components (e.g., terrestrial environment).**

The residual effects of the NSDF Project on hydrogeology are related to the alteration of groundwater levels and flows due to the construction of the NSDF Project. For groundwater quality, releases from the Engineered Containment Mound are not anticipated during operations. Potential releases during post-closure (after the design life of the facility's safety features) are not anticipated to result in significant residual effects because the inventory will have sufficiently decayed and environmental concentrations will be negligible. Therefore, **changes in groundwater quality and quantity are not expected to result in significant adverse effects to other valued components (e.g., aquatic environment and human health).**

4.6.3 Surface Water

The CRL site is located in the Allumette Lake and Lac Coulonge reach of the Ottawa River. The distance from the centre of the NSDF Project site to the closest point on the Ottawa River shoreline is approximately 1.1 km. The NSDF Project is located entirely within the Perch Creek

and Perch Lake Watershed, which drain into the Ottawa River. Surface drainage from approximately 18% of the CRL site flows through Perch Creek and subsequently into the Ottawa River. The drainage basin slopes from a highpoint ridge along the eastern limit of the CRL site to the west towards Perch Lake and the wetlands located on the western boundary. Surface water monitoring at on-site lakes and streams, off-site streams, and locations in the Ottawa River upstream and downstream of the CRL site is routinely conducted to describe the surface water quality, in accordance with CNL's Environmental Monitoring Program.

Section 5.4 of the final NSDF Environmental Impact Statement [31] seeks to understand and characterize potential residual effects of the NSDF Project and other previous, existing, and reasonably foreseeable developments on the physical aspects of the environment.

Without mitigation, NSDF Project activities have the potential to change water levels, flows, and channel and bank stability due to the discharge of treated effluent and non-contact water into adjacent wetlands or downstream locations during operations. Also, the construction and installation of the Engineered Containment Mound will physically alter drainage patterns and taking water from the Ottawa River could change its hydrology. Without mitigation, changes to local hydrology, discharge of treated effluent, air and dust emissions, surface water runoff, leakage of leachate, or other releases of substances may affect surface water quality at downstream locations.

Examples of mitigation that will be implemented to limit predicted effects to surface water include the following:

- The Surface Water Management Plan developed for the NSDF Project, which includes appropriate management techniques to collect and direct surface drainage, including stormwater management ponds and erosion and sediment control practices (e.g., silt fences and runoff management), will be used during construction around disturbed areas, where appropriate.
- Treated effluent will be sampled to confirm it meets the effluent discharge targets before release.
- The final cover system will be constructed to promote the shedding of surface water to mitigate infiltration into the mound and minimize leachate generation.

Residual effects to hydrology were identified because the installation of the Engineered Containment Mound will physically alter drainage patterns and may change downstream discharge, water levels in adjacent wetlands, and channel and bank stability. Residual effects to surface water quality were predicted because the discharge of treated effluent from the Wastewater Treatment Plant to the ground via the exfiltration gallery and via a transfer line to Perch Lake could cause changes to downstream surface water quality, and leakage of leachate from the Engineered Containment Mound during the post-closure phase could cause changes to downstream surface water quality. Changes in hydrology and surface water quality were provided to other environmental components for inclusion in their assessment (e.g., aquatic biodiversity). Overall, **changes in hydrology and surface water quality are not expected to**

result in significant adverse effects to other valued components (e.g., aquatic biodiversity and human health).

4.6.4 Aquatic Environment Assessment Results

Aquatic habitat in the local study area is found largely in Perch Lake and Perch Creek. Several fish species have been identified in the Perch Creek and Perch Lake Watershed during field programs from the 1980s to 2018. Major changes to fish productivity and community structure over time have not been observed since the introduction of northern pike to Perch Lake in the mid to late 1980s, suggesting that the historical effects of past operations on water quality pose minimal risk to the fish community and populations in Perch Lake. Specifically, Perch Lake continues to support a large-bodied fish community that includes northern pike, yellow perch, brown bullhead, and pumpkinseed. Based on historical reports of fish sampling in the Ottawa River, four fish species are or have the potential to be of conservation concern in the river reach adjacent to the CRL site (e.g., Allumette Lake). These species include lake sturgeon, American eel, river redhorse and northern brook lamprey. To the north of Perch Lake are extensive wetlands, notably Perch Lake Swamp, South Swamp, and East Swamp. The fish habitat potential of wetlands such as Perch Lake Swamp and East Swamp is predicted to be low.

Section 5.5 of the final NSDF Environmental Impact Statement [31] seeks to understand and characterize potential residual effects of the NSDF Project on aquatic biodiversity at the CRL site.

Without mitigation, the potential for effects to aquatic biodiversity are primarily related to changes in groundwater, surface water, and air quality. The NSDF Project activities have the potential to affect water levels, flows, and quality and therefore fish habitat quality and fish survival and reproduction. Activities that could affect fish habitat quality include changes to local hydrology, installation of a treated effluent transfer line, discharge of treated effluent, leakage of leachate, release or deposition of harmful substances into downstream waterbodies, and physical changes to fish habitat such as along the riverbank. As well, blasting near fish bearing waterbodies may result in pressure changes and vibrations that affect fish survival and reproduction. Examples of mitigation practices that will be implemented to limit predicted effects to aquatic biodiversity include the following:

- Work will be completed within the in water work timing window to avoid spawning and egg and larval development periods for spring spawning fish species.
- Runoff will be managed to avoid adverse environmental effects in downstream waterbodies.
- Clearing of any vegetation and organic materials along the riverbank will be minimized. Disturbed shorelines and wetlands will be re-vegetated and restored to the original stable gradient and contour.

CNL will implement mitigation and environmental design features for the NSDF Project that are well understood and include existing practices at the CRL site. Therefore, **it is not expected that residual effects from the NSDF Project on aquatic biodiversity will be significant.**

4.6.5 Terrestrial Environment

The CRL site is characterized by deciduous and coniferous forest and the Ottawa River. The NSDF Project is in a primarily undisturbed area adjacent to heavily disturbed areas, including the CRL site main campus and various waste management areas. The area is a mix of forested vegetation communities and wetlands (South Swamp, East Swamp, and the marsh wetlands) surrounding Perch Lake and Perch Creek. The area provides suitable habitat for numerous migratory birds, including species at risk such as the Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, and wood thrush. Likewise, the area provides suitable habitat for several wildlife species of mammals, reptiles, amphibians, and invertebrates including species at risk such as bats (little brown myotis, northern myotis, and tri-colored bat), Blanding's turtle, eastern milksnake, and monarch butterfly.

Section 5.6 of the final NSDF Environmental Impact Statement [31] seeks to understand and characterize potential residual effects of the NSDF Project on terrestrial biodiversity, including potential effects to the ecological and biological processes that connect species with each other and their abiotic environment.

During all phases of the NSDF Project, there are some activities such as clearing vegetation, using heavy equipment, and discharging of treated effluent, which – without mitigation – have the potential to affect vegetation and wetland communities and could have an effect on wildlife habitat, influencing abundance and distribution or survival and reproduction. Project activities that cause changes to other valued components, such as surface water quality, and soil and vegetation communities (including wetlands), could in turn affect wildlife survival, reproduction, and habitat availability and distribution. Construction activities could also result in injury or mortality to wildlife. These effects may apply to terrestrial species at risk and their habitats as well.

Examples of mitigation to limit residual effects to terrestrial biodiversity include the following:

- Avoid activities with the highest levels of noise and habitat disturbance during the most sensitive life history phase (i.e., breeding and nesting for birds) to limit effects on nesting birds.
- Implement comprehensive Sustainable Forest Management Plan at the CRL site to ensure the long-term retention of trees serving as maternity roosts for bat species.
- CNL is currently implementing a detailed Blanding's Turtle Road Mortality Mitigation Plan to eliminate road mortality at the CRL site and increase connectivity between habitats (Figure 26). This existing plan will continue to be implemented during the NSDF Project.

Figure 26: Blandings Turtle at a Newly Installed Wildlife Passage (culvert) at the Chalk River Site

The assessment predicted residual effects to vegetation communities (including wetlands), Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, wood thrush, bats, Blanding's turtle, eastern milksnake, and monarch butterfly. The residual effects to vegetation are due to loss of forest, change to forest distribution, and edge effects. The residual effects to wildlife species primarily result from loss of suitable habitat (e.g., due to clearing), avoidance due to sensory disturbance (e.g., noise), change in movement of wildlife species, and risk of injury or mortality (e.g., on roads due to traffic). With the implementation of appropriate mitigation, **residual effects of the NSDF Project on the terrestrial environment (vegetation communities and wildlife species) are not significant**.

4.6.6 Ambient Radioactivity and Ecological Health

Background radiation and radioactivity is present in the environment due to natural and anthropogenic (human made) sources including, legacy operations at the CRL site. The main natural sources of radiation are cosmic rays; naturally occurring radionuclides in air, water, and food; and naturally occurring radionuclides in the soil, rocks, and building materials used in homes. Some radionuclides released from the CRL site are already present in the environment

due to natural and human activities. The CRL site Environmental Monitoring Program includes sampling and analysis of surface water, groundwater, sediment, soil, vegetation, ambient air, milk, garden produce, game animals, farm animals, and fish at the CRL site boundary and at relevant off-site locations. Environmental concentrations are compared to expected background levels or measurements of samples to distinguish the effect of the CRL site operations from radiological contamination present due to other sources.

Section 5.7 of the final NSDF Environmental Impact Statement [31] seeks to understand and characterize existing ambient radioactivity at the CRL site.

Without mitigation, NSDF Project activities have the potential to affect ecological health during the operations and closure phases through the release of dust when handling bulk materials, emissions of gases during storage and disposal of radioactive materials, and changes to groundwater quality and downstream surface water quality. As well, effects could result from the release of volatiles or leakage of leachate during the post-closure phase. The robust NSDF design provides containment for hundreds of years, allowing for radiologic decay of the waste inventory. Once the NSDF engineered barriers degrade, after 550 years, the levels of radioactivity released to the environment is quite small.

Controls will be established to minimize the generation of wastewater in the Engineered Containment Mound. For example, waste will be covered as each disposal cell is filled. The Wastewater Treatment Plant has been designed to remove both radiological and non-radiological contaminants. Through pilot testing, CNL has demonstrated that the effluent discharge targets which are protective of human health and the environment, can be achieved. Furthermore, the plant is designed for batch releases, which means all treated effluent must be sampled and proven to meet targets before being discharged to the environment.

During the operations and closure phases, airborne emissions are negligible, and waterborne emissions result in environmental concentrations that are below levels that would result in potential adverse effects on aquatic life. During the post-closure phase, airborne and waterborne releases are below the dose benchmark values. Therefore, **residual effects of the NSDF Project on ambient radioactivity and ecological health are not significant.**

4.6.7 Land and Resource Use Assessment

The NSDF Project is located entirely within the CRL site, which is on federal lands. Aside from the operations and activities undertaken by CNL, other land uses of the CRL site are prohibited and public access is restricted.

Section 5.9 of the final NSDF Environmental Impact Statement [31] seeks to understand and characterize the potential residual effects of the NSDF Project and previous, existing and reasonably foreseeable developments on land and resource use. The land and resource assessment considers outdoor recreation and tourism, land tenure, and archaeology.

An archaeological assessment for the NSDF Project was conducted. No items of cultural heritage value or interest remain on the site, and the locations of the archaeological work have been fully documented; therefore, no further archaeological work is required.

The NSDF Project is not predicted to have any terrestrial effects beyond the CRL site, and the results of the aquatic environment assessment identified only negligible residual effects on aquatic biodiversity valued components due to NSDF Project activities. Access to the Ottawa River will not be restricted because of the NSDF Project. No effect on archaeological resources is expected as most mitigation for archaeological resources are applied and completed in advance of ground disturbance activities. The assessment concluded that **no residual effects on land and resource use are anticipated as a result of the NSDF Project.**

4.6.8 Traditional Knowledge and Land Use

Traditional land and resource use valued components were selected based on the potential for the NSDF Project to interact with the features of the land and resource use environment. In addition, valued components for traditional land and resource use were selected based on a consideration of knowledge of traditional land and resource use practices that interact with the environment, Indigenous and/or treaty rights, and community engagement. Traditional land and resource use by Indigenous Peoples is considered in Section 6.4 of the final NSDF Environmental Impact Statement [31].

The valued components selected for the NSDF Project (Table 5.1.2-1 of the final NSDF Environmental Impact Statement [31]) reflect a wide range of environmental effects and Indigenous interests. Table 6.3.2-1 of the final NSDF Environmental Impact Statement [31]) summarizes how the valued components were selected by CNL for the NSDF Project and assessed through Sections 5.2 to 5.10 of the final NSDF Environmental Impact Statement [31], reflect Indigenous interests.

For example, Métis Nation of Ontario (MNO) through their Traditional Knowledge and Land Use Study, as well as the AOO and the AOPFN through their respective Algonquin Knowledge and Land Use Studies, identified moose, deer and bear as valued components due to traditional harvesting of these specific biota, while CNL has selected hunting as a valued component to protect Indigenous traditional resource use. Turkey, grouse and partridge were also identified as potential valued components and CNL selected the Ruffed grouse (*Bonasa umbellus*) as it is an indicator species that can sufficiently represent the health of populations of other game birds.

A number of species of plants have been noted as important resources for gathering, from which CNL selected all traditionally gathered species as a valued component. Cranberries were highlighted as a particularly important resource, so CNL selected reed as it is an indicator species and a measure of habitat quality for cranberries.

Kitigan Zibi First Nation has indicated the importance of the Blanding's Turtle, which was included as a terrestrial VC as it is a *Species at Risk Act* -listed species (Section 5.6.2 of the final NSDF Environmental Impact Statement [31]). The AOO have indicated the importance of bald

eagle given it is of cultural significance to the AOO and it was included as a valued component (Section 5.7 of the final NSDF Environmental Impact Statement [31]). The AANTC expressed concern regarding potential effects to moose, beaver, and waterfowl, which are included or have surrogate species included, as valued components in Section 5.7 of the final NSDF Environmental Impact Statement [31].

Finally, CNL selected hydrology, surface water quality, fish habitat, fishing and fish species as valued components as these reflect water quality of the Ottawa River as well as lakes and streams on the CRL site, along with the health of many species of interest to all Indigenous communities that provided feedback on the NSDF Project. Surface water quality is an intermediate component that can capture any potential changes in the natural environment on which other valued components depend, however. Air quality and geology are other intermediate components that can assess Indigenous concerns for air and soil quality.

In the absence of specific feedback from other Indigenous communities and organizations, traditional land and resource use is assumed wherever there are accessible lands, which is a conservative approach to the assessment and also to reflect the dynamic practice of traditional land and resource use by Indigenous Peoples in time and space.

The NSDF Project is located entirely within the CRL site boundary, on federal lands. Therefore, aside from the operations and activities undertaken by CNL, other land uses of the CRL site are prohibited due to restricted access. The NSDF Project is not predicted to have any terrestrial effects beyond the CRL site, and results of the aquatic environment assessment identify that measurable residual effects on aquatic biodiversity are not predicted as a result of the NSDF Project. Traditional access to the Pointe au Baptême and Oiseau Rock sites along the Ottawa River will continue to occur and will not be restricted because of the NSDF Project. There are no effects anticipated to archaeological resources as most mitigation for archaeological resources is applied and completed in advance of ground disturbance activities. Consequently, the **residual effects from the NSDF Project on traditional land and resources use are not significant**.

CNL acknowledges the AOO and the AOPFN disagree with this conclusion and contend there are project specific activities that may directly impact traditional land uses and Aboriginal rights and interests beyond the CRL site. Thus this concern will remain unresolved between CNL and the AOO and the AOPFN. Determination as to whether the proposed project has impacts on Aboriginal and Treaty rights remains with the CNSC as the representative of the Crown.

4.6.9 Socio-Economic

NSDF Project activities have the potential to positively affect employment and income, economic development and government finances through the employment of personnel, procurement of goods and services, and expenditures. These positive residual effects to the socio-economic environment arise primarily from construction phase activities such as employing personnel in the region, providing contracting and supplier opportunities to local

and regional businesses, and making some use of services such as commercial accommodations.

Section 5.10 of the final NSDF Environmental Impact Statement [31] seeks to understand and characterize the potential residual effects of the NSDF Project and previous, existing and reasonably foreseeable developments on the socio-economic environment.

Overall, the NSDF Project may result in small positive effects to local Indigenous Peoples through potential contracting or employment opportunities. Indigenous Peoples have expressed an interest in potential opportunities and CNL will continue to engage with Indigenous Peoples on potential employment and contracting opportunities for the NSDF Project. Therefore, **residual effects of the NSDF Project on the labour market, economic development, and housing and accommodation are positive.**

On the other hand, there is the potential for the NSDF Project to have certain negative socio-economic effects. It could put pressure on commercial accommodations, increase public transportation and road degradation, and increase demand for community services such as health, education, and protective and emergency services. For these adverse effects, with the implementation of appropriate mitigation, **residual effects of the NSDF Project on housing and accommodation, services, and infrastructure are not significant.**

4.6.10 Cumulative Effects Assessment

The *Canadian Environmental Assessment Act, 2012* [11] requires that each environmental assessment of a designated project take into account any cumulative environmental effects that are likely to result from the designated project in combination with the environmental effects of other physical activities that have been or will be carried out.

The purpose of the cumulative effects assessment is to evaluate the contribution of effects from the NSDF Project in combination with previous, existing, or reasonably foreseeable developments or activities in the region (i.e., Reasonably Foreseeable Developments Case) that may overlap spatially (i.e., the same geographic area) and temporally (i.e., over time). Activities in the region that have not yet been approved or developments and activities that are currently under application review, or that have officially entered a regulatory application process, are considered reasonably foreseeable. The cumulative effects assessment considers all primary pathways that are likely to result in detectable changes in measurement indicators and subsequent residual effects on valued components after implementation of environmental design features and mitigation.

Reasonably foreseeable development activities included in the assessment were activities related to the proposed Small Modular Reactor on the CRL site, new support infrastructure, decommissioning and environmental remediation at the CRL site, the proposed Nuclear Power Demonstration in site decommissioning project, and activities at Garrison Petawawa.

As outlined in Section 8 of the final NSDF Environmental Impact Statement [31], results of the cumulative effects assessment were as follows:

- In most cases, a reasonably foreseeable development case was not required because the NSDF Project effects are not predicted to overlap spatially or temporally with reasonably foreseeable development project effects.
- For valued components where cumulative effects were identified, these cumulative effects were not significant.

CNL notes that there was a formal request [54] made to the Minister of Environment and Climate Change in May 2021 to conduct a regional assessment of radioactive disposal projects in the Ottawa Valley under the *Impact Assessment Act* [27]. The Impact Assessment Agency of Canada undertook a detailed review, resulting in the Minister's decision to not conduct this assessment. The reasons are detailed in the Minister's response [55], and are summarized here:

- Existing legislative and regulatory frameworks and policy initiatives are well placed to address the environmental, health, social and economic effects of radioactive disposal projects, and associated public interest in these matters. This includes the *Nuclear Safety and Control Act* [7] and the federal government's Radioactive Waste Policy [56].
- The assessments under the *Canadian Environmental Assessment Act, 2012* [11] are required to consider both project-specific and cumulative effects, and include considerable opportunities for public involvement.

Understanding that there was public interest in this topic because of this request, CNL did conduct a cumulative effects webinar in September 2021 to explain this assessment and provide an opportunity for questions and answers.

4.7 Environmental Assessment Follow-Up Monitoring Program

The NSDF Environmental Assessment Follow-Up Monitoring Program will be carefully integrated with CNL's existing environmental monitoring and management plans (Section 6.9), where appropriate, and will reference CNL Standard Practices and Procedures. Wherever possible, existing programs will be adapted to meet the objectives of monitoring the predictions made by the environmental assessment for the NSDF Project. A draft NSDF Environmental Assessment Follow-Up Monitoring Program [57] has been made publicly available.

Monitoring of air quality at the CRL site is conducted under CNL's Environmental Monitoring Program, which is compliant with CSA N288.4-10, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills* [58]. Air quality monitoring for the NSDF Project is intended to verify that mitigation is being implemented effectively and to verify the predictions of the assessment.

Operational monitoring will be implemented to verify predictions from the environmental assessment for geology. Groundwater monitoring will be integrated into the overall CNL

Groundwater Monitoring Program and will be compliant with CSA N288.7-15. *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [59]. Groundwater monitoring is intended to verify that the environmental assessment predictions on groundwater during the operations phase are accurate, and to verify the effectiveness of mitigation. Groundwater monitoring will continue through the operations, closure, and post-closure phases.

Monitoring and follow-up programs for surface water hydrology will focus on operational performance and environmental monitoring (e.g., monitoring of water levels in the stormwater management ponds to verify that they are performing as designed). Stormwater management pond monitoring will be integrated into the NSDF Project Environmental Protection Plan, while water level monitoring of the wetland system will be integrated into the current CNL Environmental Monitoring Program.

Routine surface water quality monitoring for the NSDF Project will be included in CNL's current Environmental Monitoring Program, which is compliant with CSA N288.4 *Environmental monitoring at Class I nuclear facilities and uranium mines and mills* [60]. Effluent water quality from the surface water management ponds and wastewater treatment facility will be monitored in accordance with CNL's Effluent Verification Monitoring Program, which is compliant with the CSA N288.5-11 [58]. Together, these programs will be used to verify environmental assessment predictions related to surface water quality, verify the surface water management ponds are performing as designed, and demonstrate compliance with effluent discharge targets developed for the NSDF Project. Water quality monitoring will continue through operations, closure, and post-closure (institutional control).

Monitoring and follow-up programs are recommended for Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, wood thrush, bats, Blanding's turtle, and eastern milksnake. These will be integrated into CNL's existing Biodiversity Monitoring Program and will be used to confirm the predictions made in the terrestrial biodiversity assessment, including the effectiveness of mitigation. Monitoring will be ongoing during the construction and operations phases as well as closure phase where appropriate.

If an environmental monitoring and follow-up program identifies that adverse environmental effects are greater than predicted, CNL will evaluate whether they result in changes to the conclusions in the Environmental Impact Statement. If changes are confirmed, CNL will evaluate the need for revised mitigation to manage effects. The CNL evaluation process for monitoring data includes environmental performance criteria that are based on statistical measures and ecological health benchmarks. An exceedance of environmental performance criteria triggers CNL's non-conformance and corrective action process and includes notifying management and further investigation. Where the need for revised mitigations is identified they will be developed and implemented. This evaluation process is documented in the CNL Environmental Protection procedures.

The Environmental Assessment Follow-Up Monitoring Program [57] proposes transition timing wherein the monitoring and reporting activities for the NSDF can be turned over to existing CNL programs. The objectives and other elements of the monitoring activities will remain as noted; however, the execution of the work, the groups executing the work, and the reporting will be conducted as for the existing CNL monitoring programs.

CNL is providing opportunities for public and Indigenous Peoples participation in the development of the NSDF Environmental Assessment Follow-Up Monitoring. In September/October 2021, CNL conducted webinars (Effluent Verification, Environmental Monitoring, Groundwater Monitoring) to gain feedback from the public on the proposed program.

To date, CNL has received technical comments from the AOPFN on the follow up monitoring program, and provided responses to these comments in November 2021. The AOPFN also provided a memo outlining expectations on including Algonquin Knowledge in the program as well as involvement of their community in monitoring through a Guardian Program. CNL is committed to working collaboratively with the community to address the expectations in this memo. CNL is continuing to engage with other Indigenous communities and organizations on future monitoring related to the NSDF Project.

CNL has also received comments from the Federal-Provincial Review Team (i.e., Ontario Ministry of Environment, Conservation and Parks, Quebec Direction Adjointe Des Projects Industriels et Miniers, and Environment and Climate Change Canada) on the draft Environmental Assessment Follow-Up Monitoring Program [57]. CNL has provided responses to these comments. As a result of this feedback, CNL will revising the program to include additional sediment monitoring.

The NSDF Environmental Assessment Follow-Up Monitoring Program will not be finalized until a regulatory decision is rendered by the CNSC; thus, an opportunity remains for direct involvement in its development and implementation.

The sampling and monitoring programs included in the draft Environmental Assessment Follow-Up Monitoring Program [57] may need to be updated in the future to reflect decisions by the CNSC with regards to the NSDF Project, reviews of ongoing monitoring and feedback from Indigenous communities and stakeholders.

4.8 NSDF Project Environmental Impact Statement Commitments Report

During the course of Environmental Impact Statement development and engagement activities with the public, stakeholders, and Indigenous Peoples, CNL made commitments regarding the NSDF Project and future actions. These written commitments appear in the Environmental Impact Statement document, in CNL's responses to information requests from federal and provincial agencies, and in CNL's responses to comments from the public and Indigenous communities.

CNL identified over 200 unique commitments made in the Environmental Impact Statement, along with several hundred more contained in responses to information requests and comments made on the Project. As requested by CNSC staff, a report containing the complete list of commitments was compiled and submitted [61].

Commitments described in the report will be tracked and managed in accordance with CNL's approved processes and procedures.

This report is considered an evergreen document that will be updated during the remainder of the regulatory review process, as well as if the Project is approved after the public hearings and Commission decisions, to capture any additional commitments made by CNL staff during public hearings and any actions directed by the Commission to CNL.

5. NSDF Is Protective of Human Health

The overall safety objective of CNL is to protect individuals, society, and the environment during all phases of the NSDF Project by establishing and maintaining an effective defence against radiological and non-radiological (chemical, conventional) hazards. The NSDF Safety Case [12] details how this overall safety objective is satisfied; the Safety Case demonstrates that the NSDF design, controls, and processes are adequate for the radiological protection of workers, the public, and the environment. The NSDF Safety Analysis provides the supporting calculations to demonstrate that the radiological consequences during the operation of the facility are negligible and meet the regulatory requirements which ensure protection of human health and the environment. The NSDF Post-Closure Safety Assessment provides the long-term safety analysis to demonstrate that the facility will not pose an unreasonable risk to human health and environment including a reasonable assurance that the regulatory radiological dose limit for human exposure will not be exceeded.

5.1 Background Radiation

Radiation occurs naturally from cosmic and terrestrial sources as well as from man-made materials, independent of the CRL site operations. Natural background radiation varies with location. Within Canada, the average dose from natural background radiation is 1.8 millisieverts per year (mSv/yr) [62]. Figure 27 shows the dose by pathway. The Canadian regulations [14] for radiation protection sets limits on the amount of radiation the public or nuclear energy workers may receive from licensed activities to manage nuclear substances. In Canada, the public dose limit is 1 mSv/yr, and the nuclear energy worker dose limit is 50 mSv in any one year and 100 mSv over five consecutive years. These radiation dose limits are incremental to the natural background radiation dose.

Understanding Canada's natural background levels of radiation provides a relative context of the projected doses from the NSDF Project.

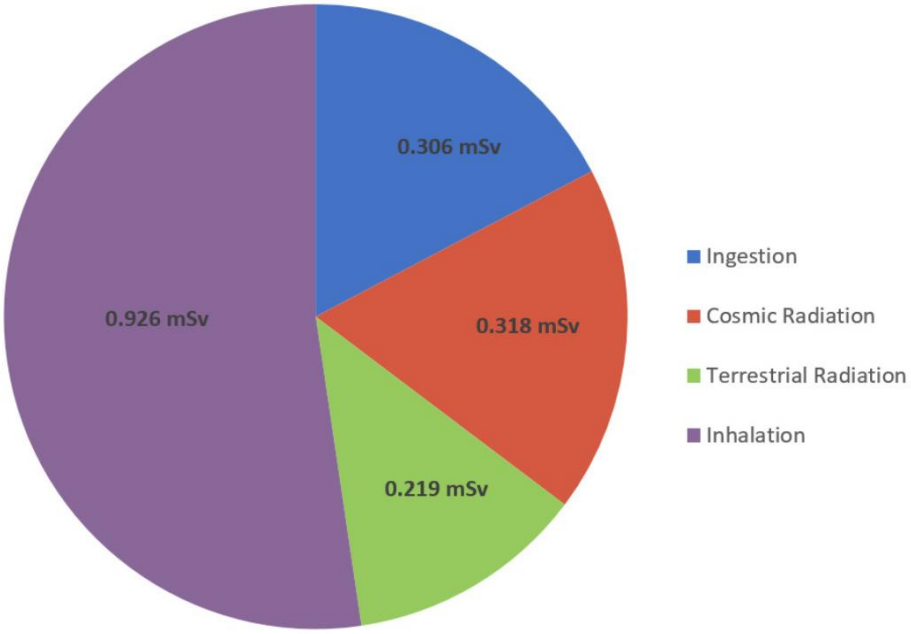


Figure 27: Sources of Background Radiation in Canada

5.2 Site Preparation and Construction Phase

The site preparation and construction of the NSDF Project does not involve any nuclear substances or radioactive wastes and thus does not increase the radiological consequence or hazard to human health or environment. The NSDF site footprint is an area that has never been used by operations at CRL that have involved radioactive (or otherwise contaminated) materials.

Conventional, occupational, non-radiological hazards that may be present during the construction of the NSDF Project are covered by CNL's Conventional Health and Safety Program (Section 6.8).

The key conventional non-radiological hazards for the site preparation and construction phase have been analyzed and the overall residual adverse effect of the NSDF Project during the construction phase is determined to be not significant. The NSDF Project conventional non-radiological hazards for the site preparation and construction phase **result in localized effects and the potential health effects to the workers and the public are negligible**.

5.3 Operations and Closure Phase

Access to the CRL site is restricted; however, without mitigation, there may be instances where the public or Indigenous Peoples receive a dose as a result of potential waterborne or airborne emissions from the NSDF Project. Dose to the public or Indigenous Peoples from waterborne emissions is calculated during the operations phase as well as during the post-closure phase for the NSDF Project. CNL limits the public dose through the establishment of effluent discharge targets, which are protective of drinking water and based on Health Canada Drinking Water

guidelines [52]. Airborne releases of dust are controlled during operations thus mitigating airborne releases. The dose to the public and Indigenous Peoples during the operations phase is expected to be negligible and is almost 50 times lower than the regulatory public dose limit of 1 mSv/yr; thus, **residual effects from the NSDF Project on the public and Indigenous Peoples during the operation phase are not significant**.

The radiological dose to an on-site worker will mainly occur during the operational phase as the result of carrying out tasks related to the placement of the low-level radioactive waste as well as activities within the Wastewater Treatment Plant and will be kept as low as reasonably achievable. For the on-site worker, the maximum estimated dose is 5 times lower than the regulatory nuclear energy worker limit of 50 mSv/yr; thus, **residual effects from the NSDF Project on worker health are not significant**.

During the closure phase, the final cover will be completely installed over the Engineered Containment Mound. With the final cover fully installed, the quantity of leachate generated will be significantly less than is generated during the operations phase, resulting in less treated effluent released to the environment. Therefore, **the potential radiological exposure to the public, Indigenous Peoples, and workers during the closure phase is far lower than that of the operations phase**. The releases during the operations phase are acceptably low, therefore the releases during the closure phase are also acceptably low.

Further information about the radiological source terms, hazard identification, and determination of radiological dose to workers, the public, and Indigenous Peoples during NSDF operation can be found in Section 4.2 of the Safety Case [12].

5.4 Accidents and Malfunctions

To identify potential accident and malfunction events during the construction and operation phases, as well as their potential human health and environmental effects, the NSDF Project used a systematic and comprehensive approach. Credible events were identified through a review of proposed activities to identify hazards, which were assigned frequency, severity, and risk rankings. The bounding or key potential accidents and malfunctions during the operations of NSDF include the following:

- dropped load during waste placement, which could result in the potential spread of contamination
- dropped load during wastewater treatment operations (i.e., dewatering of filter press), which could result in the potential spread of contamination
- fire within the Engineered Containment Mound resulting in the ignition of combustible waste, which could result in an airborne release
- fire within the Wastewater Treatment Plant, such as from flammable gas, which could result in an airborne release
- spill of contaminated resin during the wastewater treatment operations, which could result in the potential spread of contamination

Each of these events underwent an analysis to determine the dose estimate for the on-site workers as well as the public. The assessment considered both radiological and non-radiological contaminants. The dose consequences to the on-site workers and the public for all potential accidents and malfunctions meet the respective regulatory limits; thus, **residual effects from accidents and malfunctions of the NSDF Project are not significant**.

Conventional occupational hazards are anticipated to be typical of a major construction project and evaluated to be controlled by human performance; thus, CNL has established provisions including training, procedures, and oversight of contractors to achieve as-low-as-reasonably achievable possible accident and malfunction rates.

If an accident or malfunction situation occurs, CNL has procedures in place that address requirements for immediate response and post-event cleanup or remediation.

5.5 Post-closure Phase

The post-closure phase begins after the Wastewater Treatment Plant has been decommissioned and demolished, along with the rest of the surface structures. During this phase, institutional controls are in place to prevent access to the facility as well as environmental monitoring to confirm that the facility is performing as intended (Section 1.4.4).

The NSDF Post-closure Safety Assessment evaluates the performance of the Engineered Containment Mound, how contaminants migrate from the facility into the environment, and the resulting radiological dose to humans. A normal evolution scenario and a variety of sensitivity cases, disruptive events, and other lower probability scenarios were assessed. The normal evolution scenario is a reference description of the expected evolution of the Engineered Containment Mound, its surroundings, and its resulting releases, consistent with CNSC REGDOC-2.11.1, *Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste* [22]. Figure 28 is a representation of the pathways by which humans could be exposed to radiation from the facility during the post-closure phase.

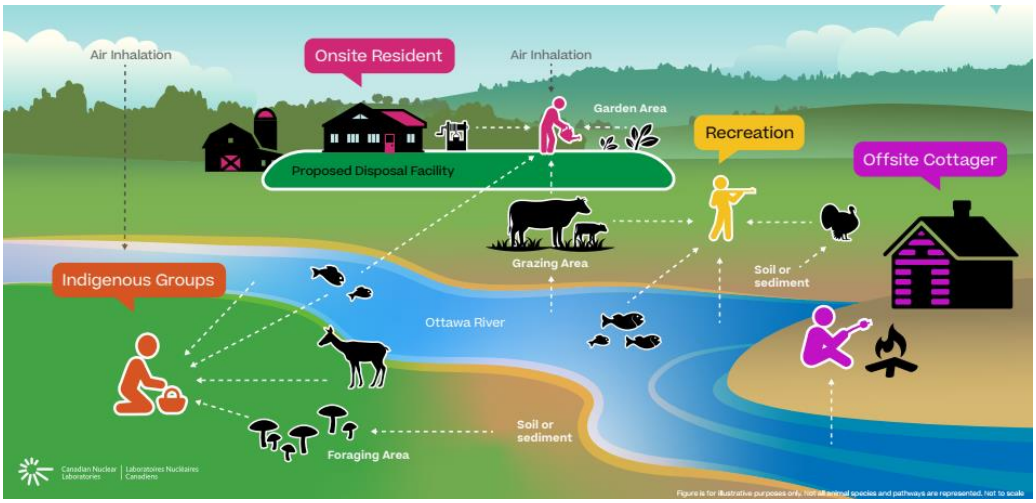


Figure 28: Post-closure Safety Assessment Simplified Pathway Interaction Summary

The dose to the public during the post-closure phase was conservatively calculated using the hypothetical case of a farmer with a family living directly on the Engineered Containment Mound who would be exposed to any potential contamination released from the facility. Under that scenario, the robust NSDF design provides containment for hundreds of years, so it will continue to isolate the waste inventory during radiologic decay. As well, the levels of radioactivity released to the environment will continue to decrease after 550 years even if the NSDF engineered barriers degrade. Even with a most disruptive event, such as unintentional intrusion, the radiological dose to a member of the public will still be at least 60 times lower than the regulatory public dose limit of 1 mSv/yr, meaning that **residual effects from the NSDF Project on human health are not significant**.

Further information and technical details about the radiological source terms, scenario development, modelling inputs and assumptions, radiological dose calculations, and calculation methodology can be found in Section 4.1 of the Safety Case [12].

5.6 Indigenous Health

Indigenous Peoples have expressed a general concern about the potential effect of the NSDF Project on their health and a perception of risk of harvesting near the CRL site. This has partially arisen from the understanding that they have a greater degree of reliance on foods obtained from traditional land and resource use than the general public. Although these concerns are not specific to the NSDF Project, CNL acknowledges its role as providing education opportunities and undertaking communications with Indigenous Peoples to alleviate such concerns and fears. The potential radiological dose to an Indigenous person was conservatively calculated using the hypothetical case of a self-sufficient Indigenous person completely reliant on local traditional food sourced from the NSDF Project site and surrounding areas. The results indicated that the estimated radiological dose to this individual would be more than 13 times lower than the current regulatory dose limit of 1 mSv/yr, meaning that **residual effects from the NSDF Project on Indigenous health are not significant.**

6. CNL Management System and CNSC Safety and Control Areas

6.1 CNL Management System

This section describes CNL's robust Management System, which is aligned to the required Safety and Control Areas outlined in the CRL Nuclear Research and Test Establishment Operating Licence [2] and Licence Condition Handbook [18]. This section provides perspectives for each of the 14 Safety and Control Areas, as related to the NSDF Licence Amendment Application [1] including a brief description of the CNL Functions that incorporate the requirements of the Safety and Control Areas and the relevance of the function to the NSDF Project.

CNL has a Management System comprised of an integrated set of documented policies, expectations, standards, procedures, and responsibilities through which CNL is governed and managed. CNL's integrated Management System demonstrates and documents the commitment to maintaining a high-level of quality and excellence in the management of all CNL activities within an environment that prioritizes safety and fosters continual improvement.

The CNL Management System provides the framework of processes, procedures, and practices used to ensure that CNL can fulfill all tasks required to achieve our objectives safely and consistently. This foundational framework delivers quality research and development; design engineering; procurement; manufacturing; qualification testing; construction; commissioning; operations; decommissioning; demolition; waste management; inspection; maintenance and plant life management; and project management for nuclear power plants, research reactors, nuclear or non-nuclear facilities, and installations.

The Management System provides, enables, and defines a detailed framework for full nuclear facility life cycle phases, including construction, commissioning, operations, decommissioning and long-term safety of the nuclear facilities and laboratories at all CNL sites, including the proposed NSDF. The various mature programs and processes already in place will continue to evolve to ensure that all regulatory requirements are achieved.

Effective corporate governance of CNL's Management System is achieved through the establishment and implementation of controls that are defined within the CNL Management System Manual [63]. A Functional Authority Structure is applied to all CNL Management System components, with assigned Responsible Executives and Functional Support Manager roles to ensure CNL Functions meet external requirements; protect workers, the public and Indigenous Peoples, and the environment; and adequately address other vulnerabilities (e.g., financial, legal, or security).

The assigned CNL Responsible Executives for each Functional Support Area are outlined in Table 6. Additional corporate functional authority roles have been established in response to regulatory and other legislative requirements (Table 6, underlined role).

Table 6: Functional Management Structure

Responsible Executive	Functional Support Area(s)
President and Chief Executive Officer, and Chief Operating Officer	Management System, and Property (Asset) Management
Vice President Business Management, and Chief Financial Officer	Chief Information Officer, Supply Chain, Prime Contact, Information Management, Project Management Office, Information Technology, Cyber Security, and Finance
Vice President Human Resources	Human Resources
Vice President Legal and Insurance	Corporate Secretary Legal Services
Vice President Corporate Affairs	Corporate Affairs
Vice President Business Development	Business Development and Commercial Ventures
Vice President Science and Technology	Conduct of Research
Vice President Health, Safety, Security and Environment	Emergency Preparedness, Environmental Protection, Fire Protection, Health Centre, Occupational Safety and Health, Radiation Protection, and Security
Vice President, Central Technical Authority and Chief Nuclear Officer	Chief Engineer, Chief Regulatory Officer, Chief Security Officer, Chief Safety & Licensing Officer, Management Representative for Quality Conduct of Operations, Maintenance (Fitness for Service), Design Authority and Design Engineering, Configuration Management, Pressure Boundary, Electrical Safety, Safety Analysis, Training and Development, Commissioning, Quality, Performance Assurance, Compliance, Nuclear Criticality Safety, and Nuclear Materials and Safeguards Management
Vice President Environmental Remediation Management, and Stewardship and Renewal Group	Transportation of Dangerous Goods, Waste Management, Cleanup, and Construction Responsibility includes NSDF construction and operations
Vice President Capital	Construction and delivery of non-nuclear builds

CNL uses the following suite of Management System document types to encompass the top tier of the CNL Management System: a Program Description Document, a Program Requirement Document, and a Program Governing Document Index. Each Functional Support Area and the associated top tier documents (i.e., Program Description Document and Program Requirement Document) are listed in CRL's Licence Condition Handbook [18] under their respective Safety and Control Area and form part of the Compliance Verification Criteria.

The CNL Management System implements the requirements in REGDOC-2.1.2, *Safety Culture* [64], CSA N286-12*, Management System Requirements for Nuclear Facilities* [8] and ISO 9001:2015*, Quality Management Systems – Requirements* [9] and ensures compliance with these regulatory requirements at CNL.

CNL continually assesses the Management System performance through the following mechanisms:

- Nuclear Performance Assurance Review Board, which reviews the performance of CNL's nuclear facilities and Safety and Control Areas on a quarterly basis
- Corrective Action Review Board, which reviews the status of the corrective action program, its outcomes, and the results of Nuclear Oversight audits
- Contractor Assurance System, which is used to integrate various performance measures and indicators to provide an evaluation of CNL performance
- Facility Authorities / Chief Nuclear Officer monthly meeting reviews of nuclear facilities safety performance

Relevance

The CNL Management System is relevant to all phases of the NSDF Project (or throughout Facility life cycle) as it ensures safe, effective and efficient conduct of design, construction, commissioning, operations, decommissioning of the nuclear facilities, and delivering against commitments within appropriate accountabilities and controls.

The CNL Management System is built on years of experience at multiple sites, conducting work through the full nuclear facility life cycle phases, including the long-term safety of the nuclear facilities. For example, CNL's Management System was applicable to CNL's execution of the design, construction, operation and closure of the Port Granby Long-Term Waste Management Facility.

As outlined in the 2018 Commission Member Document 18-H2.1, CNL's Management System is an empowering platform to enable the continuance of safe operational practices at CRL throughout the licence period. For the 2020 calendar period, CNSC staff concluded that CNL's performance in all 14 Safety and Control Areas was rated as "satisfactory" [65]. As such, CNL's Management System is effective and efficiently supported, and balances safety, execution, and innovation within project activities.

6.1.1 Quality

CNL's Quality Assurance Program is based on and meets the requirements of CSA N286-12*, Management System Requirements for Nuclear Facilities* [8] and ISO 9001:2015*, Quality Management Systems – Requirements* [9]. The CNL Quality document serves the following purpose:

- explains the CNL Quality Assurance Program and identifies CNL's top level required methods for operating within the Quality Assurance requirements

- establishes Quality Assurance requirements for conducting activities or services that affect, or may affect, nuclear safety of facilities in a graded manner to ensure that environmental, safety, and health risks or impacts are minimized
- ensures that safety, reliability, products, and performance are maximized by using effective management systems. The CNL graded approach is based on the importance to safety and safety significance of Structures, Systems, and Components and on a specific evaluation of regulations, risks, complexity, and history of previous implementation. All requirements apply to varying degrees, depending upon the safety significance and complexity of the work being performed.

Quality requirements are addressed for all CNL facilities, locations, and activities in the overall Management System using a graded and integrated approach, when possible, along with Health, Safety, Security, and Environment, statutory, and regulatory requirements. All work is executed in accordance with controlled procedures to achieve a desired performance that includes both full compliance with the applicable customer requirements along with the efficient and effective delivery of results.

Relevance

The NSDF Project uses NSDF-specific Quality Assurance Plan and corporate Quality Program Selection Procedures for the project activities. The Quality Assurance Plan defines an integral part of the processes used to prioritize, design facilities, analyze hazards, identify and apply standards and controls, procure equipment, perform work, and evaluate and improve performance.

The NSDF has been designed and will be built to ISO 9001:2015*, Quality Management Systems – Requirements* [9] standard, supplemented by additional provisions, as they apply to design and construction activities. The supplementary clauses are consistent with the requirements for the design of a Class IB nuclear facility and are related to computer software, Design Plan, Subcontract control, Design Verification, and Qualification Testing. For example, analytical software used for the design of nuclear safety related systems; structures or components was verified and validated in accordance with CSA N286.7, *Quality Assurance of Analytical, Scientific, and Design Computer Programs* [66]. For pressurized systems determined to be Class 6 items or services, CSA B51 *Boiler, Pressure Vessel, and Pressure Piping Code* [67] applies.

Supplier or contractor activities were and are subject to CNL's owner surveillance activities to confirm conformance to the accepted project specific Quality Assurance Plans.

As the NSDF Project transitions through the various project phases the Quality Assurance requirements evolve where appropriate to ensure the most applicable quality standards are applied. For example, during the construction phase the design quality management and adherence is to ISO 9001:2015*, Quality Management Systems – Requirements* [9] and also

includes the associated clauses from CSA N299.2, *Quality Assurance Program Requirements for the Supply of Items and Services for Nuclear Power Plants* [68].

6.1.2 Compliance

The Compliance Program provides the regulatory and licensing framework and independent technical reviews to provide a coordinated and consistent approach in how CNL manages relationships with its regulators. The Compliance Program supports the licencing of CNL nuclear facilities and activities to enable the fulfilment of CNL's mandate. This is accomplished through independent, but related, processes to ensure the following:

- a coordinated and consistent approach to how CNL deals with the CNSC regarding company-wide regulatory and licensing matters.
- a coordinated and consistent approach to how CNL deals with other regulators (e.g., the Technical Standards and Safety Authority, Environment and Climate Change Canada, and Employment and Social Development Canada) regarding company-wide regulatory and licensing matters
- independent technical reviews of a proposed nuclear facility or licensed activities before submission to the regulator

The processes of the Compliance Function are illustrated in Figure 29. Compliance processes either fall under regulatory and licensing activities or the Safety Review Committee. The Safety Review Committee supports independent technical reviews of major safety documentation, related to CNL's licenced facilities and activities before submission to the regulator. These reviews are based on the type of hazards present and are conducted for new facilities, major modifications to operating facilities, decommissioning activities, and nuclear criticality safety reviews.

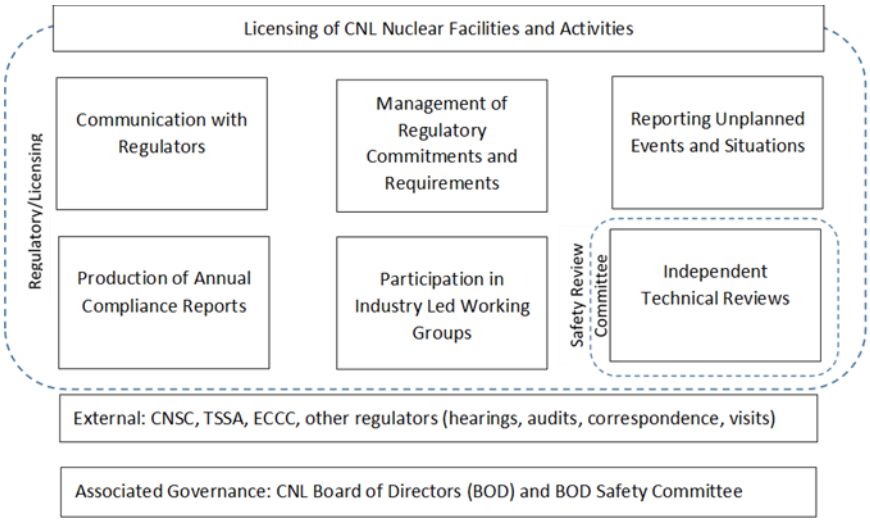


Figure 29: Processes of the Compliance Function

Relevance

The NSDF Project has and will continue to have a designated representative of licensee position to ensure a coordinated and consistent approach to communications with CNSC staff and other regulators. This role is currently assigned to the Environmental Remediation Management Licensing Support Manager; however, the assignment will be transferred to the NSDF Facility Authority during the transition to the NSDF operations phase.

To reduce uncertainties and increase confidence in the safety assessments performed in support of the NSDF, several third-party reviews were performed at various stages in the Project life cycle. These independent technical reviews were conducted by CNL's Safety Review Committee or other independent third parties identified based on expertise. The findings and recommendations of the third-party reviewers were considered during the iterative development of the design and safety assessments for the NSDF Project. Section 6.8 of the Safety Case [12] summarizes the additional third-party reviews performed in support of the NSDF Project.

CNL's Safety Review Committee reviewed the conventional nuclear safety documents such as the Safety Analysis Report, and Criticality Safety Document. Comments addressed prior to submission to the CNSC included comments on the calculated dose rates, the monitoring of contamination, flooding and water levels, the identification of Operating Limits and Conditions, frequency of accident conditions, and the application of IAEA guidance to the project.

An international expert panel, led by the US Department of Energy, was formed to provide an independent third-party review of the safety documents specific to a nuclear disposal facility and its long-term safety. The review scope was bounded by mature drafts of the NSDF Environmental Impact Statement and Safety Case document as well as the third iteration of the Post-closure Safety Assessment and a number of underpinning documents. The international expert panel evaluated the documents consistent with the non-binding expectations for a safety case and safety assessment from the IAEA Specific Safety Requirements on *Disposal of Radioactive Waste* [39], the IAEA Specific Safety Guide on *The Safety Case and Safety Assessment for the Disposal of Radioactive Waste* [40], and US Department of Energy directives. Overall, the initial panel's conclusions were that the NSDF will be conservatively designed to dispose of the planned radioactive inventory and have future releases well below all appropriate standards. The final report [69] contains 35 recommendations, 76 suggestions, and 5 good practices identified by the international expert panel. Most of the recommendations and suggestions have already been incorporated into the Safety Case [12] or otherwise addressed. The remaining actions are relevant to future phases of the NSDF life cycle.

CNL also participates in several national and international forums related to nuclear waste and decommissioning including:

- IAEA working groups
- CANDU Owners Group
- Canadian Standards Association for the Nuclear Industry

- Emerging commercial opportunities (i.e., waste characterization services)

6.1.3 Supply Chain and Procurement

The Supply Chain Program Description describes the Supply Chain organizational framework and operational arrangements through which procurement, contracting, and Supply Chain Management activity is undertaken and governed pursuant to CNL's Supply Chain policy and policy standards. Supply Chain management represents a key enabling capability and critical success factor for CNL. This company-wide process applies to all activities unique to this program and is performed by CNL across all sites. Good industry practices are drawn from both internal and external sources, including influences from CNL parent body organizations to optimize processes to improve speed to market, flexibility, and commercial innovation.

Procurement activity is organized into the five top-level process stages to cover the entire purchasing life cycle, including Contract Strategy and Planning, Solicitation and Evaluation, Contract Award, Management of Contract, and Closeout. These process stages apply to both the material acquisitions and contract management activities.

The Supply Chain Program implements the requirements in CSA N286-12, *Management system requirements for nuclear facilities* [8], ISO 9001:2015, *Quality Management Systems – Requirements* [9], CSA ISO 14001:2015, *Environmental Management Systems – Requirements With Guidance for Use* [71], CSA N285.0-08, *General requirements for pressure-retaining systems and components in CANDU nuclear power plants* , and other legal requirements and ensures compliance with these regulatory requirements at CNL.

Relevance

The NSDF contracting strategy is design-bid-build (i.e., first fully design the NSDF, then bid the construction services based on the complete design, and finally build the facility). This approach reflects experience gained on the licensing of the Port Hope and Port Granby projects.

CNL has leveraged both Canadian and international nuclear industry expertise through the supply chain. Some of the more significant procurements to date have included:

- AECOM as engineering design for the project
- Golder (Member of WSP Global Inc.) as author of the Environmental Impact Statement as well as various technical supporting documents
- Arcadis as author of the Post-Closure Safety Assessment, performing the long-term safety calculations and analysis
- Queens University and Dr. Kerry Rowe to support the geomembrane testing program and design reviews

Interfaces with contractors are managed through the procurement and technical points of contacts designated in each contract document. Interfaces include meetings and field visits as well as progress reports, deliverable submittals, and feedback.

The NSDF Project will continue to use CNL's Supply Chain requirements for developing and executing the required contracts for the NSDF Project.

6.1.4 Information Management

The Information Management Functional Support Area implements and monitors controls that apply to all Information assets, including structured, unstructured, or transitory, and extends to all activities throughout CNL. Information Management follows the requirements of all major standards CNL is certified against as well as other standards that have been adopted as best practices. All CNL employees are responsible for abiding by the controls that Information Management processes define, especially relating to the information in their direct care.

The mandate of the Information Management is as follows:

- govern the creation, classification, capture, use, dissemination, retention, preservation, and disposition processes of information throughout the enterprise
- preserve company records that are centrally archived
- uphold the integrity of the Management System document framework
- uphold the quality of document capture into the Electronic Document and Records Management System
- provide personnel with information resources on site and access to worldwide resources through online subscriptions and inter-library loans

Information Management facilitates compliance with all applicable requirements to retain and manage information, to deliver targeted services and solutions to the business groups, and to ensure that records remain available and usable until they are no longer required to meet operational or regulatory obligations. Information Management is responsible for setting the strategies to manage information, and the governance framework and procedures that guide employees from the creation to the disposition of information assets. Information Management establishes standards and procedures to facilitate the following:

- the ownership and stewardship of information assets
- the creation, capture, and use of information
- the storage and protection of records to guarantee their accessibility and usability for the length of time required
- the disposition of records with due diligence when their retention expires

Storing and handling information is a controlled activity at CNL. Information Management develops and maintains processes to ensure the authenticity and integrity of records so that CNL can meet its long-term information requirements.

The Information Management Function implements the requirements in CSA N286-12, *Management System Requirements for Nuclear Facilities* [8] and other CRL licensing basis

publications and ensures compliance with these regulatory requirements at CNL.

Relevance

Documents related to the NSDF are controlled to ensure they are prepared and accepted by qualified staff, reviewed for adequacy, approved for use, and distributed to the required personnel, as required by the Information Management Function. Essential and non-essential records are identified, controlled, filed, and maintained in accordance with company-wide procedures including project documentation, operating and maintenance procedures, waste data records, regulatory correspondence, and non-conformance reports.

Information Management applies during all stages of the NSDF life cycle, and the collection of information will be retained as a permanent record to be used by future generations. For example, CNL has recently transitioned to a modern electronic waste tracking system to ensure reliability and efficiency of waste tracking while safeguarding the information in a secure, retrievable and traceable manner to meet business and regulatory requirements. The new system will have the capability of capturing, storing, and retrieving information related to waste data including a transactional history from generation through processing to storage and/or disposal.

6.2 Human Performance Management

The CNSC Human Performance Management Safety Control Area includes the CNL Performance Assurance Function and the Training and Development Function.

6.2.1 Performance Assurance

The Performance Assurance Function demonstrates that CNL's company values of safety, respect for people, and performance excellence are embedded into the Management System's programs and processes. The Performance Assurance Program delivers many benefits to the organization including improved safety, reduced corporate risk, and increased organizational efficiency and effectiveness. Figure 30 provides an overview of the Performance Assurance Program elements.

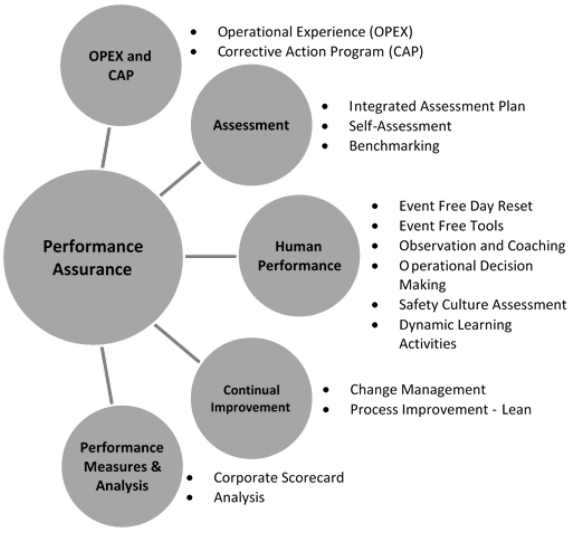


Figure 30: Performance Assurance Program

The requirements listed in the Performance Assurance Program Requirements Document, drive the structure and content of the program. The Performance Assurance Program, uses information from within CNL and from the nuclear industry to improve the safety of operations, improve operational performance, and reduce the significance and occurrence of unplanned events at CNL sites. Unplanned events are entered into an operating experience database, which is monitored for trends and used to share any lessons learned. Operating experience and corrective action programs review and analyze existing events and issues, and lessons learned both from internal and external sources. This determines actions to be implemented to correct non-compliant situations, prevents the recurrence of significant problems, and prevent the occurrence of more significant problems. Ongoing and periodic assessment activities are used to validate that the Management System is functioning according to expectations and that any deficiencies are identified, and appropriate action taken to resolve the deficiency. The Human Performance Program assists all employees with anticipating, managing, and monitoring the effects of variability in human performance on organizational outcomes. A continual improvement framework is effective in assisting with decision-making and promoting organizational learning, innovation, and transformation. CNL uses a series of key performance indicators to measure the performance of facilities, programs, and organizations. These indicators identify performance improvement or deterioration relative to established goals.

The Human Performance Program is based on the guidance provided in REGDOC-2.2.1, *Human performance management: Human Factors* [72] and other CNL licensing basis documents and ensures compliance with these regulatory requirements at CNL.

Relevance

The Performance Assurance Function will apply throughout the life cycle of the NSDF, with requirements for Facility Self-Assessment of Performance, event investigation, and application

of operating experience to share lessons learned and will commence during pre-construction and continue to apply throughout the construction activities.

A Human Factors Verification and Validation report was submitted to CNSC staff as part of the licencing process. The study helped inform some of the Wastewater Treatment Plant's design, in terms of height and size requirements of some of the process trains and human interfaces. Further Human Factors considerations will be applied during operations and maintenance of the NSDF.

Lessons Learned and Operating Experience from CNL's Port Hope and Port Granby Projects have been reviewed and recommendations have been incorporated into the design as applicable. The greatest operational challenge at both sites is water management. The NSDF leachate, contact water and non-contact water systems have been designed to collect and convey the volume of water that will accumulate from back-to-back, 100-year, 24-hour storm events. The NSDF Equalization Tank design capacity will provide sufficient storage to prevent the release of untreated water into the environment. Lessons learned associated with project management, construction, commissioning, and operations will be incorporated into NSDF Project plans accordingly.

As described in Section 4.8, CNL compiled a complete list of all NSDF commitments made during the course of environmental impact statement development and public, stakeholder, and Indigenous Peoples engagement. These written commitments appear in the final Environmental Impact Statement [31] document, in CNL's responses to information requests from Federal and Provincial agencies, and in CNL's responses to comments made by the public and Indigenous Groups. The tracking of these commitments will be accomplished within the Performance Assurance Corrective Action Program and through the associated CNL software system to provide robust tracking of commitment completion.

The minimum number of qualified workers for the safe operation of the NSDF, as well as information on shift schedule, will be provided to the CNSC once the NSDF operation procedures have been prepared, which will be prior to a Licence to Operate. The minimum staffing will meet the requirements of REGDOC-2.2.5, *Minimum Staff Complement* [75]. The shift schedule will meet the requirements in the *Canada Labour Code* and REGDOC-2.2.4, *Fitness for Duty: Managing Worker Fatigue* [76].

6.2.2 Training and Development

The primary function of the Training and Development Program is to ensure that employees are adequately and efficiently trained to perform their roles and responsibilities safely and competently. CNL has developed a Systematic Approach to training that provides a standardized approach to staff training and qualification and ensures that CNL complies with conditions in the applicable licence. The purpose of the Systematic Approach to Training process is to provide a structured, documented, and auditable set of processes that, when implemented, will provide management with the assurance that personnel are trained, competent, and qualified for the assigned work.

A graded approach, commensurate with risk, is used in the application of the Systematic Approach to Training. A graded approach supports decisions related to the specific processes used and the rigor and level of detail required in the supporting training program documents. The most comprehensive levels of Systematic Approach to Training processes are applied to the development of training programs for positions performing licensed activities. The Systematic Approach to Training is based on fundamental processes and sound practices that systematically assess the need for training, type of training, and the training content as well as provide standards for the development, implementation, and evaluation of training.

The Training and Development Program implements the requirements in REGDOC-2.2.2, *Personnel Training, Version 2* [73] and other CNL licensing basis documents and ensures compliance with these regulatory requirements at CNL.

Relevance

The NSDF Facility Authority will ensure operating staff are trained and competent to perform their assigned duties by developing an NSDF-specific training plan in accordance with the requirements of this program. The Facility Authority will authorize the training plan, ensure staff complete the initial training, authorize qualified staff to perform specific licensed activities, and specify continuing training requirements.

The construction contractor will be responsible for meeting the training requirements for their own staff. The construction contractor's training plan must be accepted by the NSDF Facility Authority and will be subject to oversight by CNL.

6.3 Operating Performance

The Operating Performance Safety and Control Area includes the CNL Management System Functions of Conduct of Operations, Construction, Commissioning, Reporting Requirements, and Configuration Management.

6.3.1 Conduct of Operations

The Conduct of Operations Program applies to all Class I and Class II nuclear facilities, to the personnel associated with the operation of these facilities, and to the activities conducted within these facilities.

The Conduct of Operations Program provides a compliance framework to ensure facility operations are managed, organized, and conducted in a manner that results in high levels of safety, performance, and reliability while maintaining compliance with the applicable acts, standards, codes, regulations, and regulatory requirements. The Class I and Class II nuclear facilities are operated within the bounds of the Facility Authorization, which defines the key requirements, conditions, and limits for their safe operation.

Figure 31 presents an overview of the Conduct of Operations organization. A Facility Authority is assigned to each Class I or II nuclear facility and corresponds with an appropriate CNSC staff member. The NSDF Facility Authority has delegated authority from the Site Licence Holder, for

ensuring safety and compliance with all applicable licensing and regulatory requirements and has the overall responsibility for the safe and compliant operation and use of their respective facility.

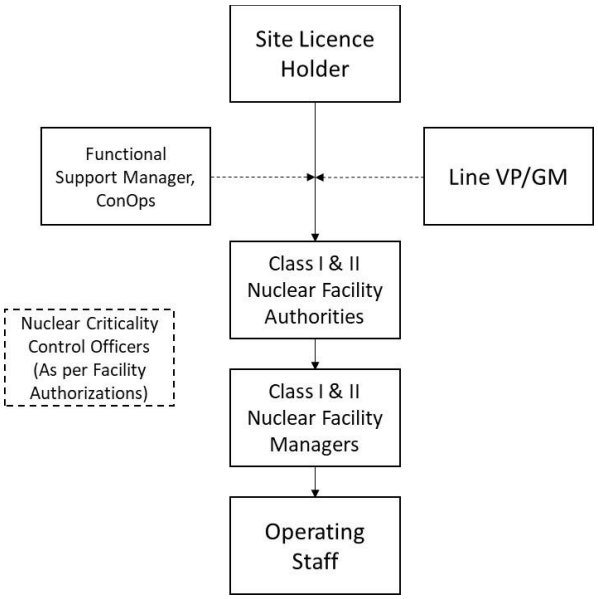


Figure 31: Conduct of Operations Organization

The Conduct of Operations Program includes a series of Management Control Procedures, and the processes detailed in these procedures assists with the creation of a tailored suite of facility-specific Conduct of Operations processes.

The Conduct of Operations Program implements the requirements in Management system requirements for nuclear facilities, CSA N286-12, *Management system requirements for nuclear facilities* [8], ISO 9001:2015, *Quality management systems – Requirements* [9], ISO 14001:2015, *Environmental Management Systems - Requirements with Guidance for Use* [70] CNSC REGDOC-2.3.1 *Conduct of Licensed Activities: Construction and Commissioning Programs* [74]. The Program also ensures Conduct of Operations compliance with these regulatory requirements at CNL.

Relevance

The Facility Authorization for the operation of the NSDF sets out the key requirements, conditions, and limits for the safe operation of the NSDF in accordance with the CRL Nuclear Research and Test Establishment Operating Licence [2] and the Licence Conditions Handbook [18]. The authorities and responsibilities for the safe operation of the facility are also defined. Although not issued for use until after a regulatory decision, the Facility Authorization for the operation of the NSDF was submitted to CNSC staff as part of the licencing process.

The Conduct of Operations Program will apply to the NSDF after inactive commissioning and turn over to operations. The NSDF Facility Authority will be responsible for ensuring the suite of NSDF Facility-Specific Conduct of Operations Procedures is prepared prior to Licence to Operate

is obtained. A series of working-level procedures will be developed prior to starting operations. A typical list of procedure subjects for nuclear facilities include the following:

- operating procedures
- maintenance procedures
- response to alarms procedures
- emergency procedures
- surveillance and monitoring procedures
- waste management procedures (for waste generated by NSDF activities)
- operating limits and conditions

6.3.2 Construction

The Construction Program Description Document describes how the CNL Construction Process manages construction and installation activities for work assigned to external contractors. The Construction Process provides the framework for external contractors performing construction and installation activities at CNL sites to ensure they are being adequately controlled and documented within approved safety margins and regulatory or statutory requirements. The Construction Process applies to all construction and installation activities executed by external contractors for nuclear and non-nuclear projects throughout CNL.

The purpose of the Construction Process is to provide effective support to the design phase as well as control and monitoring measures to ensure the execution of construction and installation activities complies with the following:

- CSA N286-12, *Management System Requirements for Nuclear Facilities* [8]
- ISO 9001:2015, *Quality management systems – Requirements* [9]
- Pressure Boundary Program and the associated Pressure Boundary Quality Assurance Plan
- *National Building Code of Canada* [77]
- *National Fire Code of Canada* [78]
- *Ontario Occupational Health and Safety Act and Regulations* [79]
- *Canada Labour Code* [37]
- applicable Site Licenses

Through the implementation of this Construction Process, CNL's customers, stakeholders, and regulatory authorities can be confident of the following:

- construction activities are efficiently, effectively, and safely delivered

- construction activities are being adequately controlled and documented
- system modifications and equipment installation results are deemed safe and appropriate for the intended use
- construction activities address any applicable regulatory or statutory requirements

During construction activities, portions of the work can be assigned to contractors and other participating organizations that are external to CNL. For all construction activities, CNL establishes the Quality Assurance requirements for the work and evaluates the Quality Assurance programs developed by such external contractors or participating organizations. CNL is responsible for the effectiveness of the Quality Assurance Program applied at the construction site.

As such, CNL performs the following controlling activities on external contractors or participating organizations:

- Review and accept the Quality Assurance Program of the external contractors or participating organizations, ensuring that it matches their scope of work and complies with the requirements of the Quality Assurance standards and overall Quality Assurance program applied at the construction site.
- Audit the external contractor or participating organizations with a frequency commensurate with their scope of work activities and the maturity of their Quality Assurance Program.
- Oversee the work performed by contractors or participating organizations using established monitoring and acceptance processes.

The Construction Program implements the requirements in REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [74] and ensures compliance with these regulatory requirements at CNL.

Relevance

The NSDF Construction Quality Assurance Plan was developed in alignment with the CNL Construction Program Requirements and requires an extensive testing regime as detailed in the design specifications. The NSDF Construction Schedule and Construction Quality Assurance Plan were submitted to CNSC staff as part of the licencing process.

During the construction phase the design quality management and adherence is to ISO 9001:2015*, Quality management systems – Requirements* [9] but also includes the associated clauses from CSA N299.2, *Quality Assurance Program Requirements for the Supply of Items and Services for Nuclear Power Plants* [68].

The Construction Quality Assurance Plan includes a table that provides a list of components, which have been identified via specifications, permit conditions, and regulatory requirements, as necessary to be tested in order to determine the post installation acceptability of the

component. The Construction Quality Assurance Plan presents the principles and practices of Quality Assurance that will be implemented during construction of the NSDF.

Although the construction contractor shall undertake its own quality control, CNL has decided to procure a Construction Quality Assurance Contractor to conduct independent quality surveillance and testing. The Construction Quality Assurance Consultant will be responsible for conducting impartial observations and performing field tests to provide written documentation that the facility is constructed in accordance with the design and all applicable specifications, plans, and the Construction Quality Assurance Plan. The Consultant for the NSDF Project will be selected by CNL, and will occur through on open bidding process, and will be based on the Consultant's expertise and experience with projects of a similar scale and complexity. The selected Consultant will be required to meet technical, qualification, and quality requirements specific to their role in the project. The Consultant may contract with third-party testing firms to conduct on-site and laboratory testing, as necessary. In order to verify the construction contractor's quality control testing, the Consultant will arrange for qualified geotechnical, geosynthetic, and other testing laboratories to evaluate the characteristics of the soils, aggregates, geosynthetics, and other structural components that will be installed during the construction of the NSDF.

Similarly, the construction of NSDF safety-related systems will receive independent quality surveillance and testing. Conventional construction activities for NSDF, including concrete work, installation of pressurized piping, etc., will be subject to testing in accordance with industry codes and standards, and will be planned by the construction contractor in inspection and test plans.

6.3.3 Commissioning

The CNL Commissioning Program applies to all new or refurbished facilities at CNL. This includes current operating facilities where new systems are installed, or an existing system is modified that alters the design intent of the original system configuration.

Commissioning starts with planning the commissioning scope, phases, and control points, and ends with the Commissioning Completion Assurance process.

The Commissioning Program defines processes to ensure that commissioning is planned, documented, executed, and verified according to applicable codes, standards, and regulatory and customer requirements.

The ultimate commissioning objective is to obtain a building or facility whose systems function in all respects according to the design intent and meet the needs of the occupants. To achieve this, the Commissioning Program provides a systematic objective method that will enable commissioning to safely proceed in a controlled manner and to a high level of quality. The Commissioning Program will also provide the necessary assurances and/or evidence that the facility has been constructed in accordance with the design intent and can be operated safely.

The Commissioning Program implements the requirements in REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [74] and ensures compliance with these regulatory requirements at CNL.

The commissioning of structures, systems and components normally consists of the following periods: planning, preparation, execution, and completion reporting.

Relevance

The NSDF Commissioning Plan, developed in alignment with the program requirements, establishes methods for ensuring accountability in addition to the preparation, review, and approval and revision control of the components of NSDF commissioning. The pre-commissioning and commissioning activities will follow the documentation hierarchy in accordance with CNL's Commissioning Program. The NSDF Commissioning Plan was submitted to CNSC staff as part of the licencing process.

Commissioning Procedures establish the conditions under which the equipment performance tests will be conducted. Typically, the procedures specify the test and measurement methods to demonstrate that individual components, individual systems, and interactive process system performance meet or exceed the functional and design performance requirements. The procedures include verification requirements, identify tests that require independent verification, and approved verifier qualifications (such as the Technical Standards and Safety Authority). The procedures will serve as a formal record, documenting actual performance results against the acceptance criteria. Deficiencies will be assessed and prioritized from a safety and functionality perspective and resolved as necessary prior to the advancement to the next commissioning phase.

Inactive commissioning ends with the Inactive Commissioning Completion Assurance Certificate and Inactive Commissioning Report. These activities are performed by the construction contractor prior of the completion of the construction scope of work.

Active commissioning is a term used at CNL to define the period where operations begin in a progressive manner, controlling the rate at which nuclear substances are introduced. Active commissioning will be performed once a licence to operate is granted since introduction of nuclear substances is necessary. This period is used to further validate the design and to confirm administrative controls are adequate, including the following:

- staff training and staffing levels are adequate
- operating procedures and response to alarm procedures are effective and correct
- safety systems function as expected (where practical to do so)
- individual systems and overall process control performance can operate safely and yield results within the acceptable design range limits

Active commissioning will be conducted by NSDF operations staff following active commissioning procedures. Active commissioning typically ends when the NSDF Facility Authority accepts the completed active commissioning reports.

6.3.4 Reporting Requirements

The reporting procedure, CNL Reporting to Regulatory Agencies, describes the requirements, processes, and responsibilities for reporting by CNL to the CNSC as required by the *Nuclear Safety and Control Act* [7] and associated regulations as well as other regulatory agencies, as per the applicable legislation. CNL is required to report to CNSC staff on unplanned situations or events, along with providing annual safety and compliance monitoring reports.

The requirements of CNL Reporting to Regulatory Agencies constitute the requirements for consistent reporting to regulatory agencies and are applicable to all sites operated by CNL.

The document applies to the CNL employees who are Designated Representatives of the Licensee and are responsible for communicating with CNSC staff and, in general, to the CNL staff responsible for reporting to other regulatory agencies. The CNL Reporting to Regulatory Agencies implements the requirements in REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills* [80] and ensures compliance with these regulatory requirements at CNL.

Relevance

The NSDF Project will comply with reporting requirements for all unplanned situations and events, should they arise, as well as yearly reporting through the CRL site annual compliance monitoring report.

6.3.5 Configuration Management

The Configuration Management Functional Support Area provides the framework to maintain and control the physical configuration of structures, systems and components at CNL. Configuration Management applies to all design, operations, decommissioning, and maintenance activities at CNL sites. Configuration Management applies to all non-nuclear and nuclear documents, policies, programs, and procedures that contain information or instructions that could impact the following:

- design (both regulatory and owner prescribed) and licensing basis
- any plant physical configuration
- any configuration item or information

Configuration Management allows for maintaining and controlling the configuration of nuclear facilities within approved safety margins and regulatory requirements when changes or nonidentical replacement parts are required. Configuration Management ensures that changes are assessed, approved, designed, implemented, commissioned, and placed into service within the safety envelope at all CNL sites in accordance with the design requirements.

The Configuration Management requirements document identifies the requirements associated with the configuration management and provides an index to governing and approved procedural documents to ensure Configuration Management is planned, implemented, and maintained.

Relevance

All temporary and permanent modifications to facilities at the CRL site, including the NSDF, are made in accordance with CNL's Engineering Change Control process. This process is overseen by an Operations Authority, who is the Facility Authority or designated individual responsible for the safe operation of the facility and configuration management of the plant.

Engineering Change Control is a collaborative process incorporating operations and engineering expertise including design control, safety analyses, and configuration management to manage and control changes throughout CNL. The process combines industry best practices for controlling risks and configuration management.

During construction any design changes or deviations from technical specifications proposed by the construction contractor are required to meet the intent of CNL's Engineering Change Control process. The change management process will ensure design changes and improvements do not affect the design basis and comply with environmental requirements. The Facility Authority is responsible for:

- approving and authorizing all changes controlled by the Engineering Change Control procedure
- ensuring that facility staff who are delegated to review and approve proposed changes have full knowledge of change control responsibilities, the change intent and requirements of the facility
- implementing, waiving or delegating existing hold points in the Engineering Change Control process
- ensuring early engagement with the Safety Analyst, the Safety Review Committee and the CNSC staff with respect to proposed changes that could reasonably be expected to have an impact on the Facility Authorization (i.e., changes to Items Important to Safety outside of the operating envelope defined by the Facility Authorization).

6.4 Safety Analysis

The Safety Analysis Safety and Control Area is comprised of the Safety Analysis Program and the Nuclear Criticality Program.

6.4.1 Safety Analysis Program

The Safety Analysis Program develops and controls the suite of nuclear safety analysis documents required to support the licensing basis of all facilities at CNL. This program applies to all safety analysis activities involving CNL structures, systems, and components and all management, supervisors, and staff. The Safety Analysis Program Requirements Document

specifies the program requirement in the relevant legislations and regulations including the requirements defined in REGDOC-2.4.1, *Deterministic Safety Analysis* [81].

As defined by REGDOC-3.6, *Glossary of CNSC Terminology* [82] safety analysis is a systematic evaluation of the potential hazards that are associated with the conduct of a proposed activity or facility and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards. The relevant hazards include radiological, nuclear criticality, fire, and chemical. However, with respect to compliance with the *Nuclear Safety and Control Act* [7] and regulations, the CNSC requirement is limited to consideration of the effects of all relevant hazards on radiological safety and prevention of nuclear criticality accidents or chemical hazards directly associated with CNSC licensed radioactive material.

Assessment of non-radiological hazards is included in the scope of other Functional Safety Areas, such as Conventional Health and Safety and Fire Protection with aspects relevant to nuclear safety taken into account in Safety Analysis. The assessment of nuclear criticality is governed by the Nuclear Criticality Safety Program and the results are an input to the Safety Analysis. Radiological hazards related to protection of workers and the public from ionizing radiation, is covered under the Radiation Protection Program.

The main objective of the program is to provide processes and procedures that define how nuclear safety analysis will be executed to permit the successful completion of safe engineering design in support of new build, facility modification, facility operation, research and product development, decommissioning, and disposal.

Safety analysis documentation is controlled and periodically reviewed and revised throughout the life of a facility or site. Safety analysis is documented in a manner that is permanently retrievable, facilitates independent review by qualified experts, provides traceability, and is reproducible. All safety analysis activities are performed by CNL using:

- qualified personnel applying a systematic analysis method with justified assumptions
- verified and validated computer codes (in accordance with CSA N286.7, *Quality Assurance of Analytical, Scientific, and Design Computer Programs* [66])
- accounted for uncertainties in the safety analysis models and inputs
- traceable and reproducible degrees of conservatism commensurate with the severity of the analyzed event and associated uncertainties
- accepted review process.

Relevance

The NSDF Safety Analysis Report was submitted to CNSC staff as part of the licencing process. The scope of the Safety Analysis Report is to present the operational safety analysis of the NSDF Project based on the detailed design package, proposed operations and identified hazards. The Safety Analysis Report uses the most up-to-date information about the NSDF design to form the basis of the assessment. In the Safety Analysis Report, nuclear safety is assessed for normal operations as well as accident conditions for on- and off-site human receptors and the

environment. The timeframe assessed includes the construction period, approximate 50-year operations period, and 30-year closure period.

The NSDF Safety Analysis Report forms the basis for a set of limiting conditions for safe operation. The key safety limit for the safe operation of the NSDF is the licensed inventory at closure, which is the maximum radioactivity of significant radionuclides in the Engineered Containment Mound at closure.

The safety analysis demonstrates that the following requirements under normal operations, anticipated operational occurrences, design basis accidents, and beyond design basis accidents, including design extension conditions in the NSDF, have been met:

- the safety of the off-site public, and on-site personnel is protected
- the dose acceptance criteria are met for radiological consequences to the on-site and off-site receptors
- there are no significant adverse impacts on the environment
- the adequacy of the NSDF design
- the proposed design of the NSDF conforms to regulatory requirements and guidance provided by the CNSC and the IAEA
- waste containment is maintained for the duration of the facility operation under normal operating conditions

The NSDF Safety Analysis Report will be updated during the life of the Facility, and specifically, will be updated following successful commissioning, to demonstrate that the Facility will provide for safe operation on the designated site over the proposed plant life.

6.4.2 Nuclear Criticality Safety Program

CNL has a Nuclear Criticality Safety program that provides a framework for safe operations involving fissionable materials and for the prevention of inadvertent nuclear criticality accidents by conforming to all applicable regulations, company policies and procedures. The Nuclear Criticality Safety program applies to the handling, storage, processing, and transportation of fissionable material throughout design, commissioning, operations, and decommissioning activities as well as the long-term management of nuclear waste.

The Nuclear Criticality Safety Program implements the requirements in REGDOC-2.4.3, *Nuclear Criticality Safety, Version 1.1* [83] and ensures compliance with these regulatory requirements at CNL.

Relevance

Documentation is in place to ensure that criticality safety processes were considered during the design and are implemented during operation of NSDF. Criticality safety assessments have been completed consistent with the requirements stated in REGDOC-2.4.3, *Nuclear Criticality Safety* [83]. The analyses have yielded adequate sub-criticality margin under all normal and credible abnormal conditions (events or event sequences having frequency of occurrence equal to or greater than 10^{-6}/year) both during operational and long-term storage of fissionable materials.

It is not credible that the fissionable material disposed in the NSDF will achieve criticality under any normal or postulated accident scenarios. Through the operating limits, restrictions and criticality safety controls outlined in the criticality safety document nuclear criticality safety will be maintained.

6.5 Physical Design

The Physical Design Safety and Control Area is comprised of the following CNL Management System components: the Design Program and the Pressure Boundary Program.

6.5.1 Design Program

The Design Authority and Design Engineering Program maintains and controls the design basis of CNL within approved safety margins and regulatory requirements, which include the *Class I Nuclear Facilities Regulations* and *National Building Code* [77]. The Design Authority and Design Engineering Program establishes the requirements for CNL design work and applies to all design engineering activities performed at CNL sites.

The purpose of the Design Authority and Design Engineering Program is to ensure that the design is planned, executed, verified, and documented according to applicable codes, standards, and regulatory and design requirements.

The Design Authority and Design Engineering Program requirements document identifies the requirements associated with the Design Process, provides an index to governing and approved procedural documents, and is applicable to the Design Process at CNL.

The Design Engineering Program complies with the following:

- CSA N286-12, *Management System Requirements for Nuclear Facilities* [8]
- CSA N285.0, *General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants* [71] when applied in conjunction with the applicable pressure boundary quality assurance manuals
- International Organization for Standardization (ISO) 9001:2015, *Quality management systems – Requirements* [9]

Relevance

Class I Nuclear Facilities Regulations require a licence application contain a description of structures, systems and components and relevant documentation of the facility design. The NSDF Design Requirements and NSDF Detailed Design Description reports were submitted to CNSC staff as part of the licencing process.

The Design Authority and Design Engineering program maintains and controls the design basis within approved safety margins and regulatory requirements and applies to all design engineering activities, including during the construction of the NSDF Project. Design work performed by external design consultants is planned and managed in accordance with the design package grading selection, which recognizes NSDF as a Class IB nuclear facility. The NSDF

design consultant`s quality program and supporting procedures have been audited by CNL. Engineering surveillance activities are performed by CNL and/or its representatives, while the design work is being executed by the design consultant.

6.5.2 Pressure Boundary Program

The Pressure Boundary Program applies to the design, procurement, fabrication, installation, examination, testing, repair, replacement, modification, construction, and maintenance of pressure retaining systems and components performed by CNL at the CRL site.

The purpose of the Pressure Boundary Program is to assure that pressure-retaining systems and components are designed, constructed, and operated in full compliance with statutory and legislative requirements, while promoting and supporting performance excellence with a strong safety culture. The ultimate objective of the Pressure Boundary Program and its governing codes and standards is “no pressure boundary failures.”

The site, facilities, and buildings that fall under the auspices of the Pressure Boundary Program are federally regulated. As such, provincial legislation does not apply to activities conducted on pressure retaining systems and components at CRL. The CRL Pressure Boundary Quality Assurance plan presents the details of the Pressure Boundary Quality Assurance Program implemented at CRL, which complies with CSA N285.0-08, *General requirements for pressure-retaining systems and components in CANDU nuclear power plants* [71].

The Pressure Boundary Program requirements document identifies the requirements associated with the Pressure Boundary Program and provides an index to governing and approved procedural documents to ensure Pressure Boundary Program work is planned, implemented, and maintained.

Relevance

The NSDF systems are designed in accordance with the CNL Pressure Boundary Program and that this program will be followed during the fabrication, installation, and testing of applicable pressure boundary systems or components.

6.6 Fitness for Service

The Fitness for Service Safety and Control Area is comprised of the Maintenance Functional Support Area and Equipment Reliability Functional Support Areas.

6.6.1 Maintenance

The primary objective of the Maintenance Functional Support area is to provide asset custodians with a strategy identifying which maintenance activities are to be performed on which structures, systems and components, and at what intervals. The type and frequency of maintenance activity applied to each structure, system, and component are commensurate with the importance to safety, design function, and required performance. The purpose is to establish consistent practices designed to improve the performance and safety of the

structures, systems, and components. Elements of this process help to improve the life and reliability of the structure, system, and component as well as avoid any unplanned maintenance activities.

The Maintenance Function Support Area uses the requirements CSA N286-12, *Management System Requirements for Nuclear Facilities* [8] and guidance in ISO 9001:2015*, Quality Management Systems – Requirements* [9] and REGDOC-2.6.2, *Maintenance Programs for Nuclear Power Plants* [84] to develop appropriate requirements for CNL sites and facilities. The Maintenance Function Support Area ensures compliance with the relevant regulatory requirements at CNL.

Relevance

Monitoring and surveillance will be performed on the Engineered Containment Mound throughout the life cycle of NSDF to ensure continuing fulfilment of the safety functions. The purpose of the surveillance is to verify through inspections that structures, systems and components of the disposal facility continue to function and to facilitate the detection of changes that might affect the performance of the disposal system. Remedial actions will be taken in response to unexpected results when appropriate to do so. The NSDF-specific Operations and Maintenance Plan defines program testing, monitoring, inspection (surveillance), and maintenance or repair activities that will be implemented during the operational and closure period of the Engineered Containment Mound and NSDF facilities. The plan is designed to verify that installed systems, components, and features are operating as designed and without impairment and to ensure that necessary maintenance, repairs, or replacements are completed or implemented for these systems, components, and features as required in a timely manner. CNL will ensure a categorized list all NSDF structures, systems, and components that will require maintenance is included in the computerized maintenance management system database).

Both the NSDF Monitoring and Surveillance Plan as well as the NSDF Operations and Maintenance Plan have been submitted to CNSC staff as part of the licensing process.

6.6.2 Equipment Reliability

The Equipment Reliability Program ensures that all systems important to safety function reliably and in accordance with the relevant design and performance criteria, including any safety goals of CNL and CNSC.

The Equipment Reliability Program applies to systems important to safety within licensed nuclear facilities and to their support facilities, which may implement any of the key equipment reliability elements (i.e., aging management, obsolescence management, and system health).

The purpose of the Equipment Reliability Program is to enable facility personnel to evaluate important equipment, develop and implement long-term equipment improvement plans, monitor equipment performance and condition, and adjust preventive maintenance tasks and frequencies based on equipment performance. The Equipment Reliability Program assists

licensed nuclear facilities and, as appropriate, custodians of other complex systems in improving and maintaining levels of safety and reliability in facility operation in an efficient and effective manner.

The Equipment Reliability Function utilizes the requirements in REGDOC-2.6.3, *Aging Management* [85] to develop appropriate requirements for nuclear facilities and ensures compliance with the relevant regulatory requirements at CNL.

Relevance

The Wastewater Treatment Plant systems and system components are either specified with materials that will endure more than 50 years of operational life or are designed for periodic refurbishment or complete replacement.

The systems important to safety within the Engineered Containment Mound are the base liner systems, cover systems, perimeter berm, and leachate transfer systems. The durability of engineered barriers is addressed in the design through the selection of natural, stable materials, high performance high-density polyethylene geomembranes, and the ongoing long term performance tests to validate the 550-year design life of the geomembranes. The rigorous Construction Quality Assurance program during construction, in-service inspection and surveillance activities during the post-closure phase to monitor the performance are all part of the aging management.

The base liner system materials were selected based on their compatibility with the predicted leachate characteristics in the ECM arising from the Waste Acceptance Criteria [51], and required design service life. The Waste Acceptance Criteria [51] limits the quantities of non-radiological constituents in the ECM, which minimizes degradation and enhances longevity of the liner systems.

Furthermore, CNL is developing a research and development plan to study the performance of the NSDF engineered barrier system, taking into consideration the full life cycle and information and data that CNL will need at the time of closure. This type of research and development would enhance confidence in the reliability of the geomembrane systems.

6.7 Radiation Protection

The Radiation Protection Program applies to the operation and activities that affect the safety of staff and equipment in terms of exposure to ionizing radiation at all CNL sites and applies to all employees and other personnel (e.g., visitors and contract staff) conducting work at CNL sites. The Radiation Protection Program applies to all activities conducted where CNL holds a CNSC issued licence in Canada.

The objective of the Radiation Protection Program is to ensure and demonstrate compliance with applicable regulations, such as the *Radiation Protection Regulations*, and acts and maintain doses to workers as low as reasonably achievable (ALARA), taking into account social and economic factors. CNL applies the ALARA principle to all activities involving the use of ionizing

radiation. All radiation doses to personnel or members of the public must be justified, in accordance with the ALARA principle, and maintained below regulatory limits.

Dosimetry is a necessary component of the program, providing a quantitative measure of the effectiveness of the Radiation Protection Program, as it applies to both the individual worker and the collective workforce. Dosimetry is a fundamental requirement for the demonstration of compliance with regulatory obligations mandated by the site licence. Dosimetry services for personnel and visitors are provided by CNL and are managed according to the CNL Dosimetry Program. These services include monitoring, assessing, recording, and reporting doses of ionizing radiation received by all individuals while on site.

Relevance

The Radiation Protection Program objectives continue to be achieved through NSDF design reviews, planning and control of work, personnel qualification and training, provision of internal and external dosimetry, radiation and contamination exposure control procedures, work supervision, and planning for abnormal hazards and exposures. An NSDF ALARA Assessment Report and NSDF Radiation Protection Plan were submitted to CNSC staff as part of the licencing process.

NSDF-specific radiation protection and dosimetry requirements are defined in the NSDF Radiation Protection Plan. All work at NSDF involving ionizing radiation will be planned and controlled as per CNL's procedure on planning and control of radiation work. The level at which the Radiation Protection Program is applied will increase as the NSDF evolves from the design phase to operation. In future phases (operations, maintenance, decommissioning, and closure), Radiation Protection staff will be included in the day-to-day work planning and monitoring activities. The Radiation Protection Requirements will continue to be applied in a graded manner throughout the life cycle of the facility.

6.8 Conventional Health and Safety

The CNL Occupational Safety and Health Program applies to all work performed by CNL employees and to work performed by others on site or at workplaces controlled by CNL. The purpose of the Occupational Safety and Health Program is to prevent accidents and injury to health arising out of, linked with, or occurring to employees in the course of employment, and to all persons on sites or workplaces controlled by CNL.

The CNL *Safety and Health Policy* establishes the CNL standards and expectations with respect to safety and health.

The Occupational Safety and Health requirements document establishes the requirements for the CNL Occupational Safety and Health Program. As a federal regulated site, CRL is subject to the requirements of *Canada Labour Code* and *Canada Occupational Health and Safety Regulations*. CNL is committed to providing a safe workplace and compliance with applicable safety and health requirements. The Occupational Safety and Health Program complies with applicable federal and provincial legislation, regulations, and standards.

Relevance

The CNL Occupational Safety and Health Program and CNL's *Safety and Health Policy* apply to all phases of the NSDF life cycle.

The NSDF Occupational Safety and Health Plan will be implemented for the work performed during site preparation, construction, waste handling and emplacement, operation, and maintenance of the NSDF. This plan will help promote a safe work environment and establish systems to recognize, prevent, evaluate, and control Occupational Safety and Health hazards through the cooperation of management, employees, contractors, and site visitors. During the pre-construction phase a construction safety hazards evaluation will be developed by the construction contractor to identify and mitigate any known or potential hazards. The NSDF Occupational Safety and Health Plan supports and is consistent with the requirements of the Canada Labour Code and the CRL Site Licence. The NSDF Occupational Safety and Health Plan will be updated by CNL as necessary to comply with the new management system and any revised occupational safety and health requirements.

In future phases of the NSDF Project (construction, operations, maintenance, decommissioning, and closure), Occupational Safety and Health staff will be included in the day-to-day work planning and monitoring activities.

6.9 Environmental Protection

The Environmental Protection Program implements CNL's Environment Policy and ensures environmental compliance and obligations are fulfilled, as applicable, at CNL-operated sites in Canada.

The Environmental Protection Program requirements apply to operations and activities that may affect the environment in and around CNL sites. A graded approach to requirements is applied based upon environmental risks or events that could occur at any given location and considering the amount of control or influence that CNL has on the activity. The Environmental Protection Program also applies to all employees and other personnel (e.g., contractors, consultants) conducting work at CNL sites.

Under the CNL Management System, the Environmental Protection Program for applicable CNL-operated sites in Canada conforms to the ISO 14001:2015 *Standard for Environmental Management Systems* [70]. The following scope of registration applies at the Chalk River Laboratories:

"The Registration covers the Environmental Management System for the operation of nuclear facilities, conducting research and development to support science and technology, waste management and decommissioning activities".

Figure 32: Protection of the Environment

Chalk River Laboratories has implemented and maintained an Environmental Protection Program that includes a set of action levels. Chalk River Laboratories has reported to the CNSC, as required, when an action level has been reached.

The following are features of the Environmental Protection Program:

- conforms to the CNSC regulatory document REGDOC-2.9.1, *Environmental Protection Policies, Programs and Procedure,* Version 1.1 [25]
- has an integrated environmental monitoring program that meets the requirements of CSA N288.4, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills* [60]
- has an effluent monitoring program that meets the requirements of CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills* [58]
- has based the scope and complexity of monitoring programs, including effluent and environmental monitoring programs, on an environmental risk assessment performed according to the CSA N288.6-12, *Environmental risk assessment at Class I nuclear facilities and uranium mines and* mills [86]; which include updated Derived Release Limits that were calculated in accordance with CSA N288.1, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities* [87]

- has a groundwater protection and monitoring program that meets the requirements of CSA N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills* [59]
- has established and implemented action levels to control releases to the environment from nuclear facilities in compliance with CSA N288.8-17, *Establishing and implementing action levels to control releases to the environment from nuclear facilities* [88]

The effectiveness of the Environmental Protection Program is assessed and reviewed through a number of different venues including the following:

- annual Environmental Management System Review conducted by the Environmental Protection Program, which covers a summary of required inputs and outputs for the ISO 14001:2015, *Standard for Environmental Management Systems* [70]
- annual Effluent, Environmental, and Groundwater Program Reviews conducted by the Environmental Protection Program, which covers a summary of required inputs and outputs for CSA N288.4, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills* [60], CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills* [58], and CSA N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills* [59] standards
- quarterly Nuclear Performance Assurance Review Board meetings includes line management as well as Senior Management, where specific environmental performance updates are provided for the previous quarter
- internal audit of the Environmental Protection Program is conducted annually for CRL and
- external audit of the Environmental Protection Program is conducted annually for CRL by the registrar

CNL is required by the CRL site licence to submit the following reports to the CNSC staff related to the Environmental Protection Program:

- the results of the effluent monitoring for radioactive nuclear substances and the effluent monitoring for hazardous substances
- the results of environmental monitoring for nuclear substances and hazardous substances
- an annual status report on open environmental assessment follow-up actions covering the preceding calendar year

Relevance

Through the Environmental Management System, CNL will review the impacts of operations, activities, and projects on the environment and establish appropriate controls or mitigation measures. This is done through one of two processes: Environmental Review of Non-routine Activities or Environmental Review of Routine Activities. For the NSDF construction activities, the Environmental Review of Non-routine Activities is covered by the environmental assessment. Once NSDF proceeds into operation, the facility will be included in CNL's Environmental Management System including environmental review of routine activities. The activities of the NSDF will be documented and the environmental aspects of those activities will be identified. Those aspects that are deemed higher risk will be assessed as significant environmental aspects and the operational controls will be documented. Through this process, we assess the facility on a periodic basis and review and update the aspects as required. In addition, as part of the Environmental Management System, the changes to regulatory requirements are reviewed and communicated and any changes required to meet these changing requirements is identified. This occurs through several management review meetings that occur throughout the year.

Annual reports will be updated as required to incorporate the results from the NSDF Environmental Assessment Follow-Up Monitoring Program and continued operations of NSDF as we transition to Chalk River Laboratories' routine monitoring programs.

6.10 Emergency Management and Fire Protection

The Emergency Management and Fire Protection safety and control area includes the Emergency Preparedness Program and the Fire Protection Program.

6.10.1 Emergency Preparedness

The Emergency Preparedness Program provides an operational framework to implement CNL's *Safety and Health Policy* and *Environment Policy* with respect to necessary emergency response measures and compliance with company priorities identified in the Strategic Emergency Management Plan. The Emergency Preparedness Program's focus is the prevention and mitigation of, preparedness for, response to, and recovery from abnormal or emergent events. The Emergency Preparedness Program Requirements Document specifies the program requirements in the relevant legislations and regulations including the requirements defined in REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response, Version 2* [89].

The Emergency Preparedness Program supports emergency response as required through mutual assistant agreements and as directed through the federal government of Canada. The Emergency Preparedness Program applies to the design, operations, and other activities that may affect emergency preparedness at Canadian CNL sites.

Emergency preparedness is required at all CNL business locations. A graded approach to requirements is applied based upon an assessment of the most credible events that could occur

at any given location. CNL uses Incident Management System methodology, ensuring a standardized approach with emergency partners for organizational structure, functions, processes, and terminology.

The Emergency Preparedness Program:

- ensures a state of readiness to prevent or mitigate the effects of an emergency or abnormal situation to protect the health and safety of workers, the public, the environment
- prepares employees for emergency responses through training, documentation, exercises, and drills
- establishes liaison and coordination with federal, provincial, and municipal officials
- establishes emergency plans and procedures for the response to and mitigation of harmful effects of emergencies

Emergency response is coordinated through individual municipalities and the provincial government. CNL has longstanding relationships with these government bodies, and with different agencies within the federal government, to ensure that emergency resources are properly deployed in the unlikely event of an incident related to CNL's activities. In case of an accident or emergency, CNL provides leadership and works closely with regional municipalities and the responsible provincial and federal agencies to implement the complementary emergency preparedness programs required to address the incident.

Relevance

During the construction phase of NSDF, the construction contractor is required to prepare and submit to CNL for acceptance, an emergency response plan that is compliant with CNL's emergency procedures. In alignment with the Emergency Preparedness Program, NSDF specific emergency procedures will be developed to support the operations phase of the Facility. These response plans are developed and revised according to the facility life cycle phase. All aspects of the program will apply, including staff emergency response training and drills specific to the NSDF Project.

There are no additional hazards added to the CRL site by the NSDF that would impact the overall CRL site emergency response plan under the requirements of the Licence Conditions Handbook [18]. That is, the NSDF will not increase the risk of an offsite release and the existing emergency response plan for the CRL site is adequate.

6.10.2 Fire Protection

The Fire Protection Program provides an overall framework, including requirements, processes and responsibilities to fulfill CNL's *Safety and Health Policy*, *Security Policy* and *Environment Policy* and regulatory responsibilities pertaining to fire protection at CNL. The Fire Protection Program provides an operational framework to implement CNL's Occupational Safety and

Health Program with respect to fire protection and to ensure compliance with applicable legal and other requirements.

The Fire Protection Program applies to all CNL employees and to other personnel (e.g., contractors and consultants) conducting work at CNL sites and applies to the design, operations, and other activities that may affect fire protection in and around CNL sites. The Fire Protection Program applies a risk-graded approach in conjunction with the defence-in-depth principles to its operations and activities to the extent that they may affect fire protection.

The Fire Protection Program requirements document specifies the requirements for the Fire Protection Program activities performed by CNL to meet the applicable licence conditions throughout the life cycle of a site or facility, including requirements in CSA N393-13, *Fire protection for facilities that process, handle, or store nuclear substances* [90], the *National Fire Code of Canada* [78], and the *National Building Code of Canada* [77].

Relevance

The NSDF Project and facilities have been designed and will be constructed in accordance with *National Fire Code of Canada* [78] *National Building Code* [77], and CSA N393-13, *Fire protection for facilities that process, handle, or store nuclear substances* [90]. Further, since NSDF is located on the CRL site, the existing fire response capabilities will be available to the NSDF facilities throughout the construction, operations, and closure phases. The NSDF Fire Hazard Analysis Report was submitted to CNSC staff as part of the licencing process.

6.11 Waste Management

The Waste Management Safety and Control Area includes the CNL Waste Management Program and the Cleanup Function (relevant to site decommissioning).

6.11.1 Waste Management Program

The Waste Management Program provides a framework to manage clean, hazardous, and radioactive waste consistently across all CNL managed sites and translates the specific waste requirements from provincial and federal regulatory documents and standards into requirements that are specific to CNL-managed sites.

The Waste Management Program is responsible for the following:

- developing and setting CNL's Waste Management governance, including procedures and other supporting materials (e.g., documentation and training materials), in compliance with applicable requirements (e.g., Acts, regulations, codes, standards, and guidance documents), internal interfaces, and other stakeholders, and based on industry best practices
- developing and maintaining CNL's Integrated Waste Strategy [6] that describes how CNL optimizes its strategic approach to waste management

- identifying best available options and developing plans for all phases of the waste management life cycle process at CNL operated sites
- identifying and addressing gaps in existing waste management life cycle processes through observation, assessments and reviews at CNL operated sites, and benchmarking against other facilities (nuclear and non-nuclear)
- providing waste oversight and subject matter expert support to Waste Generators to ensure that the Waste Management life cycle process and Waste Hierarchy are implemented in accordance with the applicable policies, procedures, and standards governing these activities
- implementing standardized waste characterization across CNL operated sites to ensure that waste meets the waste acceptance criteria for current and planned storage or disposal facilities
- managing the requirements for waste inventory data and forecasting reporting
- maintaining cross-functional knowledge spanning the various specialty areas associated with CNL's Waste Management Program (including radiological, mixed, hazardous, and clean waste; waste storage and/or disposal options and facilities; waste minimization and reduction practices; international practices with regards to the long-term management of waste)

The Waste Management Program ensures that all waste generated or received at CNL-operated sites not only meet waste management requirements but are managed in a safe and environmentally responsible manner in accordance with CNL's *Safety and Health Policy* and CNL's *Environment Policy*.

The Waste Management Program mandate applies to the full life cycle of waste from the point of generation to its final disposition. This includes all operations and activities that results from the planning, generation, transportation, processing, storage, and/or disposal of waste generated by CNL-managed sites or received by CNL-managed sites from external organizations. The Waste Hierarchy (Figure 33) is applied throughout the waste management process. Effective use of diversion (i.e., recycle and reuse routes) currently supplied by off-site service providers, requires options analysis, inventory recording, and characterization. The

Waste Management Program adheres to *CNL's Environment Policy*, which states that waste should be dealt with at the highest practicable level in the hierarchy.

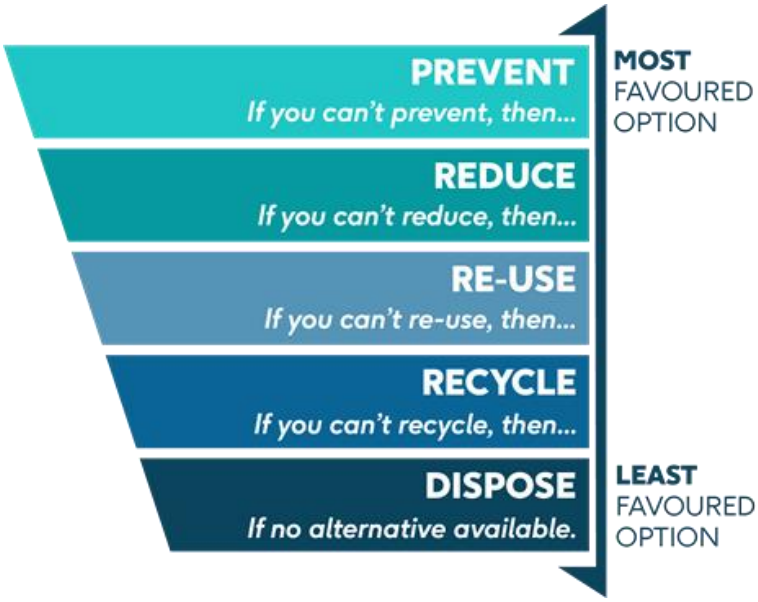


Figure 33: Waste Hierarchy

The Waste Management Program Requirements Document specifies the requirements for the Waste Management Program activities performed by CNL to meet the applicable licence conditions throughout the life cycle of a site or Facility, and includes requirements and guidance defined in REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada* [3], REGDOC-2.11.1 *Waste Management, Volume I: Management of Radioactive Waste* [20], CSA N292.0 *General Principles for the management of radioactive waste and irradiated fuel* [49], CSA N292.1, *Wet storage of irradiated fuel and other radioactive materials* [91], CSA N292.2, *Interim dry storage of irradiated fuel* , CSA N292.3, *Management of low- and intermediate-level radioactive waste* [92] CSA N292.5-11, *Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substances* [93], and CSA N292.6 *Long-term management of radioactive waste and irradiated fuel* [94].

In 2021, CNSC published or revised four new waste management regulatory documents that provides information on the governance and regulatory framework for radioactive waste management in Canada. In addition, waste management Canadian Standard Association standards that complement the regulatory documents and are relevant to CNL regulated facilities and activities have been revised and updated. CNL has committed to implementing the applicable radioactive waste management regulatory documents and Canadian Standard Association standards, into the Waste Management Program including:

- REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada* [3]
- REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Was*te [20]
- REGDOC-2.11.1, *Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste* [10]
- CSA N292.0-19, *General Principles for the management of radioactive waste and irradiated fuel* [49]
- CSA N292.1, *Wet storage of irradiated fuel and other radioactive materials* [91]
- CSA N292.2-18, *Interim dry storage of irradiated fuel* [95]
- CSA N292.3-14, *Management of low- and intermediate-level radioactive waste* [92]
- CSA N292.6, *Long-term management of radioactive waste and irradiated fuel* [94]
- CSA N294-09, *Decommissioning of facilities containing nuclear substances* [96]
- CSA N292.5-11, *Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substances* [97]

Relevance

The NSDF Project is a proposed waste disposal facility using an engineered containment mound design built at ground surface that will hold up to 1 million m^3 of low-level radioactive waste and therefore there are significant relevant aspects to the Waste Management Safety and Control Area. The NSDF Waste Acceptance Criteria [51], Post-closure Safety Assessment and the NSDF Safety Case [12] are a couple of the key submissions to the CNSC as part of the licensing process.

The wastes generated during each phase of the NSDF lifecycle will be managed in accordance with the NSDF Waste Management Plan which has been prepared to meet the requirements of the Waste Management Program.

CNL will continue to operate with the waste hierarchy in mind and with a focus on prevention and reduction of waste generation, as shown in Figure 33. The NSDF is considered an asset with a finite capacity, and application of the waste hierarchy is important to ensure other waste

options are fully explored prior to utilizing NSDF capacity. Disposal is the final option after all other means of prevention, reduction, re-use, and recycling are exhausted.

Waste Acceptance Criteria

The NSDF Waste Acceptance Criteria [51] ensures CNL meets its responsibility as the licensee; that all waste received for disposal is in compliance with the design and licensing basis. The limits specified in the Waste Acceptance Criteria [51] are reflective of the proposed disposal system (i.e., waste inventory, facility design and the surrounding environment). As a near surface design, waste acceptance criteria have been established for the radioactive waste facility to limit the consequences of human intrusion if control over the site is lost in the post-closure phase. Furthermore, low-level radioactive wastes destined for the NSDF will follow the rigorous waste management process, which will provide the necessary information to certify that wastes comply with the Waste Acceptance Criteria [51] and are verified prior to acceptance into the NSDF. Low-level radioactive wastes currently being produced that are anticipated for disposal in NSDF are being sorted, stored, and characterized to certify compliance with the Waste Acceptance Criteria [51]. All legacy waste already generated must also undergo waste characterization and segregation according to modern standards and practices.

Post-closure Safety Assessment

In accordance with REGDOC-2.11.1 *Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste* [10], the Post-closure Safety Assessment is the supporting safety assessment pertaining to the disposal of low-level radioactive waste in NSDF. The Post-closure Safety Assessment analyzes the long-term implications and demonstrates that the dose to any future generation that may interact with the disposal facility is within the established dose acceptance criteria, consistent with applicable IAEA and CNSC guidance and requirements.

Utilizing a systematic safety assessment approach, consistent with the IAEA's *Improvement of Safety Assessment Methodologies* [43], the Post-closure Safety Assessment develops models that describe the Facility's evolution through time during the post-closure phase. The features, events, and processes are a list of all reasonable and feasible items that could affect the long-term performance and safety of the disposal facility. The Post-closure Safety Assessment assesses alternative evolutions of the disposal facility and its surroundings that are developed based on the features, events and processes that could affect the disposal facility and its evolution.

The Normal Evolution Scenario is based on a reasonable extrapolation of site and facility features, events, and processes. Sensitivity cases are used to directly examine the effect of important uncertainties in the models and data used to represent the system. Sensitivity cases focus on using alternative parameter value choices. Disruptive Event scenarios can be considered similar to "accidents." They encompass disruptions of the site, system, or surroundings, and also encompass inadvertent human intrusion scenarios. Defence-in-Depth cases are aimed at building confidence in the performance of the Engineered Containment Mound after closure. These cases examine the extent to which the Engineered Containment

Mound depends on key engineered barriers, and what would happen if those barriers were not present. “What If?” cases represent a deliberately extreme set of assumptions that can be used to understand the absolute limits to safety performance. These scenarios are identified in a similar manner to the Disruptive Events but are separated from them due to their low probability of occurrence.

The Post-Closure Safety Assessment also calculates and assesses potential impacts from non-radioactive elements or chemical species in environmental media that are relevant to human health and environmental protection. There were slight exceedances for lead and uranium in select environmental media attributed to conservatisms in the model.

Safety Case

In accordance with REGDOC-2.11.1 *Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste* [10], the NSDF Safety Case [12] takes the safety arguments presented in a number of technical supporting documents and integrates them into a single body of evidence, demonstrating the operational (near-term) and long-term safety of the NSDF Project. The overall safety objective for the NSDF has been satisfied and the design, controls, and processes are adequate for the radiological protection of workers, the public, and the environment. The NSDF Safety Case [12] covering the pre-closure period and the post-closure period of the NSDF demonstrates the following:

- The NSDF Project meets the requirements of *IAEA SSR-5 Disposal of Radioactive Waste* [39] as well as all of the applicable Canadian regulations.
- The associated risks and hazards have been assessed, appropriate limits and conditions have been defined, and adequate safety measures have been identified and established.
- The conclusions of the safety assessments meet the safety objective, safety strategy, and acceptance criteria.
- The safety arguments and evidence demonstrate the operational (near-term) and long-term safety of the NSDF.
- The management of uncertainties is appropriate to ensure safety.
- The NSDF limits, controls, and conditions are appropriate to ensure safety.
- The NSDF design incorporates safety features and multiple safety functions, to ensure the protection of persons, society, and the environment.
- The NSDF design has been optimized based on design iterations.
- The construction, operation, closure, and post-closure activities of the NSDF can be undertaken safely.
- The CNL Management System meets the requirements of CNSC REGDOC 2.1.1, *Management System* [98].

Waste containment and isolation is achieved through the facility's design and is based on passive safety features and multiple barriers providing defence-in-depth and controlling the facility's operational releases to the environment. Principles of good engineering practice have been applied in the NSDF design and selection of construction materials. The construction techniques and materials foreseen for the disposal facility are well understood, and the knowledge gained from similar applications confirms that these materials are well suited for the intended use. The NSDF relies on both active and passive systems for safety during the pre-closure period and relies only on passive systems for long-term safety.

The NSDF will provide and perform the following safety functions during the long term:

- isolation of radiological and non-radiological materials
- retardation of migration of radiological and non-radiological materials
- containment of radiological and non-radiological materials

The following are key safety arguments developed in the NSDF Safety Case [12] in support of the NSDF design:

- The radiological inventory disposed of in the NSDF is only low-level radioactive waste.
- The NSDF is designed for the radiological inventory and the physical characteristics of the site.
- The proposed site is appropriate for the NSDF.
- The NSDF supports environmental sustainability, reduces environmental risk and liability, and is protective of the Ottawa River.
- The inputs and models used in the Post-closure Safety Assessment are conservative and overestimate the risk to the public, Indigenous Peoples, and the environment.
- The NSDF will isolate the waste for hundreds of years into the future and measures are in place to reduce the probability and limit any consequences of human intrusion to within the dose acceptance criteria of 1 mSv/yr.
- Natural and anthropogenic analogues demonstrate that primitive methods of constructing earthen mounds have been used to build structures that have stood for thousands of years.

6.11.2 Cleanup Function

The Cleanup Function (formerly the Decommissioning and Demolition Function) provides consistent processes and procedures to enable all CNL sites and projects to establish and meet the right next land uses and end states, in order to address the decommissioning of buildings and environmental remediation of lands impacted by past, present, and future CNL operations. The Function is comprised of three programs: Land Use, Decommissioning and Demolition, and Environmental Remediation.

The Cleanup Function requirements document specifies the requirements for the Land Use, Decommissioning and Demolition, and Environmental Remediation Program activities performed by CNL to meet the applicable licence conditions throughout the life cycle of a site or facility, including requirements defined in the following:

- CNSC Regulatory Guide G-219, *Decommissioning Planning for Licensed Activities* [99]
- CSA N294-09, *Decommissioning of Facilities containing nuclear substances* [96]
- CSA N286-12, *Management system requirements for nuclear facilitie*s [8]
- CSA N286.6, *Decommissioning Quality Assurance for Nuclear Power Plants* [100]

In 2021, CNSC published a new Decommissioning regulatory documents that provides information on the governance and regulatory framework for decommissioning in Canada. In addition, the decommissioning Canadian Standard Association standard that complements the regulatory documents and is relevant to CNL regulated facilities and activities has been updated. CNL has committed to implementing applicable Decommissioning regulatory documents and Canadian Standard Association standards into the Cleanup Function including the following:

- REGDOC-2.11.2, *Decommissioning* [21]
- CSA 294-19, *Decommissioning of Facilities Containing Nuclear Substances* [96]

In accordance with license requirements, CNL prepares an Overview Decommissioning Plan for each of the CNL Licensed Sites, to describe the strategic approach to decommissioning and environmental remediation and assure that the proposed approach is technically and financially feasible, and appropriate in the interest of health, safety, security, and protection of the environment.

Relevance

As per CSA N294-09, *Decommissioning of Facilities containing nuclear substances* [96], the decommissioning process starts at the design stage of a facility and applies throughout the life cycle of the Facility until the Facility is permanently retired from service and prepared for reuse or rendered to a predetermined end-state condition. The decommissioning strategy for the NSDF Project is documented in the Preliminary Decommissioning Plan, which addresses the decommissioning activities during the 30-year closure period. While other areas of the CRL site may be re-used, the NSDF site will continue to be restricted as a waste disposal facility. Thus in addition to the Preliminary Decommissioning Plan, a Post-closure Care Plan has been prepared for the Facility. The NSDF Preliminary Decommissioning Plan and Post-closure Care Plan have been submitted to CNSC staff as part of the licencing process; however, it will be reviewed and updated through the life cycle of the Facility.

Additionally CNL has completed a gap analysis on the recently published regulatory guidance and standards for decommissioning, which are not currently listed in CRL's Licence Condition Handbook [18]. One gap was identified related to decommissioning requirements in

REGDOC-2.11.2, D*ecommissioning* [21]. Although the NSDF Project does have a Preliminary Decommissioning Plan, it requires revision to meet the requirements. CNL has identified this as an action and is being tracked as a regulatory commitment to the CNSC.

6.12 Physical and Cyber Security

The Security Program implements CNL's *Security Policy* within CNL operating sites in Canada to ensure compliance with all applicable legal and corporate requirements. The Security Program is responsible for ensuring the protection of CNL employees, facilities and nuclear materials in accordance with the CNL *Security Policy*.

The Security Program Requirements Document specifies the program requirements in the relevant legislations and regulations, such as the *General Nuclear Safety and Control Regulations,* as well as the requirements defined in the various relevant regulatory guidance such as REGDOC-2.12.2, *Site Access Security Clearance* [101]. The Security Program also implements and ensures that CNL sites comply with these requirements.

The Cyber Security Program implements the requirements outlined in the Cyber Security Program Requirements Document, including CSA N290.7, *Cyber-Security for Nuclear Power Plants and Small Reactor Facilities* [102] and ensures compliance with these regulatory requirements at CNL.

Relevance

The Security Program applies to the operation and activities that affect the security in and around CNL sites. The Security Program also applies to all employees and other personnel (e.g., visitors and contract staff) conducting work at CNL sites. Access to the NSDF site is controlled via gates and fencing, administered in accordance with CNL's Security Program. The security measures or institutional controls proposed for NSDF are appropriate for the type of nuclear substance (i.e., low-level radioactive waste) and will provide additional assurance of the safety and nuclear security of the facility. This includes integrated measures to prevent:

- unauthorized access by individuals
- unauthorized removal of radioactive material
- acts of sabotage or attempted sabotage

The Cyber Security Program addresses requirements arising from licences and contractual obligations, as well as business needs to provide a secure infrastructure for its business functions. The Cyber Security Program includes all information technology related activities, their governance, management, and execution, and applies to everyone using CNL information technology assets. Specific to the NSDF, this includes appropriate security provisions for the supervisory control and data acquisition system, which provides monitoring and supervisory control of the Wastewater Treatment Plant.

The Security Program and the Cyber Security Program requirements apply throughout the NSDF life cycle.

6.13 Safeguards and Non-Proliferation

The Nuclear Materials and Safeguards Management Program provides Nuclear Materials and Safeguards Management compliance and services to CNL. The Nuclear Materials and Safeguards Management Program's primary focus is on facilities that contain Fissionable Materials, therefore, are subject to regulatory safeguards measures and reporting requirements.

The Nuclear Materials and Safeguards Management Program applies to all nuclear material and safeguards management activities performed at CNL facilities. The Nuclear Materials and Safeguards Management Program requirements apply to all CNL Sites, CNL employees, and non-CNL Personnel that work at these sites. The Nuclear Materials and Safeguards Management Program requirements applies to all activities involving the procurement and receipt of radioisotopes and radiation sources, as well as the procurement, receipt, disposition, transfer, accounting, safeguards management, storage, and inventory management of nuclear material.

The Nuclear Materials and Safeguards Management Program implements the requirements in REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy* [103] and ensures compliance with these regulatory requirements at CNL.

Relevance

Nuclear material that requires accounting or inventory management and reporting through CNL's Nuclear Materials and Safeguards Management Program, shall not be accepted for disposal in NSDF. Recoverable quantities of nuclear materials will not be accepted for disposal in NSDF.

6.14 Packaging and Transportation

The CNL Transportation of Dangerous Goods Program applies to all activities involving the transportation of dangerous goods performed by CNL, across all managed sites. Transport encompasses all operations associated with the movement of dangerous goods, including classification, documentation, packaging, safety marks, security, emergency response, training, and regulatory permits and licences.

The main objective of the Transportation of Dangerous Goods Program is to protect persons, property, and the environment from the effects of radioactive and hazardous material during transport by establishing and maintaining requirements and processes necessary to facilitate the safe transport of dangerous goods to and from CNL sites in accordance with regulatory requirements.

The Transportation of Dangerous Goods program implements and ensures compliance with the requirements in the following:

- *Transportation of Dangerous Goods Regulations* [104]
- *Packaging and Transport of Nuclear Substances Regulations* [105]
- IAEA SSR-6, *Regulations for the Safe Transport of the Radioactive Material* [106]
- *Nuclear Security Regulations*, SOR/2000-209 [107]

Relevance

Approximately 90% of the low-level radioactive waste planned to be placed in the NSDF is currently located on the CRL site and will not be transported on public roads. Transportation of waste from off-site waste generators is not within the scope of the environmental assessment for the NSDF Project. At present, waste transported to CRL from off-site generators is incorporated into the existing Integrated Waste Strategy [6] and is part of routine operations at the CRL site; transportation of waste from off-site locations is not specific to the NSDF Project.

However, AECL, and now CNL, has been transporting wastes safely and without incident for over 50 years. Transportation has been demonstrated to be safe and this activity will be carried out in order to consolidate AECL and CNL's radioactive wastes at the CRL site. The Transportation of Dangerous Goods Program will continue to be implemented for transporting waste into the proposed NSDF Project's operations. CNL does engage with the public on a regular basis to explain status of work underway to consolidate wastes at the CRL site and how this work reduces Canada's nuclear liability and long-term risk.

The aspects of the Transportation of Dangerous Goods Program envisaged to apply to the NSDF Project are those requirements associated with receiving and storing dangerous goods, during all life cycle phases. Dangerous goods may be used during construction, operations and closure of the facility.

7. Other Matters of Regulatory Interest

Other matters of regulatory interest are topics that are relevant to the decision but not covered by the Safety and Control Areas.

7.1 Cost Recovery

Chalk River Laboratories is in good standing with respect to the provision of CNSC licensing fees and will continue to provide all necessary fees as and when required.

7.2 Financial Guarantees

CNL understands the requirement for an acceptable financial guarantee. While ownership of CNL has transferred to the contractor Canadian National Energy Alliance, AECL retains ownership of the lands, assets, and liabilities associated with CNL's licences. These liabilities were officially recognized by the Minister of Natural Resources in a letter dated July 31, 2015 [108], as per the CRL Licence Condition 16.3 (Financial Guarantee) and re-affirmed in 2020 [109].

7.3 Nuclear Liability Insurance

Under the *Nuclear Liability and Compensation Act* [110], the limit of insurance required for the CRL site is $180 million. For CNL sites, there is a separate indemnity agreement with the Government of Canada to cover the difference between the established insurance limit and the $1 billion total liability limit.

The NSDF Project, being a facility within the CRL site and under the CRL Nuclear Research and Test Establishment Operating Licence [2], will not present an elevated risk and as such there is no change contemplated for the limit of insurance required for the CRL site.

8. Conclusions

This document provided information in support of CNL's application [1] to amend the current CRL Nuclear Research and Test Establishment Operating Licence [2]. CNL is fully equipped with the appropriate safety and control areas to proceed with construction of the NSDF. The NSDF will be a Class IB nuclear facility for the disposal of current and future solid radioactive low-level radioactive waste at the CRL site. The NSDF Project is designed to ensure the protection of people and the environment during every stage of the Facility life cycle.

As a prerequisite to the licence amendment decision, the Commission must also make an environmental assessment decision to determine whether the proposed activities are likely to cause significant adverse environmental effects. The significance of the likely environmental effects of the NSDF Project has been assessed in the final NSDF Environmental Impact Statement [31], in accordance with the requirements of the *Canadian Environmental Assessment Act, 2012*. Residual adverse effects were identified for air quality (including greenhouse gases), hydrogeology, hydrology, surface water quality, terrestrial biodiversity, ecological health, human health, and socio-economics (housing and accommodations, and services and infrastructure). Beneficial effects were identified for socio-economics (e.g., labour market, economic development). Overall, it is CNL's conclusion that with the identified mitigation, the implementation of the NSDF Project is not likely to result in significant residual adverse effects.

Engagement is a key component of the environmental assessment process. CNL operates an ongoing Public Information Program to inform groups about activities at CNL-managed sites and the potential effects of these activities on the public, Indigenous Peoples, and the environment. This Public Information Program forms the basis of communication efforts with the public and Indigenous Peoples and helps to direct the establishment of long-term, mutually beneficial working relationships with communities in proximity to CNL sites. These engagement activities have helped inform the public and Indigenous Peoples and have enabled the public to provide valuable feedback to the NSDF Project, which helps CNL understand areas of public concern and improve the NSDF Project design and environmental assessment. CNL has proactively addressed key issues raised by interested Indigenous Peoples using open and transparent communication to share information regarding traditional land use, biodiversity, and archaeology.

The development of a near surface disposal facility for solid, low-level radioactive waste at the CRL site will reduce potential risks associated with AECL’s legacy wastes liabilities and support CNL’s transition to applying modern waste management standards. The NSDF Project will enable the remediation of historically contaminated lands and legacy waste management areas as well as the decommissioning of outdated infrastructure to facilitate the CRL site revitalization.

All predicted effects for human health are well below regulatory criteria during the life of the NSDF Project, including post-closure. The maximum estimated dose during the operations period for an on-site worker is 5 times lower than the regulatory limit of 50 mSv/yr and for the

public is almost 50 times lower than the regulatory dose limit of 1 mSv/yr. During post-closure, the maximum estimated dose associated with the most likely future state of the facility is more than 60 times lower than the regulatory dose limit of 1 mSv/yr. Residual effects on Ottawa River water quality are determined to be negligible during operations and post-closure phases and may result in a net benefit due to remediation of legacy waste storage areas.

CNL will expand its already extensive environmental monitoring of the CRL site (i.e., the sampling of air, water, and groundwater) to include the NSDF. An Environmental Assessment Follow-Up Monitoring Program [57] was developed to verify that mitigation is being implemented effectively and to confirm environmental assessment predictions. The details of this program will be further developed into the detailed monitoring and follow-up programs as the environmental assessment decision is made, with input from the public, Indigenous Peoples, and regulatory agencies.

The NSDF Safety Case [12] presents the integrated collection of safety arguments and evidence to demonstrate the safety of the NSDF. The NSDF design, controls, and processes are adequate for the radiological protection of workers, the public and Indigenous Peoples, and the environment. CNL has met both Canadian and IAEA requirements and guidance for radioactive waste disposal. This includes the CNSC REGDOC 2.11.1, Volume I and Volume III (*Management of Radioactive Waste* ; *Assessing the Long-Term Safety of Radioactive Waste Management* [10], respectively) and IAEA SSG-23, *Safety Case and Safety Assessment for the Disposal of Radioactive Waste* [40], SSG-29, *Near Surface Disposal Facilities for Radioactive Waste* [41], and SSR-5 *Safety Standards for Disposal of Radioactive Waste* [39].

Potential effects of the NSDF Project on the environment are limited because the inventory is only low-level radioactive waste and the NSDF Project has been designed in consideration of site-specific characteristics and to be suitable for the proposed inventory, the vast majority of which are comprised of impacted soils and demolition debris. The Engineered Containment Mound is designed to contain and isolate the wastes from the environment for 550 years. Since the NSDF only accepts low-level radioactive waste and most of the radioactivity decays in the first 100 years after closure, the design of the NSDF is commensurate with the hazard. The safety of the NSDF during post-closure is provided by means of passive features (e.g., berm, base liner, and cover systems) that will end the need for active management, in alignment with CNSC requirements and IAEA guidance.

CNL has robust management systems and programs in place to not only execute the construction of the NSDF but also the future operation of the facility. CNL will be building on the experience gained from the construction, operation, and closure of the Port Granby Long-Term Waste Management Facility, construction and ongoing operation of the Port Hope Long-Term Waste Management Facility, and experiences other similar facilities around the world.

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Appendix A Organizational Charts

This appendix includes the various organizational charts referred to in the body of the document.

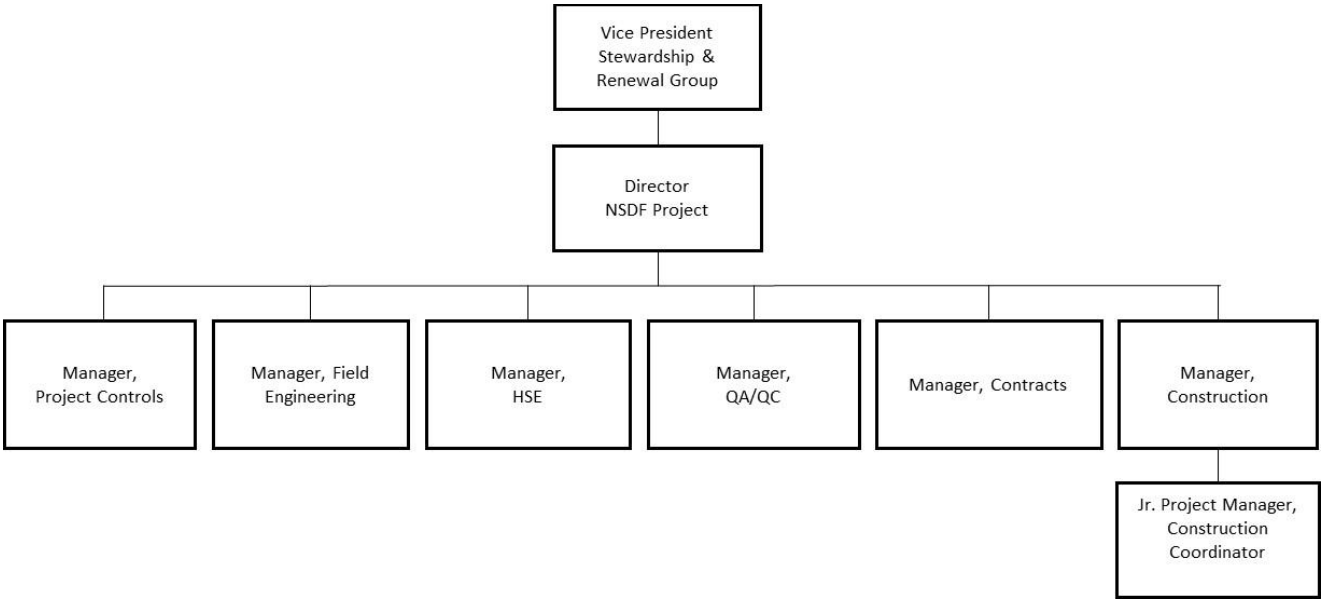

Figure 34: NSDF Construction Organizational Structure

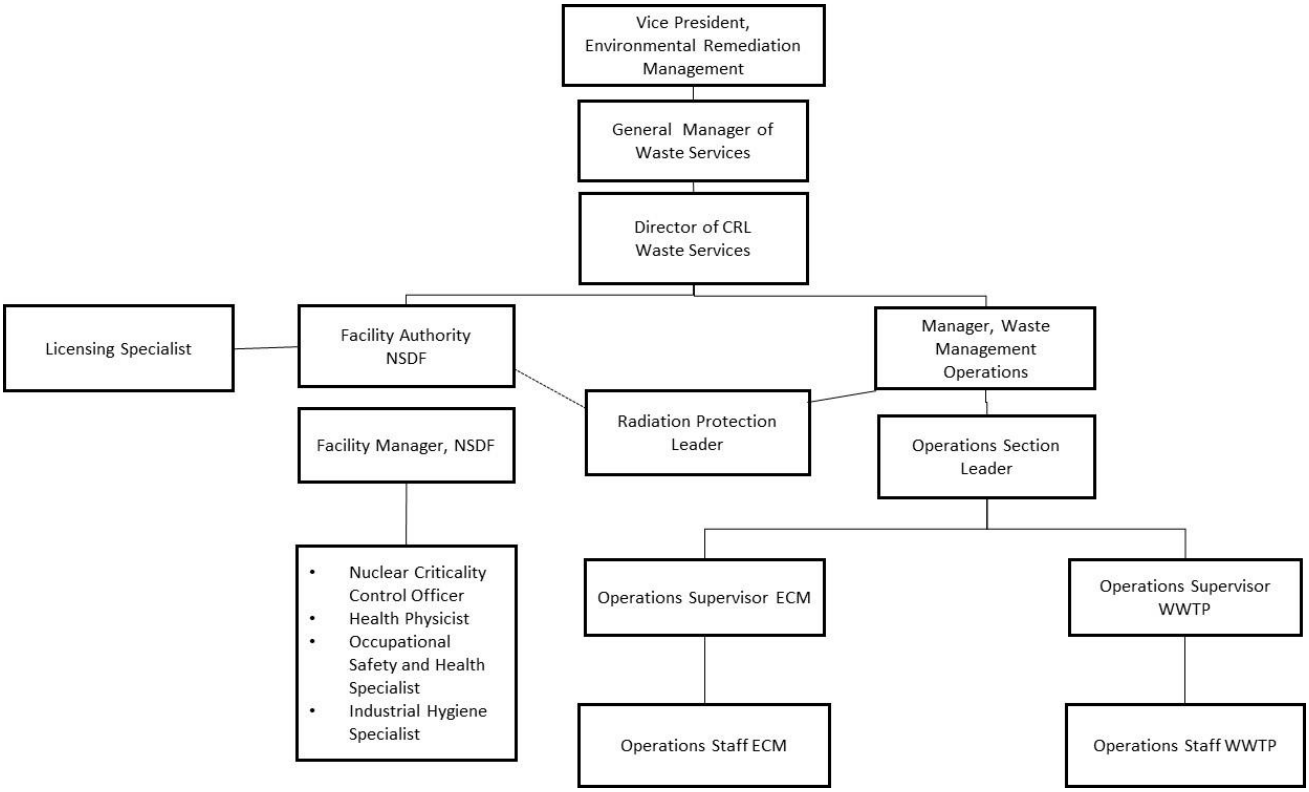

Figure 35: NSDF Operational Organization Structure

Appendix B Acronyms, Initialisms, and Definitions

Acronyms and Initialisms

There is a deliberate attempt to use as few acronyms and initialisms as possible in this document in an effort to enhance readability for all interested parties and stakeholders. The acronyms and initialisms frequently used in this document are limited to a select few commonly used terms, corporations, organizations, and Indigenous communities:

AECL	Atomic Energy Canada Limited
AAN	Algonquin Anishinabeg Nation
AANTC	Algonquin Anishinabeg Nation Tribal Council
AOO	Algonquins of Ontario
AOPFN	Algonquins of Pikwakanagan First Nation
ALARA	As Low As Reasonably Achievable
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CRL	Chalk River Laboratories
IAEA	International Atomic Energy Agency
MNO	Métis Nation of Ontario
MOU	Memorandum of Understanding
NSDF	Near Surface Disposal Facility
WTFN	Williams Treaties First Nations

Definitions

The following definitions used throughout this document are from the Glossary of CNSC Terminology , [82], the IAEA Safety Glossary [111], and final Environmental Impact Statement [31].

accident	Any unintended event, including operator errors, equipment failures or other mishaps, the consequences or potential consequences of which are significant from the point of view of protection or safety.
accident conditions	Deviations from normal operation more severe than an anticipated operational occurrence. Accident conditions include Design Basis Accidents and Beyond Design Basis Accidents.
administrative controls	Provisions relating to organization and management procedures, record keeping, assessment, and reporting necessary to ensure the safe operation of a Facility.

anticipated operational occurrence	An operational process deviating from normal operation, which is expected to occur once or several times during the operating lifetime of the Nuclear Facility but which, in view of the appropriate design provisions, does not cause any significant damage to items important to safety, nor lead to accident conditions. These include events with frequencies of occurrence greater than or equal to 10^{-2} events per year.
As Low as Reasonably Achievable (ALARA)	A principle of radiation protection that holds that exposures to radiation are kept As Low As Reasonably Achievable, social and economic factors taken into account.
barrier	A physical obstruction that prevents or inhibits the movement of people, radionuclides or some other phenomenon (e.g., fire), or provides shielding against radiation.
beyond design basis accident	Accidents falling outside the design envelope of a nuclear facility's safety systems (accident conditions more severe than those of a Design Basis Accident). These include events with frequencies of occurrence less than 10^{-5} per year.
contact water	Water that has come in contact with low-level radioactive waste within the Engineered Containment Mound open disposal cell.
containment	A method or physical structure designed to prevent or control the release of nuclear or hazardous substances. Some examples are: • For waste management: a barrier system that controls releases to the environment through different chemical and physical applications. For packaging and transport of nuclear substances: a package or a sealed source containing nuclear substances.
contamination	Radioactive substances on surfaces, or within solids, liquids or gases (including the human body), where their presence is unintended or undesirable, or the process giving rise to their presence in such places.
decontamination	The complete or partial removal of contamination by a deliberate physical, chemical or biological process.
defence-in-depth	A hierarchical deployment of different levels of diverse equipment and procedures to prevent the escalation of Anticipated Operational Occurrences and to maintain the effectiveness of physical barriers placed between a radiation source or radioactive material and workers, members of the public or the environment, in operational states and, for some barriers, in accident conditions.

design basis	The range of conditions and events taken explicitly into account in the design of a Nuclear Facility, according to established criteria, such that the facility can withstand this range without exceeding authorized limits. Note**:** Design extension conditions are not part of the design basis.
design life	The period of time during which a Facility or component is expected to perform according to the technical specifications to which it was produced.
environment	The component of the earth including: a) Land, water, and air, including all layers of the atmosphere. b) All organic and inorganic matter and living organisms. The interactive natural system that includes components referred to in (a) and (b).
event	Any unintended occurrence, including operating error, equipment failure or other mishap, or deliberate actions on part of others, the consequences or potential consequences of which are not negligible from the point of view of protection or safety.
graded approach	A method or process by which elements such as the level of analysis, the depth of documentation and the scope of actions necessary to comply with requirements are commensurate with. The relative risks to health, safety, security, the environment and the implementation of international obligations to which Canada has agreed. The particular characteristics of nuclear facility or licensed activity.
hazardous substance	A substance, other than a nuclear substance, that is used or produced in the course of carrying on a licensed activity and that may pose a risk to the environment or the health and safety of persons.
interim cover	The interim cover consists of 0.3 m layer of clean soil or clean sand that is overlain by a sacrificial liner to promote non-contact surface water run-off, and minimize precipitation infiltration into the waste material. The interim cover is applied to 1) waste disposal areas that will remain inactive for more than 30 days; and 2) waste disposal areas that have reached the design waste fill grade.

isolation (of radioactive waste in a disposal facility)	The physical separation and retention of radioactive waste away from people and from the environment: Isolation of radioactive waste with its associated hazards in a disposal facility involves the minimization of the influence of factors that could reduce the integrity of the disposal facility; provision for a very low mobility of most long lived radionuclides to impede their migration from the disposal facility; and making assess to the waste by people difficult without special technical capabilities.
leachate	Water that has percolated through the waste within the disposal facility and leached out some of the constituents.
Low-level radioactive waste	Radioactive solid waste that contains material with radionuclide content above established clearance levels and exemption quantities, but that generally has limited amounts of long-lived activity.
multiple barriers	Two or more natural or engineered barriers used to isolate radioactive waste in, and to prevent or to inhibit migration of radionuclides from a repository.
multiple safety functions	In the context of the fulfilment of multiple safety functions by a disposal system, the containment and isolation of waste (the confinement function), is fulfilled by two or more natural or engineered barriers of the disposal facility, by means of diverse physical and chemical properties or processes, together with operational controls.
near surface disposal	Disposal, under an engineered cover, with or without engineered barriers, in a near surface disposal facility. Near surface disposal refers to a range of disposal methods, including the emplacement of solid radioactive waste in earthen trenches, above ground engineered structures, engineered structures just below the ground surface and rock caverns, silos and tunnels excavated at depths of up to a few tens of metres below ground level.
non-contact water	Water that has not come in contact with low-level radioactive waste within the Engineered Containment Mound open disposal cell.

Normal Evolution Scenario	The Normal Evolution Scenario is a reference description of the expected evolution of the Engineered Containment Mound, its surroundings, and its resulting releases, consistent with the guidance provided in CNSC REGDOC 2.11.1 *Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste, Version 2* [10], which states that: *A normal evolution scenario should be based on reasonable extrapolation of present day site features and receptor lifestyles. It should include expected evolution of the site and degradation of the waste disposal system (gradual or total loss of barrier function) as it ages. Evolution scenarios are not expected to include biological evolution of individual receptor species, which can be assumed to be static for the purposes of the safety assessment.*
nuclear substance	Means: a) deuterium, thorium, uranium or an element with an atomic number greater than 92; b) a derivative or compound of deuterium, thorium, uranium or of an element with an atomic number greater than 92; c) a radioactive nuclide; d) a substance that is prescribed as being capable of releasing nuclear energy or as being required for the production or use of nuclear energy; e) a radioactive by-product of the development, production or use of nuclear energy; and a radioactive substance or radioactive thing that was used for the development or production, or in connection with the use, of nuclear energy.
packaged waste	Waste contained in rigid containers or packages for disposal.
passive safety	A design feature that functions without depending on an external input such as actuation, mechanical movement or supply of power.
receptor	Any person or environmental entity that is exposed to radiation, or a hazardous substance, or both. A receptor is usually an organism or a population, but it could also be an abiotic entity, such as surface water or sediment.
repository	An engineered facility where waste is emplaced for disposal. Near surface repository: A facility for radioactive waste disposal located at, or within, a few tens of metres of the Earth's surface.

Safety Case	An integrated collection of arguments and evidence to demonstrate the safety of a facility and the meeting of all applicable regulatory requirements. A safety case will normally include a safety assessment but could also typically include information (such as supporting evidence and reasoning) on the robustness and reliability of the safety assessment and the assumptions made therein.
structures, systems or components	A general term encompassing all of the elements of a Facility or activity that contribute to protection and safety. Structures are the passive elements: buildings, vessels, shielding, etc. A system comprises several components, assembled in such a way as to perform a specific (active) function. A component is a discrete element of a system. Some examples are wires, transistors, integrated circuits, motors, relays, solenoids, pipes, fittings, pumps, tanks, and valves.
valued components	Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Indigenous Peoples, the scientific community, or the public. Examples of valued components identified include air quality, groundwater quality, migratory birds, and human health.
Wastewater	The product of the three waste streams; leachate, contact water and operational wastewater.

Appendix C Key NSDF Technical Documents Submitted to CNSC Staff for Review

The following table demonstrates numerous technical documents were submitted to CNSC staff for review as part of the environmental assessment and licencing process for NSDF.

2016
Project Description, Near Surface Disposal Facility at Chalk River laboratories
Submission of Environmental Impact Statement for Groups 1, 2 and 3 for the NSDF Project
Aboriginal Engagement Report
2017
ALARA Assessment
Assessment of NSDF Project Documentation with Respect to IAEA SSR-5
Bearing Capacity and Settlement Analysis
Commissioning Plan
Consequence of Failure Analysis
Construction Quality Assurance Plan
Construction Schedule
Criticality Safety Document
Derivation of Specific Activity Limits for NSDF Waste Streams & NSDF Acceptable Waste Packaging
Design Requirements
Draft Safety Analysis Report
Environmental Protection Plan
Environmental Impact Statement
Features, Events, & Processes
Fire Hazard Analysis
Groundwater Flow Modelling of the NSDF 60% Design
Hazard Identification
Leachate Management Plan
Long-Term Seismic Hazard Assessment & NSDF Seismic and Structural Design Documentation
Monitoring and Reporting Plan
Multidisciplinary Subsurface Investigation, Phase 2, For the Detailed Design of the Near Surface Disposal Facility Project at CRL
NSDF Seismic Analysis
Operations and Maintenance Plan
Performance Assessment
Pilot Scale Test Report
Post-Closure Care Plan
Preliminary Decommissioning Plan
Radiation Protection Plan
Revised Groundwater Flow Report
Revised Waste Acceptance Criteria
Safety Related Systems List
Seismic Analysis & Structural Calculations
Site Selection Report
Slope Stability Analysis

Third Party Code Review & Fire Hazard Analysis
Waste Acceptance Criteria
Waste Forecast Analysis
Waste Management Plan
WWTP Process Design Report
2018
Design Codes on the systems involved in R3[1] events
Geological Survey of Canada Seismic Source Model for CNL and Probabilistic Seismic Hazard Analysis
Long-Term Seismic Hazard Assessment
Near Surface Disposal Facility Mixed Waste constituents of Potential Concern Inventory
NSDF Reference Inventory Report
Preliminary Decommissioning Plan
Revised Seismic-related Documents for the Near Surface Disposal Facility Project
Safety Classification and Design Rules for NSDF Structures, Systems and Components
Seismic Criteria and Assessment
WWTP Treated Effluent Discharge Options
2019
Air Quality Assessment for the Near Surface Disposal Facility
ALARA Assessment
Base Liner and Final Cover Evaluation and Optimization
Bearing Capacity, Settlement, and Lateral Earth Pressure Analysis
Characterization of Water and Sediments from and around Perch Lake
Climate Change Assessment for the Near Surface Disposal Facility Project
Components for Safety Classified Systems
Construction Quality Assurance Plan
Criticality Safety Document
Design Description
Design Requirements
Ecological Risk Assessment
Effluent Discharge Targets
Environmental Assessment Stakeholder Activities Report – NSDF and NPD Closure Projects
Environmental Impact Statement
Groundwater Flow Modelling of the Near Surface Disposal Facility
Hazard Identification and Analysis
Indigenous Engagement Report
Leachate and Wastewater Characterization
Multidisciplinary Subsurface Investigation Phase 1 / Subsurface Geotechnical Survey
Commissioning Plan
Site Selection Report
Effluent Discharge Targets
Facility Authorization

[1] "R3" refers to a Risk Rating of 3, a result of an assessment of frequency and consequence.

Operations and Maintenance Plan
Post-Closure Safety Assessment 3rd Iteration to the NSDF Project
Radiation Protection Plan
Reference Inventory
Revised Fire Hazards Analysis
Revised Mixed Waste Constituents of Potential Concern Inventory Technical Note
Safety Analysis Report
Seismic Analysis
Seismic Criteria and Assessment
Slope Stability Analysis
Stage 4 Archeological Assessment
Stakeholder Engagement Report
Submission of Revised Near Surface Disposal Facility Design Description
Surface Water Quality Assessment for the Near Surface Disposal Facility
Waste Acceptance Criteria
Waste Placement and Compaction Plan
2020
ALARA (As Low As Reasonably Achievable) Assessment
ALARA Memorandum
Conventional Health and Safety Plan
Criticality Safety Document
Environmental Impact Statement
Facility Authorization
Federal-Provincial Review Team Responses (Round 2, 3 and 4)
Hazard Identification Report
Independent Third Party Review Report
Post-Closure Safety Assessment 3rd Iteration to the NSDF Project
Postulated Criticality Safety Accident
Reference Inventory
Responses to Public and Indigenous Groups' Comments on the NSDF Environmental Impact Statement
Safety Analysis Report
Safety Case
Waste Acceptance Criteria
Weather Shelter Concept
2021
Application for Licence Amendment to add the NSDF to the Chalk River Laboratories Licensing Basis
Draft Environmental Assessment Follow-Up Monitoring Program
Final NSDF Environmental Impact Statement
Consolidated Commitments List for the NSDF
NSDF Geological Verification Monitoring Plan
NSDF Monitoring and Surveillance Plan
NSDF Stakeholder Engagement Report
Safety Case

Update on Corrective Action Plan for Independent Third Party Review Report
Weather Shelter Concept Design Requirements