May 9, 2017

From: Dr. J.R. Walker

To: Nicole Frigault
Canadian Nuclear Safety Commission

By email: cnsc.ea-ee.ccsn@canada.ca

Attn: Nicole Frigault - Comments on Draft Environmental Impact Statement: Near Surface Disposal Facility at Chalk River Laboratories (CEA Registry Number 80122)

CEAA Reference number: 80122

Dear Ms Frigault,

Thank you for the opportunity to comment on the Draft EIS for the Near Surface Disposal Facility at Chalk River Laboratories.

My comments are attached.

Thank you for the opportunity to provide comments on the Draft Environmental Impact Statement (EIS) [1] for the proposed near surface disposal facility at Chalk River Laboratories. My comments follow.

## 1.0 Introduction

The Draft EIS [1] and the associated project proposal contain numerous deficiencies. The extent and gravity of these deficiencies preclude a conclusion that the project is unlikely to cause significant adverse environmental effects, taking into consideration the implementation of mitigation measures.

For example:

a) The proposal employs inadequate technology and is problematically located;

b) The proposal does not meet regulatory requirements with respect to the health and safety of persons and the protection of the environment; and

c) The authors have failed to meet the requirements of the Canadian Environmental Assessment Act 2012.

## 2.0 Inadequate Technology; Problematic Location

### 2.1 Inadequate Technology

In *Disposal of Radioactive Waste* [2], the International Atomic Energy Agency (IAEA) notes that the specific aims of radioactive waste disposal are:

(a) To contain the waste;
(b) To isolate the waste from the accessible biosphere and to reduce substantially the likelihood of, and all possible consequences of, inadvertent human intrusion into the waste;
(c) To inhibit, reduce and delay the migration of radionuclides at any time from the waste to the accessible biosphere;
(d) To ensure that the amounts of radionuclides reaching the accessible biosphere due to any migration from the disposal facility are such that possible radiological consequences are acceptably low at all times.

Different classes of radioactive waste require different disposal concepts, depending upon the length of time that the waste remains a hazard. This is discussed at length in both Canadian and international guidance, e.g. [2 – 7].

The proposal, as stated in the Draft EIS [1], is for a near surface disposal facility (specifically, an engineered containment mound).

Near surface disposal is only appropriate for very low level waste (VLLW) and low level waste (LLW), because near surface disposal facilities are located in the biosphere, and, hence, can be accessed by members of the public at the end of the institutional control period. Intermediate level waste (ILW) and high level waste (HLW), which contain larger quantities of long lived radionuclides, must be disposed in deeper geological disposal facilities [6].

Consequently, the definitions of low level and intermediate level waste given in the *Classification of Radioactive Waste*, GSG-1, International Atomic Energy Agency (IAEA), 2009 [4] reflect the different technologies required for disposal of these wastes:[1]

> *Low level waste (LLW):* Waste that is above clearance levels, but with limited amounts of long lived radionuclides. Such waste requires robust isolation and containment for periods of up to a few hundred years and is suitable for disposal in engineered near surface facilities. This class covers a very broad range of waste. LLW may include short lived radionuclides at higher levels of activity concentration, and also long lived radionuclides, but only at relatively low levels of activity concentration.
>
> *Intermediate level waste (ILW):* Waste that, because of its content, particularly of long lived radionuclides, requires a greater degree of containment and isolation than that provided by near surface disposal. However, ILW needs no provision, or only limited provision, for heat dissipation during its storage and disposal. ILW may contain long lived radionuclides, in particular, alpha emitting radionuclides that will not decay to a level of activity concentration acceptable for near surface disposal during the time for which institutional controls can be relied upon. Therefore, waste in this class requires disposal at greater depths, of the order of tens of metres to a few hundred metres.

The various technological requirements for the disposal of radioactive wastes are summarized in this figure [4]:

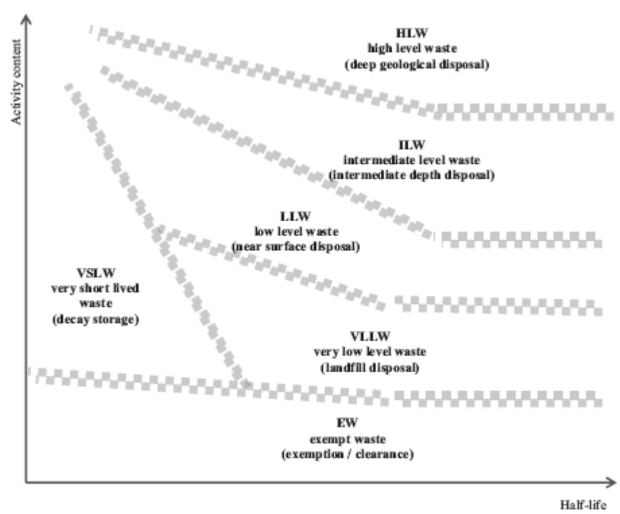


*FIG. 1. Conceptual illustration of the waste classification scheme.*

1 Similar concepts and wording are used in Canadian Standard N292.0-14, *General Principles for the Management of Radioactive Waste and Irradiated Fuel* [7].

As per the guidance noted above, Ontario Power Generation (OPG) is currently seeking to dispose of low level and intermediate level wastes in a deep geologic repository [8].

The proposal in the Draft EIS [1], however, encompasses the disposal of both low level and intermediate level wastes in an engineered containment mound (ECM), which is noncompliant with Canadian and international guidance.

The inappropriate nature of the facility can be easily demonstrated by reference to the Draft EIS [1]. Although the Draft EIS [1] contains almost no information concerning the temporal evolution of the hazard, Table 6.4.4-5 shows that doses to a farm resident from chronic exposure would, for periods exceeding 100,000 years, not only exceed the recommended dose constraint for radioactive waste disposal (0.3 mSv/year) [2, 3, 5, 6, 9] but would also exceed the regulatory limit for effective dose to a member of the public (1 mSv/year) [10]. Section 2.5.3.1.1 of the Draft EIS [1] states that the post-closure design life of the engineered containment mound is 500 years. Hence, a significant radiological hazard persists long after the engineered containment mound has failed.

The proposed near surface disposal facility (engineered containment mound) [1] is, therefore, an inappropriate technology for this waste.

### 2.1.1 Nongermane Examples

The authors claim (in Section 2.5.2.1.1 of the Draft EIS [1]) that “A near surface disposal facility is a suitable and technically feasible means of disposing of LLW and ILW and the effectiveness of such facilities for disposal of LLW and ILW has been demonstrated as illustrated through the following near surface facilities currently in operation globally:”. The authors then provide a list of nine facilities, eight of which are in the USA.

Each of the listed facilities appears to be licensed to dispose of only low level waste. The examples are nongermane and cannot support the authors’ assertions that this is a feasible means of disposing of LLW and ILW.

If the authors wish to illustrate that “a near surface disposal facility is a suitable and technically feasible means of disposing of LLW and ILW” through the use of examples, then the authors should cite examples that demonstrate where the proposed technology (engineered containment mound) has been used successfully to dispose of both low level and intermediate level wastes. The examples must show that a significant public exposure risk does not exist after the period of institutional control or after the design life of the cited facility.

## 2.2 Problematic Location

In Section 2.5.3.1.1 of the Draft EIS [1], the authors state that "An advantage of this mound-type repository design is that the waste is emplaced above the groundwater table and the waste stays dry as long as the protective barriers are intact, which may be on the order of hundreds of years (Argonne National Laboratory 2011)". [2]

In Section 3.5.2.4 of the Draft EIS [1], the authors claim that "The base liner design include both primary and secondary liner systems that are designed to have redundancy in case of premature failure and are a combination of natural and synthetic barrier systems. A compacted clay liner 0.75 m thick is placed on top, followed by a series of high-density polyethylene (HDPE), geosynthetic, and earthen layers to give a total thickness of the base liner system of 1.85 m. The composite base liner is designed to be at least 1.5 m above groundwater at all times".

Figure 5.3.2-1 in Section 5.3.2.4.2.1 of the Draft EIS [1] shows that the location of the proposed engineered containment mound is adjacent to East Swamp, South Swamp, and Perch Lake Swamp. The accompanying text states that "The depth the water table within the NSDF Project site was calculated based on groundwater elevation data collected by AMEC in January 2017. Groundwater elevations ranged from 0.22 meters below ground surface (mbgs) (at SH-4) to 12.02 mbgs (at W2-D). The average water table depth was 5.45 mbgs in January 2017. Depth to the water table is generally greatest near the top of the bedrock ridge, and decreases to the south, west, and north, towards the low-lying wetland areas."

There is no indication of the accuracy of these calculations, nor in the variability of the height of the water table. The Draft EIS [1] contains no schematics, or other information, that describe how deep the facility extends below the ground surface. However, a response to a question contained in Appendix 4.0-21 states that "The mound will vary in height from 20 to 25 metres, including the base liner and cover systems, each of which measures approximately two metres". If Figure 3-2 of the revised Project Description [12] is representative, then it would seem that the facility may extend some depth beneath the surface. This casts doubt that the design requirement, to ensure that the base liner is a minimum of 1.5 m above groundwater "at all times", can be met.

If the authors wish to claim credit for keeping the composite base liner at least 1.5 m above groundwater at all times, then they must make reasoned arguments to demonstrate that the statement is correct.

On a related matter, the authors note that soil liquefaction is an issue at the site during a seismic event (Section 9.3 of the Draft EIS [1]) and that mitigative measures are required. These mitigative measures are not described in the Draft EIS [1]. The authors need to provide a detailed description of the proposed mitigative measures and explain how these measures will protect members of the public and the environment for the period that the inventory of the engineered containment mound remains a

2 The Draft EIS [1] provides no reference to "Argonne National Laboratory 2011", but the text appears to come from Report ANL-FCT-324, *International Low Level Waste Disposal Practices and Facilities,* Argonne National Laboratory, 2011 [11]. This document [11] repeats the international guidance concerning the disposal of different classes of waste per IAEA Safety Guide GSG-1 [4]. The ANL document [11] goes on to note that "The main disadvantage for surface disposal is that the protective cover of the waste is exposed to weathering and erosion that can endanger the integrity of the repository (Bergman 2006)." See Sections 3 and 4 of these comments.

hazard. The authors must demonstrate that the proposed mitigative measures will be effective beyond the design life of the facility.

## 3.0 Noncompliance with Regulatory Requirements pursuant to the Nuclear Safety & Control Act

The Draft EIS [1] quotes from Canadian Nuclear Safety Commission (CNSC) Regulatory Policy P-290, *Managing Radioactive Waste* [13]. However, the Draft EIS reproduces only two (points “b” and “e”) of 8 points in the policy. The entire policy statement is as follows:

> POLICY STATEMENT
>
> When making regulatory decisions concerning the management of radioactive waste, it is the policy of the Canadian Nuclear Safety Commission to consider the extent to which the owners of the waste have addressed the following principles:
>
> a) The generation of radioactive waste is minimized to the extent practicable by the implementation of design measures, operating procedures and decommissioning practices;
> b) The management of radioactive waste is commensurate with its radiological, chemical and biological hazard to the health and safety of persons and the environment and to national security;
> c) The assessment of future impacts of radioactive waste on the health and safety of persons and the environment encompasses the period of time when the maximum impact is predicted to occur;
> d) The predicted impacts on the health and safety of persons and the environment from the management of radioactive waste are no greater than the impacts that are permissible in Canada at the time of the regulatory decision;
> e) The measures needed to prevent unreasonable risk to present and to future generations from the hazards of radioactive waste are developed, funded and implemented as soon as reasonably practicable; and
> f) The trans-border effects on the health and safety of persons and the environment that could result from the management of radioactive waste in Canada are not greater than the effects experienced in Canada.
>
> It is also the policy of the CNSC to consult and cooperate with provincial, national and international agencies to:
>
> g) Promote harmonized regulation and consistent national and international standards for the management of radioactive waste; and
> h) Achieve conformity with the measures of control and international obligations to which Canada has agreed concerning radioactive waste.

At the present time, I shall restrict my comments to only four of the above policy points. However, the authors need to demonstrate compliance with all of the above policy points for a radioactive waste disposal project to be successful in meeting the requirements of the CNSC's regulatory policy concerning the management of radioactive waste.

3.1 CNSC Regulatory Policy P-290, Point “b”: *The management of radioactive waste is commensurate with its radiological, chemical and biological hazard to the health and safety of persons and the environment and to national security;*

As noted previously, Table 6.4.4-5 shows that doses to a farm resident from chronic exposure would, for periods exceeding 100,000 years, not only exceed the recommended dose constraint for radioactive waste disposal (0.3 mSv/year) [2, 3, 5, 6, 9] but would also exceed the regulatory limit for effective dose to a member of the public (1 mSv/year) [10].

These doses to a farm resident in the future (Table 6.4.4-5) appear in a section of the Draft EIS [1] concerned with Human Intrusion (Section 6.4.4.4). In Section 6.4.3 of the Draft EIS [1], the authors paraphrase some of the safety criteria (criteria “c”, “d”, and “e”) from IAEA Specific Safety Requirements SSR-5, *Disposal of Radioactive Waste* [2] and state that “neither the legal dose limit of 1 mSv/yr nor the licensing dose limit of 0.3 mSv/yr to members of the public apply to doses resulting from inadvertent human intrusion.” This statement is incorrect with respect to a future farm resident, since the criteria for inadvertent human intrusion are inappropriate in reference to a future farm resident.

The complete list of relevant criteria from *Disposal of Radioactive Waste* [2] is as follows:

**Criteria**[3]

(a) The dose limit for members of the public for doses from all planned exposure situations is an effective dose of 1 mSv in a year [14]. This and its risk equivalent are considered criteria that are not to be exceeded in the future.

(b) To comply with this dose limit, a disposal facility (considered as a single source) is so designed that the calculated dose or risk to the representative person who might be exposed in the future as a result of possible natural processes[4] affecting the disposal facility does not exceed a dose constraint of 0.3 mSv in a year or a risk constraint of the order of $10^{-5}$per year[5].

(c) In relation to the effects of inadvertent human intrusion after closure, if such intrusion is expected to lead to an annual dose of less than 1 mSv to those living around the site, then efforts to reduce the probability of intrusion or to limit its consequences are not warranted.

(d) If human intrusion were expected to lead to a possible annual dose of more than 20 mSv (see Ref. [15], Table 8) to those living around the site, then alternative options for waste disposal are to be considered, for example, disposal of the waste below the surface, or separation of the radionuclide content giving rise to the higher dose.

(e) If annual doses in the range 1–20 mSv (see Ref. [15], Table 8) are indicated, then reasonable efforts are warranted at the stage of development of the facility to reduce the probability of intrusion or to limit its consequences by means of optimization of the facility’s design.

(f) Similar considerations apply where the relevant thresholds for deterministic effects in organs may be exceeded.

3 The references and footnotes conform to the numbering scheme in these comments, and not those of the original text.
4 Natural processes include the range of conditions anticipated over the lifetime of the facility and events that could occur with a lesser likelihood. However, extremely low probability events would be outside the scope of consideration.
5 Risk due to the disposal facility in this context is to be understood as the probability of fatal cancer or serious hereditary effects.

The proposed engineered containment mound [1] will fail after 500 years due to the effects of the natural processes of weathering and erosion (Section 2.5.3.1.1 of the Draft EIS [1], and [11]). A future farm resident, therefore, will become radiologically exposed as a result of natural process that are subject to the dose limit (1 mSv/year) and dose constraint (0.3 mSv/year). The dose to a future farm resident exceeds the dose constraint and dose limit (Table 6.4.4-5 of the Draft EIS [1]).

The authors also use the assessed doses to a future farm resident (Table 6.4.4-5) and the IAEA criteria concerning inadvertent human intrusion [2] (given above) to justify the acceptability of doses to the public following large seismic events. Section 9.3 of the Draft EIS [1] discusses the possibility of a large earthquake causing damage to the engineered containment mound and states:

> Furthermore, the acute human intrusion scenario discussed in Section 6.0 Malfunctions and Accidents considers consequences resulting from damage to the integrity of the ECM and exposure to waste material. Given that consequences from these bounding scenarios do not exceed the Safety Criteria, it can be concluded that damage to the structural integrity of the ECM from a seismic event after the end of Institutional Control would meet the Safety Criteria for the NSDF Project (CNL 2017).

This is incorrect, since seismic events are not the result of inadvertent human intrusion. Seismic events are natural processes and the doses arising from natural processes are subject to the dose limit (1 mSv/year) and dose constraint (0.3 mSv/year). Hence, the authors have not demonstrated that a large seismic event would lead to acceptable doses to members of the public.

The proposed project does not meet Canadian and international guidance and would require members of the public to be subject to unacceptable radiological risks into the far future. Hence, the management afforded by this proposal [1] is clearly not commensurate with the radiological hazard represented by the low level and intermediate level waste that the proposed project encompasses.

3.2 CNSC Regulatory Policy P-290, Point "c": *The assessment of future impacts of radioactive waste on the health and safety of persons and the environment encompasses the period of time when the maximum impact is predicted to occur*;

The Draft EIS [1] states that the temporal boundary of the project is "indefinite" (Section 5.1.3.2 of the Draft EIS [1]). It is clear from Section 6.4.4.4.2 of the Draft EIS [1] that a significant radiological hazard exists for more than 100,000 years.

The EIS needs to discuss the evolution of the facility, and the associated hazard, for the period of time that there is a significant hazard (i.e., for longer than 100,000 years). For example,

a) As noted elsewhere, engineered containment mounds are subject to weathering and erosion [11]. The design life of the proposed engineered containment mound is 500 years post-closure (Section 2.5.3.1.1 of the Draft EIS [1]). The authors need to discuss how the engineered containment mound fails and how the failed facility will protect people and the environment for the subsequent 100,000+ years;
b) The authors need to explain what is the largest seismic event that can be anticipated in 100,000+ years, its effect on the engineered containment mound, and the subsequent radiological exposures to people and the environment; and

c) The authors need to explain what is the largest tornado strike that can be anticipated in 100,000+ years, its effect on the engineered containment mound, and the subsequent radiological exposures to people and the environment.

The authors need to provide a comprehensive and detailed assessment of the evolution of the proposed facility over the period of time that there is a significant hazard (more than 100,000 years), including the effects of all internal and external events that can be anticipated over that period and the associated consequences of these events.

For the purpose of the long-term dose assessment, a representative person located at the failed facility, consuming local food, and using local water supplies, etc., should be considered.

3.3 CNSC Regulatory Policy P-290, Point “d”: *The predicted impacts on the health and safety of persons and the environment from the management of radioactive waste are no greater than the impacts that are permissible in Canada at the time of the regulatory decision;*

At the end of the institutional control period, the facility and its contents will be released from regulatory control. The facility will remain a significant hazard for in excess of 100,000 years.

The institutional control period ends 300 years post-closure, and the design life of the facility is 500 years post-closure. Subsequently, the facility will fail and the radionuclide inventory will be released into the environment. As noted previously, the predicted doses exceed the public dose limit specified in Canadian Regulations [10] for more than 100,000 years.

Canada has extant regulations concerning the release of radioactive materials from regulatory control and their entry into the accessible biosphere [16]. The criteria for unconditional clearance are given in Schedule 2 of the Nuclear Substances and Radiation Devices Regulations [16]. The criteria for conditional clearance are [16]:

> *conditional clearance level* means an activity concentration that does not result in an effective dose
>
> (*a*) greater than 1 mSv in a year due to a low probability event referred to in the IAEA Safety Standard RS-G-1.7; or
>
> (*b*) greater than 10 μSv in a year. (*niveau de libération conditionnelle*)

Hence, the doses given in Table 6.4.4-5 of the Draft EIS [1] exceed the limits defined by the Nuclear Substances and Radiation Devices Regulations [16] by more than 2 orders of magnitude for periods in excess of 100,000 years.

Therefore, the impacts from this proposed engineered containment mound [1] would greatly exceed the impacts that are permissible in Canada at the time of the regulatory decision.

3.4 CNSC Regulatory Policy P-290, Point “h”: *It is also the policy of the CNSC to consult and cooperate with provincial, national and international agencies to achieve conformity with the measures of control and international obligations to which Canada has agreed concerning radioactive waste.*

Following Canada’s ratification, the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* [17] entered into force with respect to Canada in 2001. Canada has been an active participant since that time.

With respect to the safety of radioactive waste management, the Joint Convention has *General Safety Requirements* and requirements for *Siting, Design and Construction, Assessment, Operation,* and *Institutional Measures after Closure* in articles 11, 13, 14, 15, 16, and 17, respectively. The authors need to show compliance with the Joint Convention in a comprehensive and detailed manner, so that Canada can demonstrate that it has met its international obligations.

## 4.0 Noncompliance with the Canadian Environmental Assessment Act 2012

The proposed project is subject to the requirements of the Canadian Environmental Assessment Act 2012 [18]. The CNSC has published generic guidelines for the preparation of an Environmental Impact Statement [19]. The authors have failed to adhere to these guidelines. A few examples:

*Alternative Means of Carrying Out the Project*

a) The proposal does not discuss alternative means in sufficient detail to allow a comparison with the effects of the project. For example, there is no comparison of the expected radiation doses to members of the public as a function of time. Hence, it is impossible to ascertain the value of any dose to members of the public that may be averted by choosing one alternative means over another.

*Project Activities*

b) The physical structure of the proposed project is not adequately described, e.g. there are no figures describing height, subsurface depth, internal structures, etc;
c) The authors admit to the bounding radiological inventory being of doubtful provenance (Section 5.7.6.1.1 of the Draft EIS [1]). The authors further state that “the waste quality and characterization program will assure the inventory envelope is not exceeded”. The “waste quality and characterization program” is not described in the Draft EIS;

*Spatial and Temporal Boundaries*

d) The Local and Regional Study Areas are insufficiently large to encompass the areas where there would be measurable changes to the environment from the project, or the potential for cumulative effects, respectively, either from normal activities, or from possible accidents or malfunctions. For example, a) downstream communities using the Ottawa River as a source of drinking water are not included in either the Local or Regional Study Area, and b) the transport of waste from other sites in Ontario, Quebec, and Manitoba, to Chalk River Laboratories are not assessed in the Draft EIS;

*Effects Assessment*

e) The effect of the environment on the project over the time period that the radiological inventory remains a hazard is not adequately discussed;
f) The effect of the project on the environment following facility failure at the end of the design life (500 years post-closure) is not adequately discussed;

*Cumulative Effects*

g) The authors have failed to adequately address the cumulative effects of present or reasonably foreseeable projects and/or activities within the study area. For example, the CNSC has previously approved the decommissioning of the Plutonium Tower (Building 223), the Plutonium Recovery Laboratory (Building 220), and the Waste Water Evaporator Building (Building 228). These current decommissioning projects are not discussed in the Draft EIS. Similarly, it is reasonable to foresee projects to decommission the NRX and NRU nuclear reactors, and the construction of a new small modular reactor (announced by Canadian Nuclear Laboratories on 2017 April 26 [20]). These reasonably foreseeable projects are not discussed in the Draft EIS.

The authors need to comprehensively address the requirements of the Canadian Environmental Assessment Act 2012.

## 5.0 Concluding Remarks

The Draft EIS [1] and the associated project proposal contain numerous deficiencies. For example,

- The proposal employs inadequate technology and is problematically located;
- The proposal does not meet regulatory requirements with respect to the health and safety of persons and the protection of the environment; and
- The authors have failed to meet the requirements of the Canadian Environmental Assessment Act 2012.

The extent and gravity of these deficiencies preclude a conclusion that the project is unlikely to cause significant adverse environmental effects, taking into consideration the implementation of mitigation measures.

## 6.0 References


[1] Canadian Nuclear Laboratories, *Environmental Impact Statement: Near Surface Disposal Facility*, 232-509220-REPT-004, Revision 0, 2017 March 17.

[2] International Atomic Energy Agency, *Disposal of Radioactive Waste*, Specific Safety Requirements SSR-5, 2011.

[3] Canadian Nuclear Safety Commission, *Assessing the Long Term Safety of Radioactive Waste Management*, G-320, 2006.

[4] International Atomic Energy Agency, *Classification of Radioactive Waste*, General Safety Guide GSG-1, 2009.

[5] International Atomic Energy Agency, *The Safety Case and Safety Assessment for the Disposal of Radioactive Waste*, Specific Safety Guide SSG-23, 2012.

[6] International Atomic Energy Agency, *Near Surface Disposal Facilities for Radioactive Waste,* Specific Safety Guide SSG-29, 2014.

[7] Canadian Standards Association, *General Principles for the Management of Radioactive Waste and Irradiated Fuel*, N292.0-14, 2014.

[8] Ontario Power Generation, *OPG's Deep Geologic Repository Project for Low and Intermediate Level Waste,* Environmental Impact Statement, Main Report, 00216-REP-07701-00001 R000, 2011 March.

[9] International Commission on Radiological Protection, *ICRP Publication 81: Radiation Protection Recommendations as Applied to the Disposal of Long-lived Solid Radioactive Waste*, 2000.

[10] Canada, *Radiation Protection Regulations*, SOR/2000-203.

[11] Argonne National Laboratory, *International Low Level Waste Disposal Practices and Facilities,* ANL-FCT-324, 2011.

[12] Canadian Nuclear Laboratories, *Project Description: Near Surface Disposal Facility at Chalk River Laboratories*, 232-509200-ENA-001, Revision 1, 2016 September.

[13] Canadian Nuclear Safety Commission, *Managing Radioactive Waste,* Regulatory Policy P-290, 2004.

[14] Food and Agriculture Organization of the United Nations, International Atomic Energy Agency, International Labour Organisation, OECD Nuclear Energy Agency, Pan American Health Organization, World Health Organization, *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources*, Safety Series No. 115, IAEA, Vienna (1996) (under revision).

[15] International Commission on Radiological Protection, *ICRP Publication 103: The 2007 Recommendations of the International Commission on Radiological Protection*, 2007.

[16] Canada, *Nuclear Substances and Radiation Devices Regulations*, SOR/2000-207.

[17] International Atomic Energy Agency, *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*, International Law Series No. 1, 2006.

[18] Canadian Environmental Assessment Act, 2012, (S.C. 2012, c. 19, s. 52, 2012.)

[19] Canadian Nuclear Safety Commission, *Generic Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012*, 2016.

[20] Canadian Nuclear Laboratories, 2016–2026 10-Year Integrated Plan Summary, CRL-502000-PLA-001, Revision 0, 2017 April 18.