Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 22-H7.74

File / dossier : 6.01.07
Date: 2022-04-10
Edocs: 6757748

Oral presentation

Written submission from the Concerned Citizens of Renfrew County and Area

In the Matter of the

Canadian Nuclear Laboratories (CNL)

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

Commission Public Hearing
Part 2

May and June 2022

Exposé oral

Mémoire des Concerned Citizens of Renfrew County and Area

À l'égard des

Laboratoires Nucléaires Canadiens (LNC)

Demande des LNC 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

Audience publique de la Commission
Partie 2

Mai et juin 2022

Canada

Submission for the Canadian Nuclear Safety Commission's public hearing on Canadian Nuclear Laboratories' application to amend its Chalk River Laboratories site licence to authorize the construction of a near surface disposal facility

Concerned Citizens of Renfrew County and Area

April 10, 2022

Concerned Citizens of Renfrew County and Area (CCRCA) is an incorporated, non-profit organization that has been working for the clean-up and prevention of radioactive pollution from the nuclear industry in the Ottawa Valley for over 45 years. We have made written and oral submissions at Canadian Nuclear Safety Commission (CNSC) hearings since the year 2000.

This submission for the CNSC hearing on the "Near Surface Disposal Facility" (NSDF) Project is based upon a document, *Critical Flaws, Errors and Omissions in CNSC staff's EA report and case to approve the Chalk River Mound*[1] that we submitted to CNSC President Rumina Velshi on February 21, 2022. Our comments are organized under 26 headings (from A to Z).

A. Long-lived radionuclides

IAEA General Safety Guide GSG-1, *Classification of Radioactive Waste*, says that intermediate-level radioactive waste (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."[2]

The partial list of radionuclides destined for the NSDF "engineered containment mound" found in the NSDF *Safety Case* indicates that 25 of the 31 radionuclides are long-lived, with half-lives ranging from 1,600 to 14 billion years. This list includes significant quantities of the "man-made" long-lived alpha-emitters plutonium-239 and uranium-233.[3] They were produced for the U.S. nuclear weapons program through reprocessing activities at Chalk River Laboratories (CRL).

Converting activities in Becquerels to mass, the NSDF waste inventory is dominated by two "natural" long-lived alpha-emitters, uranium-238 and thorium-232, the radionuclides that were irradiated to produce the two artificial nuclear substances for nuclear weapons.

Of the million-tonne mass of the mound, roughly 13% (0.13×10^{12} grams) would be packaged waste. The remaining 87% (0.87×10^{12} grams) would be bulk waste. Using the Radionuclide Concentration Limits in Table 5-18 of the *Safety Case*,[4] the 400 Bq/g limit for long-lived alpha-

[1] https://concernedcitizens.net/2022/02/21/critical-flaws-errors-and-omissions-in-cnsc-staffs-ea-report-and-case-to-approve-the-chalk-river-mound-2/
[2] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1419_web.pdf, p. 6
[3] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p. 378
[4] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p.376

emitters in packaged wastes yields a maximum of 400 Bq/g x 0.13 x 10^{12} g = 0.52E+14 Bq. The 100 Bq/g limit for bulk wastes yields a maximum of 100 Bq/g x 0.87 x 10^{12} g = 0.87E+14 Bq.

The sum of these two values is 1.39E+14 Bq, nearly 500 times higher than the 2.9E+11 Bq sum of the Licensed Inventory limits in Table 5-19 of the *Safety Case* for the long-lived alpha-emitters Pu-239/240, Ra-226, Th-230, Th-232, U-234, U-235 and U-238.[5] Furthermore, many additional long-lived alpha-emitters would be present in the waste deposited in the NSDF that are not included in the Licensed Inventory. These include U-236, and radioactive progeny of Th-232, U-235, and Ra-226. (Note that Tables 5-18 and 5-19 in the *Safety Case* are the same as Tables 4 and 13 in the *Waste Acceptance Criteria*).

Large quantities of long-lived beta/gamma emitters would also be present in the NSDF. Using a similar calculation to one used for the alpha-emitters, their maximum quantities (based on the Radionuclide Concentration Limits in Table 5-18 of the *Safety Case*) could be 1000 times greater than the 2.55E+10 sum of the Licensed Inventory limits for C-14, Cl-36, I-129, Nb-94, Ni-59, Tc-99 and Zr-93 in Table 5-19.

According to an early version of the NSDF *Reference Inventory Report*, this list of long-lived beta/gamma emitters includes "hard-to-detect radionuclides important to NSDF such as Tc-99 or C-14 [for which] gross beta measurements are essentially useless for quantification."[6] Note that this statement was removed from later versions of the *Reference Inventory Report*.

Given the large amounts of packaged and bulk wastes to be deposited in the mound, the large amounts of carbon-14, and the crude measurements proposed for the beta/gamma activity of these wastes, the potential exceedance of the Licensed Inventory limit for the mound's total radioactivity of long-lived beta/gamma emitters at time of closure could be very great.

Tables D1 and D2 in Appendix D of the NSDF *Reference Inventory Report*, Revision 3 provide a "qualitative assessment" of potential exceedances of Licensed Inventory limits.[7] These Tables purport to show that average radioactivity concentrations in bulk wastes and waste packages are only a tiny fraction of the Radionuclide Concentration limits in Table 5-18.

However, this "qualitative assessment" is not backed up by real data. Real data in Appendix E of the NSDF *Reference Inventory Report*, Revision 3 indicate a potential for massive NSDF Licensed Inventory exceedances from Waste Management Area F.[8] WMA F is proposed as the NSDF base waste layer.[9] Table 1 shows that only 60,500 m^3 of material from WMA F alone would contain 23 times the Licensed Inventory limit of the long-lived alpha-emitter thorium-230 (75,400-year half-life) and exceedances of radium-226, uranium-234, and uranium-235 as well. The actual volume of contaminated material in WMA F is six times greater than this (about

[5] *ibid*, p. 378
[6] *NSDF Reference Inventory Report* 232-508600-REPT-003, Revision1, 2018/02/14, page 5-2
[7] https://www.cnl.ca/wp-content/uploads/2021/03/NSDF-Reference-Inventory-Rev-3.pdf, p. 52
[8] *ibid*, pp. 58-62
[9] https://nuclearsafety.gc.ca/eng/resources/publications/reports/jointconvention, 7th, Section 5.1.1.6

380,000 m^3).[10] It is glaringly obvious that the NSDF would not come close to accommodating disposal requirements for the federal nuclear legacy waste found at Chalk River Laboratories.

Table 1. Radioactivity (Bq) in Waste Management Area F compared to the NSDF Licensed Inventory

	Ra-226	Th-230	Th-232	U-234	U-235	U-238
(a) WMA F, 60,500 m^3	4.57E+10	1.23E+11	1.27E+10	9.19E+10	8.98E+09	6.28E+10
(b) Licensed inventory	3.65E+10	5.30E+09	2.70E+10	6.88E+10	2.65E+09	7.57E+10
(a)[11] / (b)[12]	1.25	23.21	0.47	1.34	3.39	0.83

Waste Management Area F is not the only contaminated area at CRL with radionuclide contents that would vastly exceed the NSDF Licensed Inventory. Table 2 shows data for the Liquid Dispersal Area (LDA) in Table B2 of the *Comprehensive Preliminary Decommissioning Plan* for Chalk River Laboratories.[13] The estimated 7.4E+13 Bq of strontium-90 in Reactor Pit #1 alone is twelve times the Licensed Inventory limit of 6.05E+12 Bq. An additional 8.3E+14 Bq of beta/gamma emitters (including Sr-90) are found in the Chemical Pit and in Reactor Pit #2.

Table 2. Liquid Dispersal Area (LDA)

Area	Period of Operation	Description	Volume	Major Activity		Notes
			m^3	Type	TBq	
Reactor Pit #1	1953-1998	Liquid waste discharged to natural depression between 1953 and 1956 resulting in contaminated soil. Lightly contaminated equipment and suspect soils later used to fill depression.	7,100	β/γ α	100 0.1	Estimated disposal of 74 TBq ^{90}Sr plus 100 g (Pu equivalent) of alpha-emitters. Source of groundwater plume.
Laundry Pit	1956-1957	Aqueous waste from Decontamination Centre and Laundry discharged to engineered pit resulting in contaminated soil.	4,000	β/γ α	0.06 0.0003	Small inventory compared with other LDA pits.
Chemical Pit	1956-1995	Liquid aqueous waste from site labs and chemical operations discharged to a gravel-filled pit resulting in contaminated soil.	17,700	β/γ α Tritium	230 0.4 70	Groundwater ^{90}Sr plume. Groundwater from Chemical Pit plume is subject of pump and treat program.
Reactor Pit #2	1956-2000	Lightly contaminated water from Rod Storage Bays, and NRX & NRU operations resulting in contaminated soil.	28,200	β/γ α Tritium	500 0.5 1,000	Source of groundwater plume.

The Liquid Dispersal Area has a total of 9.3E+14 Bq of beta/gamma radioactivity in a volume of 57,000 m^3, according to the *Comprehensive Preliminary Decommissioning Plan*. This vastly exceeds the Licensed Inventory limit for medium- and long-lived beta/gamma emitters.

Table E-6 in the NSDF *Reference Inventory Report,* Revision 3, reports only 2.5E+11 Bq of radioactivity for three main beta/gamma emitters (Cs-137, Co-60, Sr-90) in a volume of 58,469

[10] *Comprehensive Preliminary Decommissioning Plan*, CPDP-508300-PDP-001, Revision 2, p. B-13
[11] https://www.cnl.ca/wp-content/uploads/2021/03/NSDF-Reference-Inventory-Rev-3.pdf, p. 62
[12] https://www.cnl.ca/wp-content/uploads/2021/03/Near-Surface-Disposal-Facility-Waste-Acceptance-Criteria-Rev-4_EN.pdf, p. 42
[13] *Comprehensive Preliminary Decommissioning Plan*, CPDP-508300-PDP-001, Revision 2, p. B-11

m^3 in the LDA.[14] This represents a 3,720-fold discrepancy between that document and the *Comprehensive Preliminary Decommissioning Plan* regarding total beta/gamma radioactivity in the LDA. The Commission should seek clarification from CNL regarding this discrepancy,

B. Cobalt-60 commercial wastes

The term "disused sources" does not occur in CMD 22 H-7, the Commission Member Document prepared by Canadian Nuclear Safety Commission (CNSC) staff for the licence hearing on the NSDF project. It nonetheless appears that CNL may plan to put large numbers of disused, highly radioactive cobalt-60 sources in the mound. Disposal of disused sources is described in sections 5.7 and A.5.7 of the NSDF *Waste Acceptance Criteria*, the key document providing limits on quantities and radioactivity concentrations of radioactive substances destined for the mound.[15]

IAEA guidance does not allow near-surface disposal of high-activity cobalt-60 disused sources. The IAEA says that higher-activity disused Cobalt-60 sources represent intermediate-level waste. Higher-activity disused sources cannot be placed in near surface disposal until they decay below a certain concentration of radioactivity.[16] This complex and important matter is completely ignored by CNSC staff in CMD 22 H-7.

The 9.06E+16 Bq of cobalt-60 alone would provide 98% of the initial radioactivity in the mound.[17]

Lead shielding must be used to protect workers handling such waste. Roughly 200 tonnes of lead would be disposed of in the mound, [18] leading to contamination of groundwater. However, groundwater contamination by lead (and uranium) from the NSDF is dismissed by CNSC staff as "not likely to pose any impacts to human health or the environment" (CMD 22-H7, p. 48 of 590). Risks to workers of a loss-of-shielding accident are also not discussed in the CMD.

The NSDF *Waste Acceptance Criteria* document does not prescribe any radioactivity per unit mass limit for a radionuclide with a half-life of less than 30 years if it is placed in a "leachate-controlled" waste package.[19] This could allow very highly radioactive cobalt-60 disused sources to be put in the mound if they are in "leachate-controlled" waste packages.

Canadian Nuclear Laboratories (CNL) has apparently provided no description of "shielded" or "leachate-controlled" packages to the CNSC. These packages are not mentioned or described in CMD 22 H-7. There is no evidence provided that "shielded" or "leachate-controlled" packages would stand up to compaction in the mound or prevent water entry.

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[14] https://www.cnl.ca/wp-content/uploads/2021/03/NSDF-Reference-Inventory-Rev-3.pdf, p. 61
[15] https://www.cnl.ca/wp-content/uploads/2021/03/Near-Surface-Disposal-Facility-Waste-Acceptance-Criteria-Rev-4_EN.pdf, pp. 24 and 38
[16] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1419_web.pdf, p.41
[17] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p. 530
[18] https://www.cnl.ca/wp-content/uploads/2021/03/Near-Surface-Disposal-Facility-Waste-Acceptance-Criteria-Rev-4_EN.pdf, p. 41
[19] *ibid,* p. 21

CNL's calculation of the stress on packages accounted only for the weight of overlying waste, but not compaction by rollers or other heavy equipment.[20] Heavy equipment could damage the shielding on waste packages, resulting in excessive worker radiation exposures.

C. Waste characterization

The *Environmental Assessment Report* portion of CMD 22-H7 says "Under CNSC licence, Canadian Nuclear Laboratories (CNL) would also have to comply with the CNSC waste characterization requirements as outlined in CNSC Regulatory Document, REGDOC-2.1.1.1 (sic), volume 1" (pp. 362, 412, and 420 of 590). The document referred to, REGDOC-2.11.1, Volume 1, is not included in the licence, so CNL would not have to comply with it. And even if it were included in the licence, it contains no substantial requirements for waste characterization, stating that the licensee shall characterize "principal" radionuclides "as applicable".[21]

Accurate measurement of alpha-emitting radionuclides in waste destined for the NSDF is a particular concern. Section 3.3.2 of The NSDF *Safety Case,* "Uncertainties Associated with the Waste Inventory," says that "Gross alpha and beta measurements were used to estimate concentrations of alpha and low energy beta emitting radionuclides."[22] CMD 22-H7 also says (p. 101 of 590) that "Low-level waste generated during operation activities will be subject to gross alpha and gross beta/gamma screening before their transfer to the WWTP for treatment or to the ECM for disposal."

This approach would fall short of requirements for radiation survey during decommissioning of nuclear facilities in the U.S. found in NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey for Instruments for Various Contaminants and Field Conditions.*[23] CNL should demonstrate an understanding of the importance of data quality objectives in reducing uncertainty associated with waste characterization data to an acceptable level found in NUREG-1575, the "Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM)."[24]

D. Siting

The IAEA says siting is a "fundamentally important activity in the disposal of radioactive waste,"[25] but it appears that proximity to contaminated structures awaiting demolition at AECL's Chalk River Laboratories -- not safety or environmental protection -- was the priority in siting of the NSDF.

The NSDF siting process only examined locations on Atomic Energy of Canada (AECL) properties at Chalk River and Rolphton on the Ottawa River, and at Whiteshell Laboratories on the Winnipeg River. CNL rejected any locations other than those at the Chalk River Laboratories.

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[20] *Calculated pressure on packaged containers inside the ECM.* CNL ID REA # 217388 June 2019.
[21] https://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/REGDOC-2-11-1-volume-I-management-of-radioactive-waste.pdf, p. 5
[22] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p. 190
[23] https://www.nrc.gov/docs/ML2023/ML20233A507.pdf
[24] https://www.nrc.gov/docs/ML0037/ML003761445.pdf
[25] https://www-pub.iaea.org/MTCD/publications/PDF/Pub1637_web.pdf, p. 83

CNL failed to consider alternative sites that would avoid rapid discharge of radioactive and hazardous substances to a major water body or that would avoid placing wastes in an area with a high water table (CMD 22-H7, Section 3.2, Design Options Evaluation).

The southern portion of the site chosen for the mound is underlain by a feature categorized in 1994 as a ""high-probability" fracture zone," ten meters wide and over a kilometer long – a potential groundwater flow pathway with "permeability values several orders of magnitude greater than bulk rock mass."[26] This feature should have eliminated the proposed site from further consideration during the site evaluation stage.

Original site selection criteria announced by the proponent would have excluded any site with more than a 10% slope. The criterion was changed to 25% to allow CNL's desired site[27] – even though it lies on a hillside, over fractured rock, with a high water table, surrounded on three sides by wetlands that drain into Perch Lake 50 metres from the base of the hill. Perch Creek drains the water from Perch Lake into the Ottawa River, one kilometre away.

E. Alternative means

According to the IAEA, a disposal facility at or near the surface is "susceptible to processes and events that will degrade its containment and isolation capacity over much shorter periods of time."[28] Such a facility is not suitable for long-lived radioactive materials.

Waste containing long-lived alpha-emitting radionuclides is considered to be "intermediate-level waste" (ILW) according to the IAEA.[29] The IAEA notes that "Owing to the presence of non-negligible amounts of long lived alpha emitters, waste from research facilities [such as the Chalk River Laboratories] generally belongs to the ILW class and even, in some circumstances, to the HLW class.[30]

However, 95% of the ILW at Chalk River was recently reclassified as low-level waste, presumably to allow its disposal in the NSDF mound.[31]

The NSDF project does not comply with international safety standards for radioactive waste disposal. It would violate a key principle of radioactive waste management that the radioactive inventory must decay to an internationally accepted level within the design life of the facility to allow release from regulatory oversight.[32] The Environmental Assessment Report ("EA report") contained within CMD 22-H7 does not examine alternative, in-ground facility types that would better contain the wastes and not expose them to rain, wind, and snow; and that would not require unproven water treatment or "weather cover structure" technologies.

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[26] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. 5-109
[27] *Near Surface Disposal Facility Site Selection Report* 232-10300-TN-001 Revision 2. Oct. 2016.
[28] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1637_web.pdf, p. 18
[29] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1419_web.pdf, p. 6
[30] *ibid*, p. 38
[31] https://concernedcitizens.net/2021/07/12/questioning-information-in-canadas-seventh-report-to-the-joint-convention-letter-to-iaea-from-ccrca/
[32] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1449_web.pdf, p. 26

F. Human health risks

The EA report says little about health risks to workers or the public, other than to claim that radiation doses will be within "acceptable limits." CMD 22-H7 (p. 279 of 590) says that "predicted annual effective and equivalent doses to persons on-site and off-site during the normal operation of all phases of the proposed project, as well as during disruptive event scenarios, will not exceed the applicable dose limits." This assertion is based on non-transparent models with numerous built-in assumptions. Use of these models results in large uncertainties in assessments of risks and doses. The *International Nuclear Workers' Study* (INWORKS) suggests radiation risks are greater than previously understood and exist even at very low doses.[33]

The EA report does not consider future human exposures to nuclear waste packages containing plutonium and other long-lived alpha-emitting substances that will remain dangerously radioactive for tens of thousands of years.

CMD 22-H7 says (p. 273 of 590) that "The proponent completed a human health risk assessment (HHRA) to assess potential impacts of the project on workers on site, members of the public (which include permanent and seasonal residents in the vicinity of the facility), and self-sufficient Indigenous Nations and communities." This health risk assessment considered only the Regional Study Area that "extends roughly 8 km downstream in the Ottawa River."[34]

Population-level health risks could be considerable, given the large numbers of downstream residents using Ottawa River water, and the very long time period during which the NSDF would be releasing contaminants to the river. Population-level health consequences of both routine and accidental releases of radioactive substances from the NSDF (such as tritium, proposed to be released in large quantities) should be estimated prior to approval of the NSDF (or any disposal facility on a major water body). This would indicate whether a facility providing better containment of radionuclides is warranted.

G. End state and release from regulatory control

CNSC cannot licence the NSDF without clarity on what "end state", "institutional control", and "regulatory control" mean in a disposal context. "End state" is central to the concept of disposal. The IAEA *Safety Glossary*[35] has the following definitions:

- ***end state***: The state of radioactive waste in the final stage of radioactive waste management, in which the waste is passively safe and does not depend on institutional control. In the context of radioactive waste management, the end state refers to disposal.
- ***institutional control***: Control of a radioactive waste site by an authority or institution designated under the laws of a State

[33] https://academic.oup.com/rpd/article/173/1-3/21/2558799
[34] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. 5-730
[35] https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1830_web.pdf

- ***regulatory control***: Any form of control or regulation applied to facilities and activities by a regulatory body for reasons relating to nuclear safety and radiation protection or to nuclear security

REGDOC-3.6, *Glossary of CNSC Terminology*, lacks definitions of these terms specific to radioactive waste. It defines "end state" as the "condition of a facility at the end of the decommissioning program" and "institutional control" as "control of residual risks at a site after it has been decommissioned." The *Glossary* has no definition of "regulatory control".[36]

The CNSC has no guidance on the "end state" of a radioactive waste disposal facility – how to determine if "waste is passively safe and does not depend on institutional control."

An above-ground mound that contains long-lived radioactive waste and hazardous waste is not "passively safe" according to safety requirements of the International Atomic Energy Agency. If a disposal facility is not designed to be "passively safe", or at least as "passively safe" as possible, it imposes an unacceptable burden on future generations. A 300-year institutional control period is nearly twice the duration of Canada's history as a nation. Institutions that exist today are very unlikely to still be in existence 300 years from now.

CMD 22-H7 has contradictory statements about release of the NSDF from regulatory control:

- "The Post-Institutional Control Period will occur after the IC period and continues indefinitely, subject to either federal or provincial regulatory control" (p. 27 of 590).
- "At a given time in the future and/or after year 2400, and taking into consideration the regulatory requirements in effect at that time, CNL will seek Commission approval for the removal of the NSDF from CNSC regulatory control" (p. 29 of 590).

Either the intent is to eventually remove the NSDF from regulatory control, or to continue regulatory control indefinitely. Both cannot be true. If the latter is true, then the NSDF would not be a disposal facility. This lack of clarity precludes Commission approval.

H. External natural hazards

Members of the public have expressed concern about effects of earthquakes, floods, fires and tornadoes on the mound's integrity. CMD 22-H7 (p. 302 of 590) says "CNSC staff is satisfied that the proponent has adequately considered the effects." In our view, credible threats to the mound's integrity were not adequately assessed in the EA report.

The Ottawa River occupies a major fault. The Chalk River Laboratories property is within the Western Quebec Seismic Zone.[37] Climate change is increasing the frequency of extreme rainfall events, floods and fires. The Ottawa Valley has become tornado prone in recent years. [38]

[36] https://nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc3-6/index.cfm
[37] *Western Quebec Seismic Zone.* https://en.wikipedia.org/wiki/Western_Quebec_Seismic_Zone
[38] https://www.cbc.ca/news/canada/ottawa/eastern-ontario-tornado-ottawa-gatineau-1.5674117

A tornado or microburst during waste emplacement could spread contaminated materials well beyond the Local Study Area. But CNL says "The effects of a tornado or extreme winds on the engineered containment mound are expected to have negligible consequences."[39] An above-ground facility is obviously more vulnerable to these threats than an in-ground facility. This was not taken into consideration in the alternative means assessment.

I. Human intrusion for recovery of scrap metal

Human intrusion after an Institutional Control Period is a safety-limiting factor for a near-surface disposal facility. The *Environmental Assessment Report* includes two scenarios for inadvertent human intrusion, but is mute on the much more likely scenario of scavengers digging into the mound for scrap metal. The NSDF is expected to contain an estimated 33 tonnes of aluminum, 178 tonnes of lead, 3,520 tonnes of copper, and 10,442 tonnes of iron.[40] There is no discussion in the report of the need to prevent scavenging of these materials, or estimates of radiation doses associated with human exposure to radioactively-contaminated metals.

J. Degradation of the mound

CMD 22-H7 poorly describes the degradation of the mound. On page 45 of 590 the CMD refers to "the anticipated degradation of the engineered barriers (e.g., corrosion of waste containers in the ECM and degradation of the ECM cover and base liners)." It then refers to "the restoration of the ECM following gradual degradation of the cover." The meaning of "restoration" is unclear.

CMD 22-H7, on the same page, assumes that "gradual degradation" will only begin at the end of a 300-year "institutional control" period. Degradation would likely begin immediately upon closure.

A *Performance Assessment* [41] prepared by CNL also describes the mound's degradation.[42] After 300 years the mound would still contain large quantities of dangerous long-lived radioactive materials disposed of during the operation phase, as well as hazardous wastes. During the mound's degradation and disintegration, mixed radioactive and hazardous wastes would leak into the Ottawa River, essentially forever. Hazardous wastes would include arsenic, beryllium, cadmium, chromium, lead and mercury; along with organic compounds such as benzene, dioxins, and PCBs. Long-lived radionuclides released from the degraded mound would include isotopes of americium, uranium, neptunium, plutonium, radium, technetium, and many other elements.

CMD 22-H7 does not adequately describe how degradation of the top cover, bottom liner, and waste packages will affect the release of the mound's contents. It does not account for faster mound degradation with more extreme weather events caused by climate change. It addresses climate change effects only by assuming a 3.9°C increase in temperature and a 3% increase in

[39] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. ES-21
[40] https://www.cnl.ca/wp-content/uploads/2021/03/Near-Surface-Disposal-Facility-Waste-Acceptance-Criteria-Rev-4_EN.pdf, p. 41
[41] *Performance Assessment for Near Surface Disposal Facility to Support the Environmental Impact Statement.* CNL, March 2017 232-509240-ASD-001 Revision 0
[42] https://concernedcitizens.net/2020/11/04/the-proponents-own-study-shows-that-the-chalk-river-mound-will-disintegrate/

precipitation over the next 10,000 years (CMD 22-H7, p. 45 of 590). This does not account for accelerated mound degradation associated with a higher frequency of extreme weather events.

The inevitable disintegration of an above-ground mound due to extreme weather events, erosion, plant growth, burrowing animals etc. is why a landfill-type facility such as the NSDF is unsuitable for most of the federal legacy waste that currently lacks a safe long-term management strategy.

K. Comparing radioactivity in the mound to local ore bodies – the thousand-fold error

At the February 22nd part 1 hearing, CNSC staff included a thousand-fold error in a graph comparing radioactivity in local ore samples to radioactivity in the proposed mound.

Slide 23 of CMD 22-H7.A shows the radioactivity of the mound quickly declining below the radioactivity of local rocks.[43] However, the gray band showing the radioactivity of "rocks found in the Renfrew-Pembroke area" is wrong by approximately three orders of magnitude.

It is likely that the units for "Radioactivity Concentration" of rocks, shown as Becquerels per gram (Bq/g) in the figure, should be Becquerels per kilogram (Bq/kg), accounting for the error.

It appears that this 1000-fold error originated in Figure 2-2 in the *Safety Case*.[44] Even the most radioactive uranium ore sample in Ontario Geological Survey Report 211 (referenced in both CMD 22-H7.A and in the *Safety Case*) would have far less radioactivity than the lower limit of the gray band.[45] Many samples in Report 211 have levels of radioactivity similar to the background radioactivity of Chalk River soils (also shown in the Figure).

It is quite unfortunate that CNSC staff reproduced this graph from the *Safety Case* and presented it to the Commission on February 22nd.

We request that CNSC staff issue a correction and explain the error to Commission members during the part 2 hearing.

The Safety Case says that when only uranium-238 and thorium-232 are included in a calculation of the radioactivity of ore body samples, "the radiotoxicity of the NSDF waste declines quickly with time due to radioactive decay, equalling the average radiotoxicity of surficial ore deposits at approximately ten years into the post-closure phase."[46]

This statement, which is also wrong by orders of magnitude, introduces the concept of "radiotoxicity". Radiotoxicity refers to radiation dose per unit mass of material ingested. It is not defined in the CNSC Glossary and has questionable relevance to an assessment of the safety

[43] https://www.nuclearsafety.gc.ca/eng/the-commission/hearings/cmd/pdf/CMD22/CMD22-H7-A.pdf
[44] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p. 59
[45] http://www.geologyontario.mndm.gov.on.ca/mndmfiles/pub/data/imaging/R211//R211.pdf
[46] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p. 60

of the NSDF. Ingestion of rocks is highly unlikely.[47] Ingestion of materials in the NSDF (e.g., a child, centuries in the future, eating soil or breathing in dust) is a far more likely scenario.

CNSC Staff also make the "radiotoxicity" comparison in CMD 22-H7 (pages 52 and 54 of 590). It is asserted that 300 years after closure, radiotoxicity "will be approximately two orders of magnitude lower than the average radiotoxicity of natural surficial uranium ore bodies found in the Pembroke-Renfrew region." A correction should also be issued for this error.

Some packages of waste in the mound would remain far more radioactive than any local rock samples for thousands of years. Radioactivity levels averaged over the entire mass of the mound cannot be compared to rocks. This indicates a need to revise the NSDF reference inventory, rerun the models used in developing the *Post-Closure Safety Assessment* and the *Safety Case*, and to revise the "Licensed Inventory"[48] based on the new modeling results.

L. "Only low-level waste"

Waste with significant quantities of long-lived radionuclides, or of shorter-lived, high-activity radionuclides, is categorized as intermediate-level waste (ILW) by the IAEA.[49]

The claim made in October 2017 by Canadian Nuclear Laboratories (CNL) that the NSDF would "only contain low-level radioactive waste" [50] is misleading and should be corrected. CNL revealed its true intention to put ILW (as well as low-level waste) in the NSDF when it later told the CNSC (in June 2019) that "There are current plans to place ILW in aboveground mounds."[51]

The "only low-level" phrase appears repeatedly in CMD 22-H7 (pp. 52, 195, 276, 362, 412, and 420 of 590). Repetition of a falsehood does not make a truth.

M. An "engineered containment mound" is a landfill, not a near surface disposal facility

The internationally accepted definition of "near surface disposal" is "Disposal in a facility consisting of engineered trenches or vaults constructed on the ground surface or up to a few tens of metres below ground level."[52] The NSDF *Environmental Impact Statement* (EIS) says the "NSDF" would be "similar to a municipal landfill"[53] -- an above-ground mound 60 feet high.

The IAEA says that landfills are only suitable for "very low level waste." The IAEA says that if artificial radionuclides are to be put in a landfill, they should be short-lived, with limited total

[47] https://concernedcitizens.net/2022/02/20/safer-to-eat-radioactive-waste-than-local-rocks/
[48] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p. 378
[49] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1419_web.pdf (Figure 1, Conceptual illustration of the waste classification scheme)
[50] https://www.cnl.ca/success_stories/cnl-updates-nsdf-waste-inventory/
[51] https://www.nuclearsafety.gc.ca/eng/pdfs/REGDOC-comments-received/Comments-REGDOC-2-11-1-v1-CNL.pdf, p. 11 of 25
[52] https://www.iaea.org/publications/8420/disposal-of-radioactive-waste, p. 4
[53] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. 1-5

activity. The IAEA says that radioactivity concentrations of short-lived radionuclides in a landfill should be at most "one or two orders of magnitude above the levels for exempt waste."[54]

However, the NSDF *Waste Acceptance Criteria* (WAC) allows unlimited activity concentrations of cobalt-60 in packaged wastes[55] (the cobalt-60 exemption level in the *Nuclear Substances and Radioactive Devices Regulations* is 10 Bq/g).[56] The WAC allows unlimited activity of plutonium-241 in packaged wastes, compared to an exemption level of 100 B/g. The WAC allows 10,000 Bq/g of cesium-137 in packaged wastes, one thousand times its 10 Bg/g exemption level.

A major deficiency of the NSDF design is the absence of natural barriers to waste migration and human intrusion following closure. IAEA Specific Safety Guide SSG-29, *Near Surface Disposal Facilities for Radioactive Waste*, says that a near surface facility should "provide the necessary degree of containment and isolation, so that the migration of radionuclides from the waste into the biosphere is reduced to an acceptably low level and so that the likelihood of, and all possible consequences of, human intrusion are sufficiently reduced."[57]

The NSDF Project does not meet this requirement. As an above-ground landfill type facility, the NSDF is essentially wholly dependent on engineered barriers. Although Figure 7 in CMD 22-H7 (p. 54 of 590) lists "dilution in the geosphere" as a "natural barrier", this is a denial of reality. Dilution occurs precisely because waste is migrating into the biosphere.

An artificial, engineered, above-ground mound provides essentially no natural barriers to waste migration or human intrusion after closure. Above-ground disposal of waste in such a facility is acceptable only if i) the waste is composed mainly of short-lived radionuclides that decay below exemption levels during the lifetime of the engineered barriers; and ii) the waste contains insignificant quantities of non-radiological hazardous materials. Neither is true for the NSDF.

N. Forest clearing and loss of endangered species habitat

"Members of the public expressed concerns regarding destruction of critical or high-quality habitat for both the Blanding's turtle and bats within the CRL site, and the lack of detailed mitigation measures provided in the EIS for endangered species" (CMD 22-H7, p.289 of 590). Roughly 30 hectares of high-quality forest habitat will be lost if the NSDF Project is approved.

No effective measures are proposed to address habitat loss. The proposed NSDF site is home to four bat species. Three (Little Brown Myotis, Northern Myotis, Tri-Coloured Bat) are protected under the federal *Species at Risk* Act, and another (Eastern Small-Footed Myotis) is protected provincially. For these bat species, "NSDF Project activities will result in the permanent loss of approximately 28 hectares of potential maternity roost habitat, potential long-term avoidance of

[54] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1419_web.pdf, p.11
[55] https://www.cnl.ca/wp-content/uploads/2021/03/Near-Surface-Disposal-Facility-Waste-Acceptance-Criteria-Rev-4_EN.pdf, p.21
[56] https://laws-lois.justice.gc.ca/PDF/SOR-2000-207.pdf, p. 35
[57] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1637_web.pdf, p.21

adjacent maternity roosting habitat…from sensory disturbance, and permanent change in movement corridors between maternity roosting habitat patches." (CMD 22-H7, p. 283 of 590)

Federally protected bird species in this forest area include Canada Warbler, Eastern Whip-Poor-Will, Wood Thrush, and Golden-Winged Warbler. As is true for bats, no effective mitigation measures are proposed to address the loss of habitat for these species. The *Consolidated Commitment Lists* – the supposed mitigation measures if the NSDF is approved – would even allow vegetation clearing activities during the migratory bird nesting period (or bat maternity roosting period) if nest searches are conducted. [58]

Major increases in traffic would increase stress on bats and nesting birds. Noise from rock blasting, followed by 50 years of waste dumping activities, would interfere with communication through bird song. Trucks would drive back and forth to soil stockpile areas to obtain "daily cover" ("Clean cover/aggregate stockpile areas will be established both within and outside of the ECM to support waste placement operations.")[59] Habitat losses associated with those stockpile areas are ignored in the EA report.

No effective means of mitigating these significant adverse environmental impacts on species at risk is foreseen, or likely even possible. For example, the promise to temporarily suspend blasting activities "if wildlife are [sic] observed in the blasting area" is pathetically weak.[60]

CMD 22-H7 (p. 290 of 590) says "CNSC staff have found that the NSDF Project is not likely to cause significant adverse environmental effects on the species at risk." This assertion is not supported by evidence. Habitat loss would be long-term and irreversible. Impacts will inevitably be felt well beyond the local study area.

The NSDF siting process only involved biodiversity surveys at two sites on the CRL property. Exclusion criteria in the *Site Selection Report* state that "Known or proposed critical habitats for species listed under the Federal Species at Risk Act (SARA) or listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) shall be excluded or used such that the habitats shall have mitigation measures put in place to safeguard the species."[61]

This should have led to rejection of the NSDF site. Other sites for a disposal facility, including on the adjacent Department of National Defence (Garrison Petawawa) property, should be sought.

There is no information about the fate of the trees that would be sacrificed for the NSDF project. No provision has been made to offset carbon that would be permanently released as a result of clear-cutting over 30 hectares of mature forest. Would trees be piled and burned? Would they be put in the mound? The EA report is silent on these matters.

[58] https://iaac-aeic.gc.ca/050/documents/p80122/139601E.pdf, p. 31
[59] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. 3-43
[60] *ibid*, p.31
[61] *Near Surface Disposal Facility Site Selection Report* 232-10300-TN-001 Revision 2. Oct. 2016.

These trees may already be contaminated with tritium and carbon-14 from years of radioactive gas releases at Chalk River. Have analyses been done on contaminant levels in trees? Will cutting and burning allow contaminants to be spread further?

The proponent should be required conduct a search for an alternate disposal facility site that would not involve the loss of high-quality endangered species habitat and tens of thousands of mature trees.

O. Demolition wastes

The EA report fails to mention the truckloads of radioactive demolition waste piling up in intermodal shipping containers[62] at Area H. CNL apparently plans to directly abandon them in the mound. There is no evidence that the contents of intermodal shipping containers have been properly analyzed. Abandoning shipping containers full of waste in a landfill would represent an extraordinary means of disposal of radioactive waste. To our knowledge, this has never before been done before at any disposal facility anywhere in the world. No evidence has been provided that the contents of these shipping containers would be properly characterized prior to disposal.

P. Waste transport

Risks of transporting wastes to the facility were not considered in the EA report. Indigenous communities are on record as opposing transport of radioactive materials through their territories.[63] The April 2021 Ottawa City Council resolution opposes importation of radioactive waste from other provinces.[64] Legacy federal wastes from three provinces are destined for the mound along with commercial wastes from many locations. Risks associated with transportation include accidents, worker and public exposures, and extra waste handling in temporary storage before wastes are moved a second time. These risks are not addressed in the EA report.

Q. Groundwater table

The EA report does not acknowledge or adequately address the serious problem that the groundwater table is right at the surface of the NSDF site. CMD 22-H7 (p. 18 of 590) says "slope depressurization accompanied by rock blasting will be needed to drain groundwater within the rock mass and lower groundwater elevations." Prior to rock blasting, horizontal drains "will be drilled in the rock mass to lower the water table". This is an admission that the groundwater table at the surface is a serious problem with the chosen site. This feature should have eliminated the proposed site from further consideration during the site evaluation stage.

Nothing about slope depressurization or horizontal drains can be found in the *Environmental Impact Statement*. There is no definition in the report of a "horizontal drain". There is no indication that this concept has been reviewed by a hydro-geologist.

[62] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. 3-23
[63] https://www.anishinabek.ca/2017/05/02/joint-declaration-between-the-anishinabek-nation-and-the-iroquois-caucus-on-the-transport-and-abandonment-of-radioactive-waste/
[64] https://iaac-aeic.gc.ca/050/documents/p81624/139087E.pdf

The lack of references in the EA report essentially destroys its credibility and its utility as a basis for a decision under the *Canadian Environmental Assessment Act, 2012*.

R. Licensed inventory

The Licensed Inventory is intended to place a limit on the total amount of radioactivity for each of 31 individual radionuclides contained in the waste to be disposed of in the mound.[65] The Licensed Inventory (Table 13 in the *Waste Acceptance Criteria*) is not included in the licence.

The failure to include the Licensed Inventory as a condition in an amended licence for the Chalk River Laboratories raises doubts as to whether it would provide effective limits on the total radioactivity of the mound, or whether inventory limits would be enforced through independent oversight of CNL's waste characterization, classification, and record keeping activities.

Also of concern is that many radionuclides known to be present in the federal legacy waste are not included in the Licensed Inventory. Table A-1 in the NSDF R*eference Inventory Report* indicates that long-lived radionuclides such as calcium-41 (a major contaminant of irradiated concrete), uranium-236 and curium-244 are excluded from the Licensed Inventory, even though these are included in the Waste Inventory Program (WIP-III) database.[66] No explanation is given as to why certain radionuclides were excluded from the NSDF reference inventory, which was the main input into the models used to assess long-term safety of the proposed facility.

The *Safety Case* refers to radioactive progeny appearing gradually over time through "ingrowth" in waste packages (e.g., p. 193). However, radioactive progeny associated with the bulk wastes that would comprise 85% of the volume of the mound are not described in detail. For example, wastes in the Thorium Pit include roughly four tonnes of natural thorium, according to the 2014 *Comprehensive Preliminary Decommissioning Plan* for CRL.[67] Uranium- and thorium-containing bulk wastes placed in the mound would likely already contain their radioactive progeny. Most of these radionuclides are omitted from the Licensed Inventory.

Radioactive progeny of natural uranium and natural thorium are also not addressed in the *Safety Case* or the EA report. The 2.7E+10 Becquerels of thorium-232 shown in the Licensed Inventory are equivalent to a mass of 6.59 tonnes (based on the specific activity of Th-232 of 4100 Bq/g). Thorium-232 would constitute the largest amount (mass) of any single radionuclide in the mound. CMD22 H-7 does not mention why this radionuclide is found in large amounts at CRL: Th-232 targets were irradiated in nuclear reactors to produce U-233 for nuclear weapons.

Thorium-232 decays through radium-228, actinium-228, thorium-228, radium-224, radon-220, polonium-216, bismuth-212, polonium-212, and thallium-208. Of these nine decay products, none are included in the inventory. Depending on the purity of the thorium-232 put in the mound, the total radioactivity associated with this radionuclide could be ten times higher than

[65] https://www.cnl.ca/wp-content/uploads/2021/03/Near-Surface-Disposal-Facility-Waste-Acceptance-Criteria-Rev-4_EN.pdf, p. 42
[66] https://www.cnl.ca/wp-content/uploads/2021/03/NSDF-Reference-Inventory-Rev-3.pdf, p.31
[67] *Comprehensive Preliminary Decommissioning Plan*, CPDP-508300-PDP-001, Revision 2, p. B-14

the amount shown in the Licensed Inventory. This would result in a large underestimate of radiation doses in the *Post-Closure Safety Assessment* and the *Safety Case*.

Similarly, the *Safety Case* makes no mention of the decay chain of uranium-238. This radionuclide would have the second highest mass in the mound, 6.08 tonnes. With respect to progeny of uranium-238 (thorium-234, protactinium-234m, uranium-234, thorium-230, radium-226, radon-222, polonium-218, lead-214, bismuth-214, polonium-214, lead-210, bismuth-210 and lead-210), only uranium, thorium and radium are included in the Licensed Inventory.

A decay product of particular concern is radon. It is likely present in high levels in certain bulk wastes. The Licensed Inventory has no limit on quantities of radon. Waste Management Area F contains approximately 5.15E+11 Bq of radium-226,[68] 14 times the Licensed Inventory limit for this radionuclide, which decays to radon-222 (this provides further evidence that the NSDF could safely contain only a tiny proportion of the federal nuclear legacy wastes). Radon-220, a product of the thorium-232 decay chain, would be present in the Thorium Pit wastes as well.

According to the *Safety Case*, the contribution of radon to post-closure doses was "overshadowing" contributions from other radionuclides, so its contribution to annual dose was removed from scenarios involving future construction of a residence near the mound.[69] This decision to exclude doses from radon is unjustified. Radiation doses from radon and other progeny of U-238 and Th-232 must be estimated and presented in a transparent manner.

In general, the history of production of weapons-grade plutonium and uranium-233 at Chalk River[70] is critical to understanding risks associated with the wastes that might go in the NSDF. The CNSC should require information on origins of waste proposed to be put in the NSDF, in accordance with section 3(1)(j) of the G*eneral Nuclear Safety and Control Regulations*.

S. Pipeline to Perch Lake

Environmental impacts of building a pipeline to discharge treated leachate from the Waste Water Treatment Plant (WWTP) directly into Perch Lake are not described in the EA report. This pipeline would release wastewater into the lake, rather than into the wetlands next to the NSDF, when the ground is frozen or covered with water. (CMD 22-H7, p. 254 of 590) The EA report does not identify the impacts of building the pipeline or assess the significance of these impacts. Impacts could include disturbance of overwintering habitat for at-risk Blanding's Turtles, disruption of fish spawning habitat, removal of wetland vegetation, and release of drilling mud.[71]

Construction of a so-called "exfiltration gallery" to discharge wastes from the mound into the adjacent contaminated East Swamp Wetland (CMD 22-H7, p. 237 of 590) would also have adverse environmental impacts. This could mobilize existing contaminant plumes in the wetland,

[68] *ibid,* p. B-13
[69] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p.382
[70] *https://www.cns-snc.ca/media/history/1945Aug13PressReleasePart1.pdf*
[71] https://iaac-aeic.gc.ca/050/evaluations/document/141455, p. 42

creating a pulse of radioactive and hazardous substances into the Ottawa River. Impacts of this construction activity are also ignored in the EA report.

The EA Report calls the pipeline a "mitigation measure". Although the pipeline might mitigate adverse effects of the "exfiltration gallery" on surface water levels and water table elevations in the wetlands adjacent to the NSDF site, the pipeline would create its own adverse effects.

The pipeline would discharge partly treated leachate from the mound, including large quantities of tritium, directly into Perch Lake, a water body that drains into the Ottawa River, 1 km away. Tritium, the radioactive form of hydrogen, cannot be removed by leachate treatment. One of the justifications for choosing the NSDF site was that discharge of tritium-containing waste water into adjacent wetlands would provide "additional retention time for radioactive decay of tritium prior to reaching biotic receptors." (CMD 22-H7, p. 264 of 590)

An effort to mitigate impacts of the high water table at the poorly chosen NSDF site has resulted in a new significant adverse environmental effect.

The NSDF would release extraordinarily large quantities of tritium to Perch Lake and the Ottawa River. Table 6.1 in CMD 22-H7 (p.238 of 590) refers to an "Effluent Discharge Target" for tritium of 360,000 Bq/L. This is over 50 times higher than the 7,000 Bq/L Ontario drinking water standard and 18,000 times higher than the 20 Bq/L standard recommended by the Ontario Drinking Water Advisory Council in May 2009.[72] Table 6.1 predicts that treated wastewater from the NSDF would have a maximum tritium concentration of 129,415 Bq/L.

CMD 22-H7 does not discuss the source of these extraordinarily high tritium concentrations; nor does it state explicitly that tritium cannot be removed from leachate by wastewater treatment. CMD 22-H7 (p. 275 of 590) says that "Cobalt-60 is expected to be the only radionuclide released in a significant quantity from the WWTP." This statement is clearly false, considering the massive quantities of tritium predicted to be released from the NSDF via the WWTP.

T. Weather cover structure

IAEA Specific Safety Guide SSG-29, *Near Surface Disposal Facilities for Radioactive Waste*, says that "ingress of water into the facility towards the waste and the migration of radionuclides from the waste to the biosphere should be prevented," or "limited to the extent possible."[73]

A late add-on to the NSDF project, referred to as a "weather cover structure" (CMD 22-H-7, p. 126 of 590), remains in the design stage. Submission of "design requirements and design description documents" for this structure is mentioned in the draft *Licensing Regulatory Actions Licensing Phase: Construction* document under Licence Condition G.7.[74]

[72] http://ccnr.org/ODWAC_tritium_2009.pdf
[73] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1637_web.pdf, p.23
[74] *Near Surface Disposal Facility (NSDF) Licensing Regulatory Actions Licensing Phase: Construction Licence Conditions Handbook* NRTEOL-LCH-01.00/2028 Revision 5, p. 3

The *Consolidated Commitments List,* which contains the environmental assessment mitigation measures under Licence Condition G.8, says that weather cover structure "designs are being evaluated for compatibility with the NSDF Project configuration and if feasible, could be implemented as a mitigation measure.[75]

In CMD 22-H7, CNSC staff say that "CNL will further develop and assess the weather cover structure concept and finalize the design" (p. 126 of 590). They then go on to make several unsupported claims about this structure: that it will "maintain waste containment for the duration of facility operation;" that it will "prevent precipitation from coming into contact with the waste during operation;" and that such a structure "has been proven to be effective."

These claims are deceptive and dishonest. The amended licence would not require such a structure -- it would only require evaluation of the feasibility of such a structure. An evaluation of the feasibility of a mitigation measure is not a real mitigation measure.

If the NSDF project included a structure that truly prevented precipitation from coming into contact with the waste, it would not be necessary to include the Waste Water Treatment Plant as part of the project design.

It is impossible to assess whether or not a "weather cover structure" might make a significant contribution with respect to containing waste in the NSDF. The capacity of such as structure to prevent or limit waste migration to the biosphere during extreme weather events involving intense precipitation, rapid snow melt, high winds, etc. is completely hypothetical. Allowing radioactive waste to come into contact with water is the cause of some of the most significant adverse environmental impacts associated with the NSDF project. The lack of effective means to mitigate these impacts makes the project unacceptable.

U. Daily cover

The EIS says that "Cover materials are used to reduce personnel radiation exposure or contact with contaminated materials, to control the release of fugitive dust from the surface of the waste, to promote non-contact surface water run-off, and minimize precipitation infiltration into the waste material."[76] It also says "The daily cover applied at the end of each work day consists of 0.150 m layer of clean soil or an alternative daily cover material."[77]

If 15 cm of clean soil were used to cover the entire 12,000 m^2 area of an active waste cell each day, the eventual total emplaced volume of clean soil alone would exceed the entire volume capacity of the NSDF by a factor of 33. As an alternative to using clean soil, a "tarpaulin, fixative (crusting agent), or similar temporary cover system material" could be substituted.[78]

[75] https://iaac-aeic.gc.ca/050/evaluations/document/141455, p. 36
[76] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. 3-44
[77] *ibid*, p. 14-4
[78] *ibid*, p. 3-44

Given the loss of volume capacity for waste in NSDF if clean soil were used for daily cover, there would be a strong incentive for CNL to use alternative daily cover materials. But if a tarp or fixative were used instead of a 15 cm layer of clean soil, worker radiation doses would increase.

The requirement for daily cover is a major flaw with the mound design. It increases costs and vehicle traffic. The choice of daily cover would have significant impacts on worker radiation doses and the potential for off-site movement of wastes. These impacts should be examined as part of the environmental assessment, but they are not considered in CMD 22-H7.

V. Commercial wastes

Chalk River is Canada's only licensed storage facility for commercial radioactive wastes.[79] It would be reasonable to expect a discussion of commercial and industrial wastes in CMD 22 H-7. The taxpayers of Canada are paying for commercial waste storage at Chalk River, and they will be paying for the long-term management of these wastes in some type of facility when one becomes licensed at some point in the future.

Important questions around industrial and commercial wastes include risks of transport, the potential presence of long-lived radioisotopes, the high-activity cobalt-60 disused sources and tritium wastes imported from other countries, the risks that these wastes pose to workers during waste emplacement, and risks to humans during the post closure period.

These issues should be part of a comprehensive EA report. Indigenous communities and the City of Ottawa are on record as opposing importation of additional radioactive waste to the CRL site.

W. Costs

Canadian taxpayers would be on the hook for CNL's estimated $750 million cost for the NSDF.[80]

CMD 22-H7 (p. 38 of 590) says that “CNL estimated the facility lifecycle costs associated with the concrete vaults to be approximately 4.5 times the cost of the ECM alternative,” but claims that cost “is not factored into CNSC staff’s review.”

It appears that prioritizing a least-cost approach has resulted in a facility type and location that would not adequately contain radioactive and hazardous substances, and would not conform to international safety standards.

That being said, the accuracy of the NSDF cost estimate is in doubt. Maintaining an above-ground mound and a waste treatment facility (to deal with leachate from wastes exposed to snow and rain) could result in long-term costs exceeding those of a properly designed in-ground facility.

[79] https://concernedcitizens.net/2020/10/06/the-government-of-canadas-radioactive-wastes-costs-and-liabilities-growing-under-public-private-partnership/#comments

[80] https://www.iaac-aeic.gc.ca/050/evaluations/document/139596, p. 2-19

It would be highly irresponsible for the CNSC to issue a decision on approval of the NSDF without an independent review of the $750 million cost estimate, and an examination of whether the NSDF would provide "value for money".

Such an independent review should examine the full range of alternative means for long-term management of the federal government's nuclear legacy wastes, taking into account waste origins, forms, quantities, radioactivity, and specific radionuclides.

X. Information and record-keeping

Requirement 22 in IAEA Safety Standard SSR-5 states that plans shall be made for "the arrangements for maintaining the availability of information on the disposal facility."[81] SSR-5 also says that:

- "The need to preserve the records for long periods of time has to be taken into account in selecting the format and media to be used for records;"[82] and
- "Arrangements have to be made to be able to pass on information about the disposal facility and its contents to future generations to enable any future decisions on the disposal facility and its safety to be made."[83]

The EA report fails to mention international safety requirements to maintain information on a disposal facility.

In the NSDF *Safety Case*, CNL says that the requirement in the *Class 1 Nuclear Facilities Regulations* for "records to be kept and retained" is "not applicable to the NSDF Project."[84] CNL says that the SSR-5 requirement to "preserve the records for long periods of time" is "demonstrated" in the *CNL-CNSC Administrative Protocol for the Near Surface Disposal Facility*.

However, this *Administrative Protocol* relates to the licensing and environmental assessment processes for the NSDF. It has nothing to do with keeping records if the NSDF is approved.

CNL should be required to comply with international and domestic record-keeping requirements for radioactive wastes and for radioactive waste storage and disposal facilities.

Y. Mitigation measures

CMD 22-H7 claims that a 105-page "*Consolidated Commitment Lists*"[85] document prepared by CNL "captures all mitigation measures" and would "become an enforceable condition that is set out in the Commission's decision." (CMD 22-H7, p. 217 of 590) This document would be associated with new licence condition G.8, one of the two proposed licence amendments.

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[81] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1449_web.pdf, p.41
[82] *ibid,* p. 20
[83] *ibid,* p. 43
[84] https://www.cnl.ca/wp-content/uploads/2021/03/Near_Surface_Disposal_Facility_Safety_Case_Rev_2.pdf, p. 569
[85] https://iaac-aeic.gc.ca/050/documents/p80122/139601E.pdf

These so-called "mitigation measures" are largely unenforceable, empty promises. To be enforceable, each commitment should have associated compliance verification provisions. It is inconceivable that the Commission could review such a large number of “commitments” prior to “prescribing” them. Nor is it credible that CNSC staff could regularly review and enforce them. One shudders to imagine what a “Regulatory Oversight Report” for CNL sites would look like if it attempted to address the 856 “commitments” in this list.

Many are directed at Indigenous communities. This has potential to create a heavy work load for Indigenous communities, and unrealistic expectations related to engagement on matters such as environmental monitoring at the NSDF site (e.g., CMD 22-H7, pp. 325 and 380 of 590).

Most of the 856 "commitments" merely repeat statements found in CNL's 1661-page EIS. Some are new, such as the provision that radioactive waste remaining in the Port Hope area after the closure of the two mounds there would be sent to Chalk River for disposal.[86]

Shipping additional Port Hope waste to CRL would worsen, not mitigate, the environmental impacts of the NSDF. This is not a mitigation measure for the NSDF. It is not discussed in the EA report. It is not acceptable. It would create additional health and environmental risks for Ottawa Valley residents.

Z. Amendments to the Chalk River Laboratories (CRL) site licence

Construction of a disposal facility and disposal of radioactive wastes are authorized activities under Part IV of the CRL site licence. It appears that the Commission may not actually have to make a decision on licensing of the NSDF. If this is true, the only decision that the Commission must make during the public hearing is related to the significance of the environmental impacts of the proposed facility.

The current CRL site licence does not appear to provide a sound legal basis for enforcement of activities related to the NSDF or other class 1 nuclear facilities at CRL.

To restore the legal basis for Commission oversight of the NSDF and other Class 1 facilities at CRL, we request the following amendments to Part IV of the site licence:

- Replace “prepare a site for, construct, operate, modify, decommission or abandon a nuclear facility” with “operate or modify a nuclear facility;”
- Replace “possess, transfer, use or abandon a nuclear substance” with “possess, transfer, or use a nuclear substance”; and
- Replace “manage, store or dispose of a nuclear substance” with “manage or store a nuclear substance.”

[86] *ibid*, pp. 38 and 73 of 105

A Draft *Licensing Regulatory Actions Licensing Phase: Construction* document prepared by CNSC staff contains regulatory actions for proposed amendment G.7 of the Chalk River site licence (CMD 22-H7, p. 26 of 590). Although our group requested and received a copy of this document,[87] to our knowledge it was not made publicly available in advance of the April 11, 2022 deadline for public submissions.

The draft *Licensing Regulatory Actions* document indicates that many key NSDF documents, including the *Safety Analysis Report,* the *Waste Acceptance Criteria,* and the *Post-Closure Safety Assessment* (which includes the contaminant transport model) are still undergoing revisions.

Plans for activities with a potential for highly significant adverse environmental impacts during the construction phase (such as the *Blasting Safety Plan*) also have not yet been finalized.

It is premature to consider licensing of the NSDF. The Commission would not act reasonably were it to "prescribe" regulatory actions that it may not even have seen. The public cannot comment on the adequacy of regulatory actions and documents that have not been finalized.

The Commission cannot render an informed "opinion" pursuant to section 24(4) of the *Nuclear Safety and Control Act* as to whether CNL would "make adequate provision for the protection of the environment, the health and safety of persons."

[87] *Near Surface Disposal Facility (NSDF) Licensing Regulatory Actions Licensing Phase: Construction Licence Conditions Handbook* NRTEOL-LCH-01.00/2028, Revision 5