Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

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## Oral presentation

## Written submission from the Canadian Nuclear Workers' Council

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 du Conseil canadien des travailleurs du nucléaire

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

CANADIAN NUCLEAR WORKERS' COUNCIL

**Canadian Nuclear Workers' Council**
**244 Eglinton Ave E, Toronto, ON, Canada M4P 1K2 | Tel: 416-804-5542 | cnwc-cctn.ca**

April 11, 2022

Members of the Commission

c/o Louise Levert
Senior Tribunal Officer, Commission Secrétariat
Canadian Nuclear Safety Commission
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**Reference 2022-H-07**

**CNWC Submission to the Canadian Nuclear Safety Commission regarding the request from Canadian Nuclear Laboratories to amend the Chalk River Laboratories' Operating Licence to authorize the construction of a Near Surface Disposal Facility**

Dear President Velshi and Members of the Commission,

Please accept this letter as the written submission from the Canadian Nuclear Workers' Council (CNWC) for the Canadian Nuclear Safety Commission (CNSC) public hearing regarding the request from Canadian Nuclear Laboratories' (CNL) for an amendment to their Nuclear Research and Test Establishment Operating Licence (NRTEOL) for Chalk River Laboratories (CRL), NRTEOL-01.00/2028, to add a new Class 1B Nuclear Facility, the Near Surface Disposal Facility (NSDF).

The CNWC is also requesting an opportunity to make an oral presentation at the CNSC Public Hearing - Part 2, scheduled to begin on May 31, 2022.

**The Canadian Nuclear Workers' Council**

The CNWC was formed in 1993 as an association of Unions representing Workers across Canada's nuclear industry. Our Membership encompasses uranium mines and mills, nuclear fuel production, nuclear power plant (NPP) operation and maintenance, engineering, NPP construction and refurbishment, medical isotope production, nuclear research and development, nuclear waste handling and decommissioning. This includes Unions at CNL's CRL Site.

The goals of the CNWC are to:

- ensure the perspectives of Canada's Nuclear Workers are heard by decision makers,
- strengthen the collective role of Nuclear Workers via their Unions as partners in Canada's Nuclear Industries,
- enhance public knowledge about the benefits of Canada's Nuclear Industry, and
- share our experiences with each other.

The CNWC engages in a number of activities to further our goals including a quarterly newsletter, website, updates to Member Unions, lobbying, outreach and an annual conference for CNWC Members in communities hosting Canada's nuclear facilities. We have held a conference in Pembroke with tours of CRL. That was a great opportunity to see the birthplace of Canada's nuclear industry. The CNWC is also a regular participant in the regulatory process for Canada's nuclear industry.

<u>Specific to the NSDF Project and this submission.</u>

The CNWC regularly makes submissions on CNSC Staff's annual Regulatory Oversight Reports (ROR) including the most recent ROR on Canadian Nuclear Laboratories (CNL) Sites, reference CMD 20-M22. The CNWC started following the progress of the NSDF project early and continued to follow it as it evolved. The CNWC and CNWC Member Unions requested a meeting with CNL to provide us with a better understanding of how the NSDF project was evolving, ask questions and raise a couple concerns. On June 17, 2018 representatives from the CNWC, United Steel Workers (USW), Professional Institute of the Public Service of Canada (PIPSC) and Power Workers' Union (PWU) met with representatives from CNL. This meeting provided an overview of the proposed NSDF project along with a tour of the proposed site and an opportunity for meaningful dialogue. Our questions and concerns were addressed to our satisfaction. In November 2019 our application for funding from the CNSC's Participant Funding Program was approved. In December 2019 Representatives of the CNWC, Society of United Professionals (SUP) and the PWU met with Ottawa Riverkeeper to compare our thoughts on the project generally. The SUP Representative at that meeting was not an expert on CNL's proposed NSDF project but he had expertise in the field of radioactive waste management. The CNWC has participated in webinars on the NSDF with both CNL and the CNSC. We ensured our Members were provided with regular up to date information by way of emails, quarterly National Director Reports to the CNWC Board and National Director updates to CNWC Members.

In preparation for this submission we reviewed the information found on CNL's website including CNL's application for a licence amendment, the 2021 Final Environmental Impact Statement (EIS) and supporting documentation. We also observed the Part 1 public hearing on February 22, 2022 and reviewed the Commission Member Documents (CMD) for that hearing: submission and presentation from CNL on their application, CMD 22-H7.1 and CMD 22-H7.1A, as well as CNSC Staff's submission and presentation on their assessment, CMD 22-H7 and CMD 22-H7A. The Environmental Assessment (EA) on the NSDF is contained in CMD 22-H7.

To get an expert evaluation and maximize the value of our submission, Dr. Michael Ivanco was asked to review the proposed NSDF project and provide a report to support our submission. Dr. Ivanco is the Past President of the Society of Professional Engineers and Associates (SPEA) and continues to represent SPEA on the CNWC Board. He worked with AECL at CRL from 1984 to 1997 where he had daily interaction with professionals working in the Waste Management Division. He moved to the engineering division in Mississauga, Ontario where he worked till 2015. He is a sessional lecturer at the University of Toronto. His biography is found at the end of his report. An earlier draft of his report was shared with our Member Unions at CRL. His report forms the foundation of this submission and is found immediately following our closing comments. For the remainder of the submission preceding the supporting report we will strive to minimize any duplication with that report and the previously mentioned reference materials.

**CNL's Application**

The CRL site is located in Deep River, Ontario adjacent to the Ottawa River. Atomic Energy of Canada Limited (AECL), a federal Crown Corporation, is the owner of the site as well as the radioactive waste located there. The site is operated by CNL under a contract arrangement. Chalk River has served Canadians well for about 70 years with the early development of nuclear science and technology, the Canada Deuterium Uranium (CANDU) Reactor and the advancement of nuclear medicine. Now CNL needs to permanently dispose of the site's low level radioactive waste. CNL submitted a project description followed by an application to construct a near surface disposal facility (NSDF) for the permanent, safe disposal of solid low-level radioactive waste at CRL. The proposed NSDF is considered a Class IB nuclear facility and is subject to a licensing regulatory review under the Nuclear Safety and Control Act (NSCA) and to an environmental assessment (EA) under the Canadian Environmental Assessment Act, 2012 (CEAA 2012).

CNL updated the CNWC and the Unions at CRL on the NSDF project and EIS as they evolved. Following a review of the application, the EIS and supporting documentation the CNWC supports CNL's application. CNL has mature, successful programs in place to effectively manage all Safety and Control Areas (SCAs) and we have no reason to believe that will not continue with the addition of NSDF.

**CNSC Staff's Assessment on CNL's application**

The CNWC is in full support of CNSC Staff's assessment of the application including the EA Report. We believe they considered the appropriate information and reached the appropriate findings, conclusions and recommendations as set out in CMD: 22-H7, specifically:

- CNSC Staff conducted an EA of the proposed NSDF under CEAA 2012 and determined that the proposed NSDF Project is not likely to cause significant adverse environmental effects.
- CNSC Staff concluded that CNL's application to construct an NSDF at the CRL site complies with all applicable regulatory requirements.
- CNSC Staff determined that the proposed NSDF project is protective of people and the environment.
- CNL is qualified to carry out the activities authorized by the proposed licence amendment and, in carrying on those activities, will continue to make adequate provisions for the health and safety of people and protection of the environment.
- The proposed NSDF is suitable for the permanent containment and isolation of the waste for as long as the waste's radiological hazards remain.
- CNSC oversight will continue throughout the lifecycle of the project.
- Recommendation that the Commission determine that the NSDF Project is not likely to cause significant adverse environmental effects as per the EA under CEAA 2012.
- Recommendation that the Commission approve CNL's application to construct the NSDF and amend the CRL NRTEOL.

**Concluding Remarks**

Canada's nuclear industry is important for Canada and for all Canadians. Nuclear energy provides us with a source of clean, reliable electricity without greenhouse gas emissions. This is becoming increasingly important as concerns grow regarding the effects of climate change. Nuclear also provides us with medical isotopes, high-quality employment, economic growth and support for innovation. CNL is an essential part of Canada's nuclear industry and poised to open new doors with the advancement of our next generation of nuclear technologies such as small modular reactors (SMRs). Radioactive waste has been safely managed for the life of our nuclear facilities and continues to be safely managed today but we have a responsibility to implement a permanent solution. For many reasons the success of the NSDF is important for all of us.

An engineered near surface disposal facility, as described in the application, is suitable for the disposal of low level radioactive waste. The NSDF will only contain solid, low level radioactive waste and primarily short-lived radionuclides. The design life will allow for the radioactive decay of the waste inventory. The NSDF is protective of the environment, the Ottawa River and human health.

In conclusion, the CNWC fully supports CNL's application to construct a Near Surface Disposal Facility project at the Chalk River site. We have a shared responsibility to safely dispose of the radioactive waste and not leave it for future generations. The NSDF provides a safe and responsible solution and addresses environmental concerns. As Dr. Ivanco says in his conclusion, "the NSDF will be a good solution for the disposal of historic low level waste and a great improvement over the current situation."

We recommend that the Commission determine that the NSDF Project is not likely to cause significant adverse environmental effects and approve CNL's application to construct the NSDF.

Thank you for the opportunity to submit our thoughts on the proposed licence amendment.

I would once again like to use our submission as an opportunity to thank the Members of the Commission, CNSC Staff and all Intervenors. This public process and strong regulatory oversight serve to protect the environment and maintain the high level of health and safety in our workplaces and our communities.

Bob Walker
National Director
Canadian Nuclear Workers' Council

Review of the Proposed Near Surface Disposal Facility (NSDF) at Chalk River Labs by the Canadian Nuclear Worker's Council (CNWC)

Prepared by Dr. Michael Ivanco (Canadian Nuclear Worker's Council)

The Canadian Nuclear Workers Council (CNWC), founded in 1993 is an umbrella organization of Unions representing workers in all sectors of the Canadian nuclear industry. Represented sectors include electric power utilities, uranium mining and processing, radioisotope production for medical and industrial purposes and nuclear research.

## 1. Chalk River History in the Context of Nuclear Development

Chalk River Nuclear Laboratories was founded in 1942 as part of the National Research Council and was originally a top secret installation associated with the Manhattan project during World War II. At the time both Canada and the United States of America were at war in Europe with NAZI Germany and the latter were known to be trying to develop nuclear weapons, hence there was a race to do so on both sides of the Atlantic Ocean. The contribution of scientists and engineers at Chalk River was, originally, to find ways to make heavy water, since heavy water reactors were perceived at the time as the most efficient way of making plutonium.

We all know who won that race. At the end of the war Canada was left with a considerable amount of expertise related to nuclear physics and engineering at Chalk River, arguably at the leading edge of nuclear technology. Indeed, at Chalk River the scientists and engineers built only the 1st functioning reactor in the world outside of the United States, the Zero Energy Experimental Pile (ZEEP) one of the first heavy water reactors.

In 1952, under the direction of Minister C.D. Howe, Atomic Energy of Canada Ltd (AECL) was formed and tasked with exploiting nuclear energy for peaceful purposes. This ultimately led to the development of the CANDU reactor, the field of nuclear medicine, radiation therapy for treatment of cancer and the development of electron and proton accelerators for industrial and medical uses, to name the best known of many accomplishments. A Nobel Prize in Physics, awarded to Canadian Bertram Brockhouse, was for work he did while a scientist at Chalk River.

While there was a significant developing body of knowledge about how to use nuclear energy to make weapons, and for peaceful purposes, in the late 1940s and 50s, the knowledge of the radiological effects of smaller doses of radiation was less well known. As recently as the 1920s and 30s, people consumed radioactive cocktails[1], the first "energy" drinks, for their health. And while it became known by the early 1930s, that large amounts of radiation were lethal, as was consuming large amounts of radioactive energy

[1] "Medicine: Radium Drinks". *Time*. Apr 11, 1932.

drinks, the impact of smaller amounts was not clear. Certainly in the early days of nuclear power there was a much less cautious approach to dealing with radioactive materials. This approach, in part, has led to a legacy of waste, at CRL and other locations around the world, with various degrees of radioactivity, in different chemical and physical forms and with different methods of containment. The characterization of waste that was stored in the earlier days of the industry was also quite poor in some instances, making the job of remediation today more complex.

For about 60 years, the NRU reactor at Chalk River was the world's single biggest source of medical isotopes, principally Mo-99 (the precursor of Tc-99m). This product of the reactor, and others, has saved countless lives over the decades but comes with a waste legacy, since all of the neutron targets in the reactor were highly enriched uranium and, even after irradiation, remain quite highly enriched and with the full periodic table of neutron rich fission products and their activation products and daughters.

The Near Surface Disposal Facility (NSDF), however, does not deal with disposal of any of these higher level waste products, except as trace elements in a much larger volume of relatively benign waste. Most of this waste exists at the Chalk River site but about 10% of it is generated at other Canadian sites, mostly hospitals that have nuclear medicine capability and a small amount comes from one of AECL's previous sister site, Whiteshell Nuclear Laboratories in Pinawa, Manitoba.

## 2. Review of the NSDF

### 2.1 General Concepts

The need for transitioning from storage to disposal for low-level waste at CRL has been recognized for decades[2]. In the late 1980s, AECL designed a facility called the Intrusion Resistant Underground Structure (IRUS) for the disposal of low level waste which, at the time, was defined as waste that would remain hazardous for up to 500 years, very similar to the NSDF time scale. IRUS was never built at Chalk River, and it is not mentioned in the CRL Submission to the CNSC, but the NSDF appears to be an evolution of the IRUS concept and includes waste water treatment, which IRUS did not have.

Any waste disposal system needs to minimize radiation dose to different groups of people. In the short term (i.e. during the 50 years of operation of the facility) the NSDF needs to minimize dose, through its design and operating procedures, to operators who will transport the waste to the disposal site and handle it. Since the likelihood that operators will be exposed to some level of radiation is 100%, the amount of dose that they receive must also be accurately measured. At Chalk River there is a well-developed radiation protection program to deal with this.

In the short, and medium term (medium being the length of time that there is a defined and operating Chalk River site after the 50 years of operation of the NSDF) the NSDF also needs to minimize exposure to nearby residents who live near the plant boundary. This needs to be dealt with by plant design as well as operating procedures.

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[2] (https://inis.iaea.org/collection/NCLCollectionStore/_Public/23/025/23025698.pdf)

In the long term the design of the facility needs to address what might be called inadvertent intrusion, hundreds of years in the future, which could be farming, construction, excavation or other activities.

The danger of radioactive substances over time also needs to be understood. It is common to hear, from critics of this, or any disposal facility for radioactive material, of chemical species that are dangerously radioactive for 10's of thousands of years. One should understand that this is an oxymoron. The most dangerous radioactive species are those with short half lives, since they are the most unstable and their nuclei break apart while releasing radiation over short periods of time. For example, polonium-210, which is known to have been used as a poison for the purposes of assassination in recent years[3], has a half-life of 140 days. It is very dangerous. By definition, elements with long half-lives are not particularly radioactive. This is not to say that they aren't harmful if ingested and have chemical natures that allow them to stay in the body for long periods of time. For example, the first "energy" drinks, that were popular in the 1920s and early 30s, actually contained "energy", typically radium-226, a radioactive species with a half-life of 1600 years. If it just went into the body and then exited in a short period of time, like water, it would still be hazardous but not lethal. But the chemistry of radium is such that it gets incorporated into bone where it then sits forever, emitting radiation as it decays into various daughter products. Indeed, most heavy metals tend to stay in the body for a long time.

One of the most lethal elements that we have in our food chain, for example, is mercury (Hg) which is not radioactive at all but which finds its way into all landfill sites in the world because it is widely used in fluorescent lighting, batteries, thermometers, switches etc. It is also released by the burning of coal and is a common contaminant in fish, since it finds its way into ocean water and ground water. Regulations for ordinary landfill sites are not nearly as stringent as for ones that may contain radioactive elements, which has allowed mercury to escape many of them and get into the food chain. While radioactive waste products become less hazardous over time, mercury does not and once in the body it stays there for many months.

While regulations for municipal landfill sites are more stringent now than they used to be there are thousands of landfill sites around the world that have been buried that never had much in the way of regulation and that contain substances that will remain toxic forever. We mention this because there are no such historic sites for radioactive waste since it has all been stored. It is really only in recent years that the older sites for nuclear power development and use are shifting from storage to disposal. And this process is very highly regulated, as these proceedings regarding the NSDF illustrate.

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[3] See for example: https://www.medicalnewstoday.com/articles/58088#what_is_polonium210

## 2.2 How Hazardous is the Waste that is to be disposed of in the NSDF?

There has been considerable criticism in the press about the NSDF because it would contain materials that would be "dangerously radioactive for 1000s of years"[4], whereas the proposed NSDF site is designed for only 550 years. As explained in section 2.1, nuclear materials that are dangerously radioactive are those that have shorter radioactive half lives since they are the most unstable. Materials with long half lives may be dangerous, but not dangerously radioactive. The Chalk River Labs (CNL) submission to the CNSC (CMD 22-H7.1) deals with this issue appropriately in the CNWC's opinion.

To begin with, about 90% of the waste that would go into the engineered NSDF facility is already on site in storage, some of it just in trenches. Anything that would remove such material from storage to an engineered disposal facility can only be an improvement to the current situation. As explained in the CNL submission *"The NSDF will contain only low-level radioactive waste. Low-level radioactive waste contains primarily short-lived radionuclides (i.e., half-life ≤30 years) and restricts the number of long lived radionuclides (i.e., half-life > 30 years); thus, isolation and containment are only required for periods of time up to a few hundred years. Long-lived radionuclides are included in the NSDF inventory as they are intrinsically part of the radiological fingerprints of waste streams at CRL and other CNL sites."*

While the short half-life radionuclides are less stable and more active than long lived radionuclides, their degree of hazard also depends on their concentration and if that is low, as it must be to qualify for disposal in the NSDF, then the hazard is minimized. One benefit of short lived radionuclides is that after 10 half lives (this is a rule of thumb for all radionuclides)[5] they are not considered hazardous from a radiological point of view. In the CNL submission they go on to say that:

*"Long-lived radionuclides are included in tends inventory as they are intrinsically part of the radiological fingerprints of waste streams at CRL and other CNL sites "and that it is not practical, technical, or economical to separate the long-lived radionuclides from the waste streams, especially since many of the waste streams are in the form of soil and building debris. However, the concentrations of long-lived radionuclides that are proposed in the NSDF inventory are limited, consistent with CSA N292.0 General principles for the management of radioactive waste and irradiated fuel"*

It may be difficult for some people to accept the statement that "*it is not practical, technically or economically to separate long-lived radionuclides from the waste streams*." It might help to have an example of why this is the case.

Many of the buildings that are on the CNL site are still, what are colloquially called, WWII temporary structures. These were built, as one might expect, during WWII and are frame buildings with clapboard siding, usually painted white. They are still commonly seen in the Montreal Road site of the National Research Council in Ottawa as well as at Chalk River. Many of these temporary buildings are quite old now.

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[4] see for example https://www.thestar.com/local-renfrew/news/2022/02/23/citizens-groups-criticize-chalk-river-nsdf-project.html?itm_source=parsely-api)

[5] See for example https://ionactive.co.uk/resource-hub/guidance/the-10-half-life-rule-of-thumb-for-radioactive-materials

One such building was Building 107 in Chalk River. It is one of 3 buildings used to forecast volume and radioactivity for decommissioning waste for the NSDF[6,7] .

Building 107 was built in the very early days of the Chalk River site. It served various purposes during its lifetime. It was initially the home of the Chemistry Division, and also housed the Waste Management Division for a number of decades before its demolition and decommissioning about 10 years ago. Building 107 was a multi-use building that had a library and also housed offices for scientists, engineers and technicians and technologists who worked there. There were also laboratories of various types, chemical, mechanical, laser isotope separation etc. However, historically, there were also labs that handled radionuclides, so there were active fumehoods, shielding and ventilation systems. These were not used for at least the last 30 years that the building stood. They were cleaned and left sealed up while people continued to use the building for other purposes. It was generally understood that some of the vents from the active fumehoods may have trace contaminants of a number of radionuclides.

When the building was demolished there would have been extensive quantities of wood, concrete, metal and likely some contaminated earth (since significant parts of the building were supported by concrete posts, with no basement – only a crawl space with an earthen floor). The demolition of a building as large as building 107 likely resulted in hundreds of tonnes of debris. Trace contaminants would likely have been in the order of grams of material spread over surfaces of very long runs of piping. Trying to separate such radionuclides from large quantities of benign material would be impractical. Measuring the activity and disposing of it according to existing safety standards is the prudent thing to do.

We have CSA standards for a reason and that is to protect the health and safety of people. If a site and its operating procedures meet the standards then we judge them to be safe. If the NSDF meets these standards then we consider it to be safe and it is designed to meet these standards. The standards have input from a wide variety of experts in different fields. If the NSDF, through its design and operation, is judged to meet the safety standards but there is still objection to its safety, then those objections must be with the CSA standards and should be addressed at that level.

Figure 1 is a reproduction of Figure 18 of the CRL submission to the CNSC and is reproduced here. It illustrates the predicted activity of the NSDF as a function of time (based on the inventory of decommissioning waste from buildings 107, 204 - J-Rod Bays and 204- Process Piping). Because it is a log scale, the degree of radiological decay appears less dramatic than it actually is and after 5000 years, the radioactivity within the NSDF looks much larger than normal background levels by a factor of 10 instead of a factor of 2.

[6] Note: The author was, in the early 1990s, head of the health and safety committee for buildings 320, 330 and 107. The committee was responsible for, amongst other things, regular safety inspections of these building.
[7] https://www.cnl.ca/wp-content/uploads/2021/03/NSDF-Reference-Inventory-Rev-3.pdf

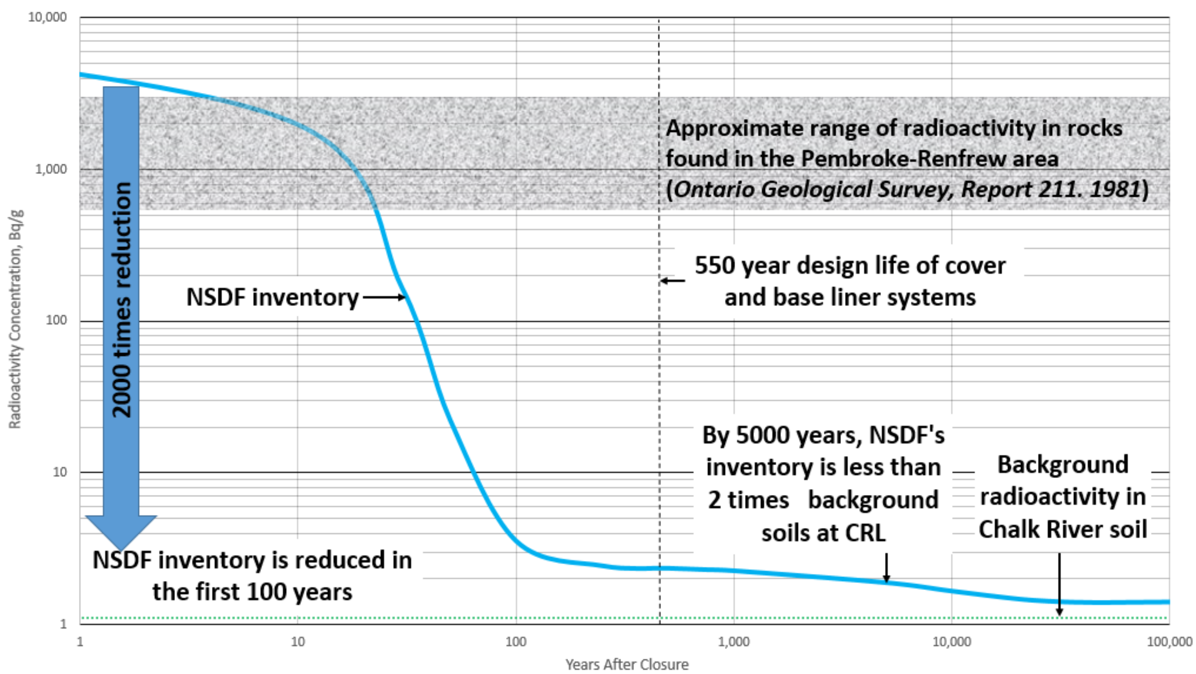


**Figure 1. Radiological Decay of the NSDF Inventory with Time**

In the CRL submission there is a section on background levels of radiation that attempts to provide context that we will expand on here. In Canada, the public dose limit is 1 mSv/yr, and the nuclear energy worker dose limit is 50 mSv, in any one year and 100 mSv over five consecutive years. As detailed on the CNSC website[8], the total worldwide average effective dose from natural radiation is approximately 2.4 mSv per year, while in Canada, it is 1.8 mSv.

Figure 2 shows what the sources of this radiation are.

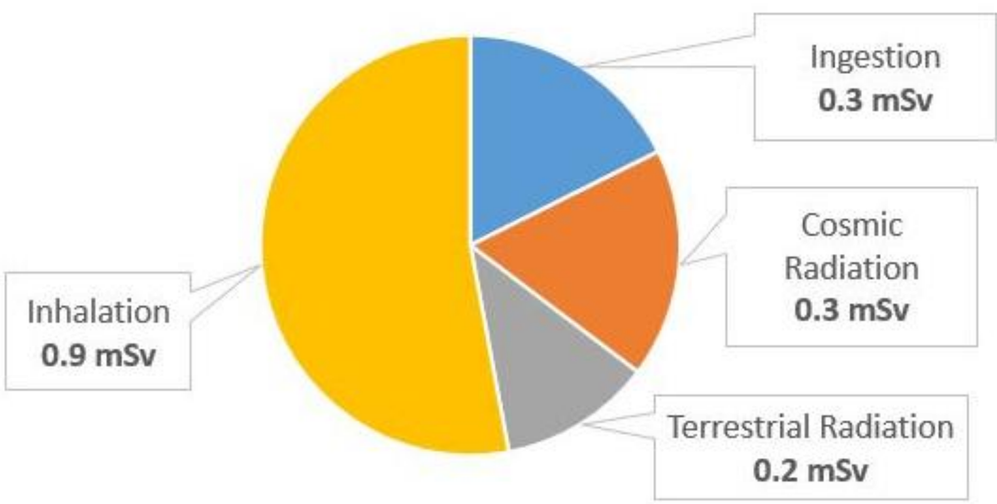


Figure 2: Doses from Natural Background radiation in Canada

[8] https://nuclearsafety.gc.ca/eng/pdfs/Fact_Sheets/Fact-Sheet-Background-Radiation-eng.pdf

In Canada more than half of our exposure comes from inhalation of radon gas, which is a decay product of uranium, which is found in rocks in the Canadian Shield and finds its way into home construction.

We are also exposed to man-made radiation that adds, on average, an additional 40 % exposure on top of natural background. So in Canada (and the United States for that matter), approximately 60% of the radiation that we are exposed to comes from natural sources and 40% from man-made sources[9]. Of this man-made radiation, the vast majority comes from medical procedures. The amount due to the operation of nuclear facilities is miniscule; approximately 0.003% of natural background for anyone who lives within 50 km of a nuclear facility[10].

In some parts of the world, natural background radiation is much higher than in Canada– for instance on the Kerala Coast in India, the annual effective dose is 12.5 mSv[11], mostly on account of the relatively high thorium content of the sands found there. Thorium is naturally occurring.

The dose varies with the source of the radiation. For example, in northern Iran, geological characteristics result in a dose that can reach 260 mSv/year, which is more than 5 times higher than the maximum annual limit for radiation workers[12]. This large background is caused by, again, high thorium concentrations in soil and rock but also because of hot springs that have large amounts of Ra-226 dissolved in them, which also speaks to natural rock deep underground that has substantial uranium content. It should be noted that our understanding of the effects of radiation on human health come largely from studies of Hiroshima survivors, who received most of their lifetime radiation doses all at once. Those studies suggest that doses higher than 200 mSv/year should be inducing genetic mutations in cells and lead to high cancer rates[13]. But studies of the inhabitants of that high background region of Iran actually show no increase in cancer rates and actually show reduced levels of mutation[14] compared to the general population. This does not mean to suggest that high levels of radiation are good for you. However, it does suggest that even if levels of activity within the NSDF after 5000 years are twice the natural background of other soils it is not necessarily dangerous based on data from other parts of the world.

### 2.3 How can the Ottawa River be kept safe from the NSDF?

One of the most common criticisms of the NSDF is that it should not be located at the Chalk River site because of the proximity of the Ottawa River, which is a recreation source for many people as well as a drinking water source for many communities downstream. These are valid concerns for the location of any waste depository. The CNWC believes that CNL staff have overdesigned the NSDF to allay any such concerns.

To begin with, as already mentioned, 90% of the waste is on Chalk River site in storage, with some of it stored in trenches. Removal of much of this waste and placing it in an engineered repository can only be an

[9] http://nuclearsafety.gc.ca/eng/resources/radiation/introduction-to-radiation/radiation-doses.cfm
[10] https://www.nrc.gov/about-nrc/radiation/related-info/faq.html
[11] https://nuclearsafety.gc.ca/eng/resources/fact-sheets/natural-background-radiation.cfm
[12] See for example https://www.sciencedirect.com/science/article/abs/pii/S0531513104018412
[13] https://www.ncbi.nlm.nih.gov/books/NBK218706/
[14] https://www.researchgate.net/publication/11588980_Very_high_background_radiation_areas_of_Ramsar_Iran_Preliminary_biological_studies

improvement. Of the potential Chalk River sites, the one chosen provides the best geological location and when combined with the engineered features of the NSDF, will safely sequester the waste. As described in the CNL submission, the NSDF will be situated on bedrock that slopes away from the Ottawa River

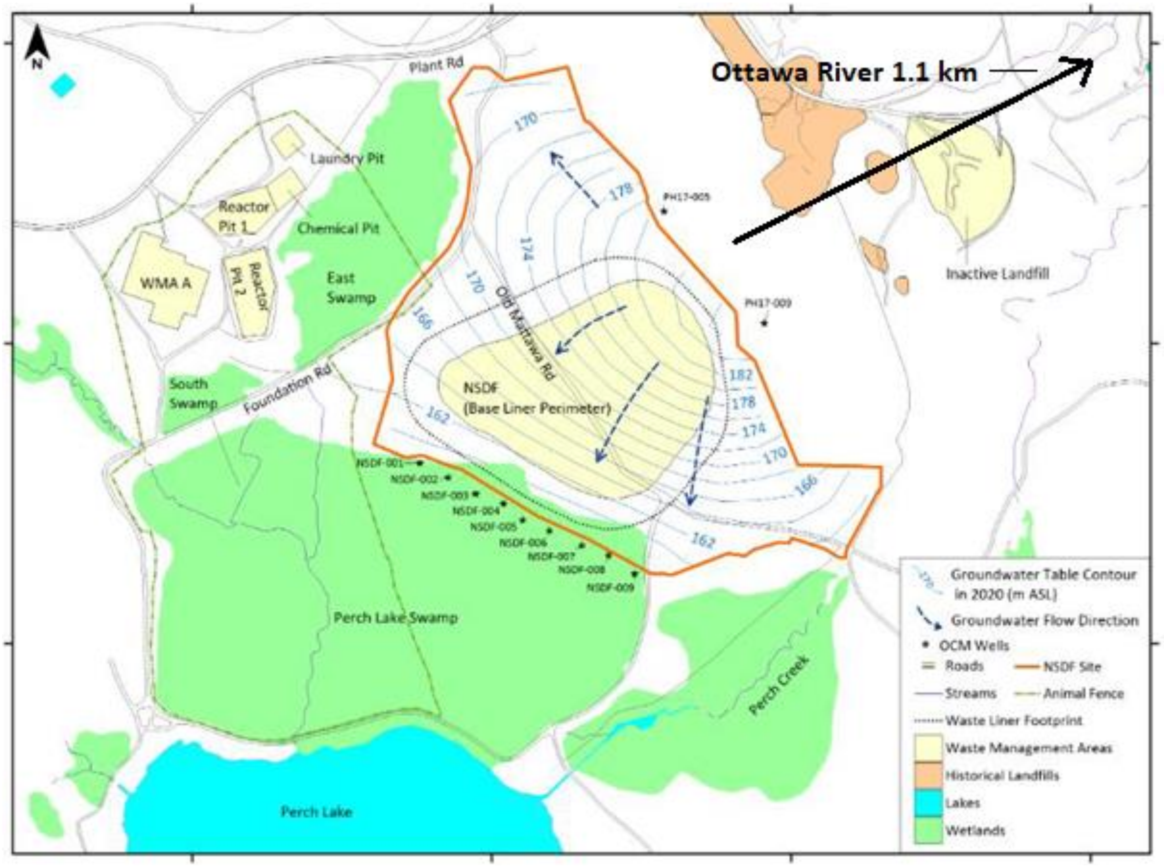


**Figure 3: Near Surface Disposal Facility local water flow gradients**

Figure 3 is a reproduction of Figure 14 of the CNL submission to the CNSC with the direction of the Ottawa River, with respect to the NSDF site shown. There is a 20 m drop from the top of the facility to the bottom. As the CNL report adds, the groundwater passing below the NSDF, discharges to Perch Creek before draining to the Ottawa River, providing a flow path distance of about 2.6 km and the groundwater transit time from the NSDF site to the nearest surface waterbody is estimated to be 5 to 15 years with an average transit time of approximately 7 years. How, confident can we be in these estimates? Well we can be very confident because they are based not on modeling but on actual data. As mentioned in the introduction, in the early days of nuclear research there was a less cautious approach to waste storage and the Perch Lake basin has some relatively small legacy waste management areas that have radioactive contaminants. Therefore there are decades of data showing how different species migrate[15]. This longer transit time is important because it gives some of the shorter half-life components of the NSDF time to decay should they be accidentally released. However, there are multiple barriers and mitigation features to ensure that such releases don't happen.

[15] https://inis.iaea.org/collection/NCLCollectionStore/_Public/23/025/23025698.pdf)

One of the criticisms of the NSDF is that although it is situated on bedrock that slopes away from the Ottawa River, the bedrock is fractured. We don't know if this criticism is valid but even if it were, the natural bedrock is but one of many barriers. There is a double- high-density polyethylene Geo-membrane liner system backed up by multiple natural and artificial clay liners.

Why choose clay, one might ask? Clay is used because it is known that it can provide a hydrological barrier for many thousands of years and is the standard recommended for any depository for radioactive material. There are some very good natural analogues for the containment of radioactive material that are based on clay. For example, the Cigar Lake uranium deposit in Saskatchewan contains the richest uranium deposits in the world, with an average ore concentration of about 16%. These deposits are about as radioactive as spent CANDU fuel after it has been out of the reactor for only 100 years[16]. These deposits are located in sandstone, which is very permeable to water, and located about 400 metres below the surface. But they are covered with a dome of clay and have been in place for over 1 billion years[17].

Radioactive elements are very easy to detect with sensitivity far greater than any non-radioactive contaminants. Because of this it is possible to measure the degree to which decay products of uranium have migrated to the surface, through the clay barrier. But no chemical or radioactive signature can be detected on the ground above it. This is quite significant since this deposit has survived the formation of the Rocky Mountains and thousands of ice ages and remained intact without allowing the migration of uranium or any of its radioactive products. This is why clay is used as the final barrier, because of its demonstrated mechanical and elastic properties.

The first low level waste depository design at Chalk River, as mentioned earlier, was IRUS. It had some similarities to the NSDF in terms of barriers between the waste and the environment but the NSDF has one thing that it did not, namely a water treatment plant to capture and treat any water that may come in contact with the waste, most commonly through rainfall interacting with waste before it is capped. The hydrological barriers between the NSDF and the environment, one of which is clay, enable the diversion of waste water to the water treatment plant. The NSDF itself is divided into 10 cells so that at any one time, at most, 10% of the inventory could be exposed to rainfall. The NSDF water treatment plant has a variety of pumps and holding tanks and, like any good nuclear facility, has redundant systems, in case one should fail, each of which can handle the full system flow. Discharge into the Perch Lake water basin then only occurs when the water has been treated to levels deemed acceptable by the relevant CSA standards.

## 3. Conclusion

The NSDF is not a unique facility with "first of a kind" risks. There are two other low-level waste disposal facilities in Ontario, one in Port Granby and another in Port Hope. The latter two are for the disposal of low level waste associated with past uranium processing activities and they are similar in size to the NSDF. There are seven such facilities in the United States, five in operation, one under construction and one that has been capped and closed.

[16] https://inis.iaea.org/collection/NCLCollectionStore/_Public/49/101/49101472.pdf

[17] https://www.nwmo.ca/~/media/Site/Files/PDFs/2015/11/16/20/36/Secure_Accessible_MultipleBarrier_Backgrounder_EN.ashx?la=en

We conclude that the NSDF proposed for the Chalk River site of Atomic Energy of Canada will be a safe depository for low level waste. In the short term and medium term, which covers the construction of the site, operation of the site and closure of the site, it will be staffed by operators, have a mature radiation protection program and be isolated from the general public by the site boundary. Non-human biota are not bound by these restrictions but have been studied for decades by scientists at the site and will continue to be in the short and medium term. In general the non-human resident population at the Chalk River site is a thriving one, largely because hunting and fishing are not allowed there. Between the time that the facility is commissioned and the closure of the site is completed, a period of 80 years, the radioactivity of the disposed material will have decreased by a factor of 200 (according to Figure 1) and after an additional 20 years, by a factor of 2000, at which point the activity is about 3 times natural background. At this point the waste will still be isolated from the environment and will become less hazardous as time passes.

There is concern about what happens in the long term, hundreds or thousands of years into the future when there is no Chalk River site with a physical boundary and, perhaps, no memory of any such site. The physical barriers in place to sequester the waste, a combination of artificial polyethylene barriers and clay, have been shown to be very effective hydrological barriers in other locations, in particular clay barriers and the latter have no known design life limitation, as experience in natural formations like Cigar Lake have shown. These barriers should keep radiation from the site out of the ground water and thus out of the food chain. But, if these barriers do break down or are breached through excavation or drilling, we know that after 100 years from the opening of the facility, the radiation is only 3 times that of natural background in Canada. We also know that there are many places in the world where the natural background is much higher with no ill effects. What we also know is the radioactive waste, unlike other chemical wastes, becomes less harmful over time.

The CNWC believes that the NSDF will be a good solution for the disposal of historic low level waste and a great improvement over the current situation.

Dr. Michael Ivanco (Bio)

Michael Ivanco is the representative for the Society of Professional Engineers (SPEA) on the Canadian Nuclear Worker's Council (CNWC) Board. He has over 30 years of experience in product development, mostly in the nuclear industry, in technical areas ranging from: laser isotope separation to steam generator cleaning and advanced fuel cycles. This work was carried out while with Atomic Energy of Canada and SNC Lavalin. While at AECL he worked at Chalk River Labs from 1984 till 1997 and had daily interaction with professionals working in the Waste Management Division. He then moved to the engineering division in Mississauga, Ontario where he worked till 2015. Later, working with the department of Environmental and Civil Engineering at the University of Toronto, where he is also a sessional lecturer, he has maintained an active interest in electricity generation, energy use and its impact on greenhouse gas emissions and has published papers on the subject. As a past president of SPEA he has also been a representative of engineers and scientists who work in the industry. He has had several op-eds published in major newspapers, over 50 letters to editors in papers from coast to coast and has appeared on a number of national and regional television and radio news programs. Dr. Ivanco has also been called upon to give expert testimony at Parliamentary committees (federal and provincial) on nuclear and other energy related issues and has also given many presentations at nuclear licensing hearings on behalf of SPEA. He also serves as a director on a number of community service organization Boards.

Michael Ivanco has a BSc in Chemistry, a Masters degree in Physical Chemistry and a PhD in Physical Chemistry from the University of Toronto.