To: Canadian Nuclear Safety Commission
From: Canadian Coalition for Nuclear Responsibility
Contact: Gordon Edwards, Ph.D., CCNR President
Re: NSDF project – "Near Surface Disposal Facility"
Date: April 11 2022

I am writing on behalf of the Canadian Coalition for Nuclear Responsibility (CCNR). CCNR intends to make an oral intervention during the public hearings on the licensing of the NSDF, the so-called Near Surface Disposal Facility, proposed by Canadian Nuclear Laboratories (CNL), to be constructed at Chalk River Ontario. The NSDF is an "engineered mound" intended to contain up to one million cubic metres of mixed radioactive waste and other radioactively contaminated and/or chemically toxic materials.

Post-Fission Radioactive Wastes

The majority of the radionuclides to be stored in the mound are human-made post-fission nuclear wastes, including activation products such as cobalt-60, carbon-14, and hydrogen-3 (tritium), transuranic actinides such as plutonium, neptunium and americium, and fission products such as cesium-137, technetium-99 and iodine-129. The radioactive emissions from these materials are damaging to living cells and, in the event of chronic exposure, can cause a host of debilitating and/or deadly diseases. Each radionuclide has its own unique chemical and biological properties, which means that each has its own pathways through the environment and through the human body.

For example, tritium can escape from containment as a gas or as radioactive water vapour and return to earth in the form of radioactive rain or radioactive snow. Tritium can also escape in liquid form as aqueous runoff with radioactive water molecules. Tritium can be absorbed into the body through the lungs by inhalation, by ingesting tritium contaminated food, by drinking contaminated water, or by direct absorption through the skin. While tritium in contaminated water vapour is absorbed almost entirely when it is inhaled, as much tritium is absorbed directly through exposed skin as through the lungs. In a pregnant female, ingested tritium crosses the placenta and enters the foetus, giving the foetus a larger radiation dose than the mother. Tritium also becomes organically bound in all types of organic molecules, including DNA molecules, because hydrogen is one of the basic building blocks of all such molecules. There is no commercially available method for removing tritium from municipal drinking water, since radioactive water

molecules are chemically identical to non-radioactive water molecules – and water cannot be filtered from water.

Other radionuclides having their own pathways include carbon-14, which can be emitted from a radioactive waste dump as radioactive carbon dioxide gas, or can be converted to carbonic acid and eat its own pathway out of the containment, creating in the process a pathway for other radionuclides to escape as well. It may take a while, but carbon-14 has plenty of time, with its half-life of 5,700 years.

Tritium and carbon-14 are among the few nuclear waste products that are also created naturally by the action of cosmic rays entering the atmosphere, and are consequently found in low concentrations everywhere on earth. However, the average tritium concentration in Lake Ontario is twice that of Lake Superior, and this difference is almost entirely due to the operation of Ontario's twenty CANDU reactors at Pickering, Darlington and Bruce. Tritium is created in extraordinarily large amounts in CANDU reactors through the neutron activation of deuterium atoms in the heavy water moderator: deuterium + neutron = tritium.

Carbon-14 is also created in unusually high concentrations in CANDU reactors due to the routine neutron activation of the abundant oxygen-17 atoms within the heavy water moderator: oxygen-17 + neutron - alpha particle = carbon-14.

Most other post-fission radionuclides, such as activated nickel and niobium, as well as radioactive strontium and radioactive iodine, were not a normal feature of the natural landscape before the advent of fission technology. What is found in the environment today is the result of nuclear weapons tests, nuclear reactor leaks, spills and accidents, and releases from nuclear fuel reprocessing plants.

It is often forgotten that some of these exceptional radionuclides, like technetium-99, are far more mobile in the environment than other exceptional radionuclides, like plutonium-239. In such cases the more mobile radionuclide may pose a greater hazard to the population than the less mobile one, even though the latter may be intrinsically more radiotoxic. Such is the case with technetium-99 and plutonium-239. Then again, there are some surprising mechanisms by which plutonium can also find its way into human habitation – for example, some of the plutonium deposited by a Sellafield effluent pipeline into the sediments on the bottom of the Irish sea, almost two miles offshore, has somehow migrated and ended up in the vacuum bags of seaside cottagers in Northern England.

All industries produce waste, some of it quite toxic. But the nuclear industry is the only industry that creates a host of new toxic elements – elements with unstable atoms. Most of these post-fission radioactive elements did not previously exist in nature except in microscopically minute amounts. Because the radiotoxic nature of these elements lies in the fundamental instability of the nuclei of their atoms, there is no chemical treatment known to science that can slow down or stop the radioactive emissions of these unstable atoms. Radioactivity is the only form of nuclear energy that cannot be shut off. This is why we have such a radioactive waste problem, and this is why these materials must be isolated from the environment of living things.

The NSDF facility, if approved, will be the first permanent repository to be authorized by the Canadian government, through the CNSC, for the permanent irretrievable storage of post-fission radioactive elements. These radioactive poisons have been mass-produced by humans as waste byproducts of the nuclear age. Keeping them out of the environment is an unprecedented challenge, with a virtually infinite time horizon. Technetium-99 has a 210,000 year half-life. Plutonium-239 has a 24,400 year half-life. Worse yet, every atom of plutonium-239 eventually decays, turning into an atom of uranium-235 – and uranium-235 has a 700 million year half-life. We are talking about an infinite time horizon.

I sometimes wonder whether such information is ever communicated to the Commissioners. It certainly is not communicated to the general public. The industry, and the regulator, seem to prefer not to disrupt the benign state of ignorance about radioactive materials that is so prevalent in our society. Too bad. The CNSC could perform a great public service by educating people on the facts, in an objective and unbiased way, thereby dispelling the ignorance.

When I graduated from the University of Toronto in 1961 with a gold medal in mathematics and physics, I did not know that nuclear power creates radioactive waste, because I had been led to believe by nuclear proponents that nuclear power is a completely clean technology. One of the reasons why some people have come to distrust the nuclear industry and the nuclear regulator is because they discover that they are not told the truth. Today a whole new generation of young people are being told the same untruth about Small Modular Reactors. I beg the Commissioners to do everything in their power to prevent CNSC from being a party to that lie. Every nuclear reactor, small or large, creates a formidable legacy of nuclear waste materials, and there is no point in pretending otherwise. Trust cannot be earned except by telling the truth, the whole truth, and nothing but the truth.

The Cobalt-60 Inventory

Which brings us to the amazing fact that over 99 percent of the radioactivity to be emplaced in the NSDF facility is due to a single radioactive element – the activation product cobalt-60. According to Table 3.3.1-2 in the final EIS for the NSDF, there would be 9.06 x 10^16 becquerels of cobalt-60 – that's almost 100 billion megabecquerels of cobalt-60.

It took a long time for citizen intervenors to discover that this huge inventory of cobalt-60 is mostly made up of radioactive waste imported from other countries, in the form of disused cobalt-60 sources. Neither CNL nor CNSC thought it important enough to be open or transparent about the nature and origin of this, the largest component of the radioactive inventory of the NSDF by orders of magnitude. This, despite the fact that the CNSC is legally obliged to "disseminate objective scientific information" about all that it does, according to article 9 of the Nuclear Safety and Control Act. Apparently CNSC does not take this obligation to heart!

The sale of cobalt-60 is a commercial, profit-making enterprise by a private company, Nordion, currently owned by the Sotera Health corporation. So CNL, a consortium of private profit-making companies, is demanding that Canadians accept the construction of a gigantic radioactive waste facility within one kilometre of the Ottawa River, using hundreds of millions of our own taxpayer's money, for the primary purpose of storing the unwanted radioactive wastes of other private profit-making enterprises in various parts of the world, all the while claiming that the goal of the NSDF is to deal with the federally-owned legacy of radioactive wastes that were created by our government while pursuing activities in the public interest. The rationale for the NSDF is a shocking tissue of lies, perpetrated by CNL with the full support of CNSC staff.

There are several aspects of this situation that are outrageous. First of all, why must the public pay for the importation and disposal of the radioactive wastes of private profit-making companies? Secondly, why is Canada importing radioactive wastes from other countries anyway? Assurances have been given repeatedly by the Nuclear Waste Management Organization (NWMO) and by the government of Canada that there will be no import of radioactive waste from other countries. When the news broke that Jean Chretien, our former Liberal Prime Minister, was negotiating the importation of used nuclear fuel from other countries for possible

disposal in Labrador, the current Liberal government was quick to deny that such activity would ever be allowed. Yet this is what is happening with the NSDF.

What is most disturbing about this situation is the fact that CNSC has apparently colluded with CNL to hide the truth from the Canadian public, taking advantage of the naivety and the good-natured trust that most Canadians have towards their institutions. There is a strong groundswell of opinion among most Canadians that we should not be and will not be importing radioactive waste. Yet here we are, doing exactly that, with the willing complicity of CNSC to keep that fact hidden all throughout the public comment period on the draft Environmental Impact Statement three years ago. It is difficult to avoid the conclusion that the CNSC is committed to serving the interests of the nuclear industry rather than fulfilling its only legal obligation which is to the public – to disseminate objective information, and to protect Canadians from unnecessary exposures to radioactive risks.

There is another aspect of this situation that is equally disturbing, and that is the cavalier pretense by CNL and CNSC that disused cobalt-60 sources constitute "Low-Level Radioactive Waste. That designation clearly implies to the uneducated public that these cobalt-60 sources are relatively harmless. On the contrary, disused cobalt-60 sources are among the most dangerous radioactive objects that one might encounter. They are in fact extremely dangerous and have been implicated in several horrific episodes of wanton public exposure.

> *In 1984, New York Times reported an incident involving tiny silvery pellets of cobalt-60 "that looked like cake decorations" accidentally ending up in a metal scrapyard in Juarez Mexico. Each tiny little pellet delivered a radiation dose of 25 rads per hour at a distance of two inches, or 219 thousand rads per year. The maximum dose permitted for an atomic worker is 50 rads per year. Exposure to 400 rads of gamma radiation in a short time (e.g. 16 hours with one of these pellets in a shoe or pocket) would kill half the people so exposed.*
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> *The cobalt-60 pellets were melted down and mixed in with other scrap metal for re-use. This resulted in over 400 tons of dangerously radioactive steel reinforcement rods being shipped to construction sites in seven different states of the USA, as well as thousands of radioactive table legs intended for restaurants and cafés throughout North America. In a Winnipeg café, the table legs had to be retrieved as dangerous nuclear waste.*

The New York Times said the incident was "recognized as potentially the worst spill of radioactive material in North American history". The Washington Post reported that the contaminated metal would not have been detected were it not for a confused truck driver, hauling radioactive scrap, taking a wrong turn into the property of Los Alamos Nuclear Laboratories and accidentally triggering radiation alarms.

The total amount of cobalt-60 involved in the 1984 accident was 400 curies, equivalent to 14.8 billion becquerels. The amount of cobalt-60 that CNL plans to put in the Chalk River megadump is 6000 times greater. This is hardly "low-level" radioactive material!

If the Commissioners choose to grant CNL the licence it seeks for the NSDF, Canada will be sending a distressing signal to the rest of the world by suggesting – through example! – that some of the most intensely dangerous and life-threatening radioactive materials known to science can be safely discarded in what is essentially a surface landfill operation. It is a travesty to do so. Here is what F. King from Ontario Power Generation said at a 2005 Conference on the Safety of Radioactive Waste Disposal:

"*F. KING (OPG, Canada): As far as my country is concerned, the Canadian company Nordion supplies the world with a large percentage of the Co-60 used for medical irradiation. The Co-60 supplied by Nordion comes from the reactors in Ontario, and we have an arrangement with Nordion to take back the spent Co-60 sources. So, we are responsible for that waste stream.*

"When the radioactive material comes back, we put it into wet bays used for the storage of spent nuclear fuel. It is still thermally hot, in fact, it is thermally hotter than the spent fuel — and it therefore has to cool for a long time. The long-term plan is to dispose of it along with spent fuel in a deep geological repository."

Dr. Frank Greening, an experienced nuclear chemist who worked at Pickering NGS for more than two decades, wrote to me on January 30, 2020, saying:

"Data I have from BTL's Licence Renewal Hearing from May last year show that between 2014 and 2019 it returned 493 Co-60 sources (PRESUMABLY TO CHALK RIVER) for permanent disposal with a total activity of 10,113 TBq. This works out to 20.5 TBq per source (or 554 Ci/source).

> "According to Glasstone's *Nuclear Reactor Engineering* textbook, the absorbed dose in soft tissue at 1 meter from an unshielded 1 Ci source of Co-60 is 1.22 Rad/hour. So, for a 554 Ci source we have 676 Rad/hour!
>
> I would describe this as VERY RADIOACTIVE……."

Note that 400 rads of whole-body gamma radiation exposure in a short time is the LD50 dose (killing half of those so exposed within 30 days of the exposure). Based on the disused cobalt-60 source described by Dr. Greening in his email cited above, such a life-threatening dose would be obtained by anyone standing just one metre away from that unshielded source for 36 seconds. How can the CNSC countenance the designation of such material as Low-Level Radioactive Waste?

Of course cobalt-60 has a 5.7 year half-life, so after 57 years the radioactivity from that element will have diminished. by a factor of 1000. Instead of 100 billion megabecquerels of cobalt-60, we will then have 100 million megabecquerels. And after another 57 years we will have 100 thousand megabecquerels. Still far from insignificant!

Longer-Lived Radioactive Components

There are other post-fission radioactive elements in the proposed inventory for the NSDF. These are the non-commercial wastes which are actually a legitimate part of the federal government's radioactive legacy liability. Here is a table of some of those elements with their half-lives. Note that after ten half lives, the radioactivity (measured in becquerels) for any radioactive element is reduces by almost exactly a factor of 1000. Thus terabecquerels will be diminished to gigabecquerels during the passage of ten half-lives, and in the same span of time gigabecquerels are reduced to megabecquerels.

You will notice that 19 of the 29 radionuclides listed by CNL have half-lives of more than a thousand years. That means they will not disappear for more than 10,000 years (using the "ten half-lives" trick). In fact, 12 of the radionuclides listed have half-lives of more than 100,000 years, so they will be around in the Mound for well over a million years.

Radionuclide	Half-life	10 x Half-life
Silver-108m	418 y	4200 y
Americium-241	432.2 y	4300 y
Americium-243	7370 y	73,700 y
Carbon-14	5730 y	5730 y
Chlorine-36	300,000 Y	3 million y
Cobalt-60	5.26 Y	53 y
Cesium-135	2.3 million y	23 million y
Cesium-137	30.17 y	301 y
Hydrogen-3	12.3 y	123 y
Iodine-129	16. Million y	160 million y
Molybdenum-93	4000 y	40,000 y
Niobium-94	20,300 y	203,000 y
Nickel-59	76,000 y	760,000 y
Nickel-63	100 y	1000 y
Neptunium-237	2.17 million y	22 million y
Plutonium-238	87.7 y	877 y
Plutonium-239	24,400 y	240,000 y
Plutonium-240	6560 y	65,600 y
Plutonium-241	14 y	140 y
Plutonium-242	373,000 y	3,730,000 y
Radium-226	1600 y	16,000 y
Selenium-79	>65,000 years	>650,000 y
Tin-126	230,000 y	2.3 million y
Strontium-90	28 y	280 y
Technetium-99	210,000 y	2.1 million y
Uranium-233	160,000 y	1.6 million y
Uranium-234	245,500 y	2.5 million y
Uranium-235	700 million y	7 billion y
Uranium-238	4.5 billion y	45 billion y
Zirconium-93	1.5 million y	15 million y

Keeping these radioactive poisons out of the environment for such an enormous length of time is a challenge of unprecedented scope. Commissioners, please take note that, in our opinion, this licence application should NOT be seen as just "business as usual". We at CCNR regard this as a monumental moment in our history. It marks the beginning of a whole new era: the Age of Nuclear Waste. The radioactive legacy of our nuclear age is about to be consigned to future generations for good or for ill. It is a point of no return, and it should not be undertaken lightly or in a spirit of subterfuge.

As currently planned, the waste in the NSDF will be essentially irretrievable. If and when the facility is hit with a flash flood or a raging tornado, or is shaken by a violent earthquake, or is invaded by animals or children or picknickers or homesteaders, or simply collapses or crumbles away and is washed into the river, there will be no detailed description available to future generations or even to future governments to guide their recovery efforts. There will be no Plan B and no manual to consult.

The idea that Canadian authorities would consider a surface landfill – with no solid barriers, open to the elements for many years before closure, accessible by shovel thereafter, and very close to the Ottawa River – as an appropriate edifice to protect the river and thus future generations of Canadians from unwanted and unnecessary radioactive exposures, is deeply discouraging. The NSDF is about the cheapest and least imaginative option one could possibly envisage, and yet the consortium of private multinational corporations that owns CNL and is contracted to manage all federally owned nuclear facilities and associated nuclear wastes, is receiving close to a billion dollars a year from federal taxpayers. Indeed the consortium receives annually FAR more government funding than was ever allocated to AECL for radioactive waste management when it was still a sizable crown corporation, before the birth of CNL and the signing of the GoCo contract negotiated by the Harper administration. Now AECL has been decimated from a staff of several thousands to a total consort of only about 40 people.

Why has CNL never considered a site away from the River? Why has CNL never considered an underground reinforced bunker to protect the waste from human intrusion and extreme weather events? One simple answer comes to mind: it's because they were never asked to, or ordered to. CNSC (we are told) has a "non-prescriptive regulatory policy" whereby they do not exactly tell industry what to do, but it appears to us that industry essentially tells CNSC what to do. Of course, they have to have a safety plan that is acceptable to the Commission. But that can

always be arranged with relatively inexpensive mathematical models and mitigation measures that may or may not work as planned.

But where is the precautionary principle in all of this? Where have the lessons of the Fukushima disaster gone? Wasn't it agreed some years ago that we have to consider the consequences of any unanticipated catastrophic failure, no matter how small the probability is thought to be? As the Scottish bard Robert Burns wrote, "The best laid plans of mice and men gang aft agley".

On a more down-to-earth note, where is the consideration, the regard, the respect, for the Indigenous peoples, the affected municipalities, and the other Canadian citizens for whose benefit the CNSC was created?

Over 140 municipalities, including some 80 municipal members of the Montreal Agglomeration Council, have expressed their opposition to the siting of this gigantic radioactive and toxic waste mound so close to the Ottawa River. The wishes of these municipalities have been ignored by the CNSC, despite the fact that millions of people take their drinking water from the Ottawa River. Does the CNSC understand that people not only need to be safe, they also need to feel safe? There is such a thing as "peace of mind", and losing it can be quite unhealthy.

Two Algonquin First Nations, both having territorial claims to the land on which Chalk River Laboratories is situated, have requested the CNSC to cancel these licencing hearings until some form of proper consultation has been carried out. These requests have not been heeded, but no reason has been given for denying these requests. Surely there is no need to hurry. The NSDF is not going to be providing electricity or any other societal good. The wastes have been largely ignored for decades, and the NSDF will be there forever, so why not slow down and make sure it is done right? It is after all a totally unprecedented proposal that may reverberate down through the years and all over the globe.

When it comes to the final decommissioning of nuclear reactors, CNSC is content to have the proponent delay the inevitable day of reckoning for 40 years, or even for 100 years. Why is it so urgent to have the NSDF up and running that we cannot afford to meet and discuss and come to a mutual understanding with Indigenous peoples and other Canadians – the ones who are being asked to pay the costs with their tax dollars and bear the risks with their bodies? God knows, the CNSC staff have had numerous closed door meetings with the CNL people, working out a detailed common position so that by the time of the public hearings, everything has

been decided between them. By the time of the hearings the licence appears like a fait accompli, and the hearings themselves seem like window dressing.

But CNSC is supposed to be representing the interests of the public, not the interests of the industry. These interests are not the same. The industry wants to get rid of a liability as cheaply as possible, within the limits of acceptability. Unlike the licensing of a nuclear facility, where the industry has a direct interest in safety so that the value of the asset is protected and the production continues uninterrupted, there is no corporate asset to protect when it comes to waste. We ask the Commissioners to reassert the requirement that the health and safety of Canadians and the environment cannot be negotiated behind closed doors with the industry alone, excluding the views of municipalities and Indigenous peoples and other concerned Canadians. We ask the Commissioners not to approve the licence for the NSDF at this time but to require a more profound discussion of alternatives with those whose sole interest is the public welfare.

In 2017 the IAEA recommended that Canada formulate a more detailed and explicit policy on the management of radioactive wastes, and to articulate a national strategy for the management of radioactive wastes. These processes are underway and ae incomplete. Is it not counter-productive to proceed with the licensing of the NSDF before Canada has developed an acceptable policy and an associated radioactive waste strategy? In a similar vein, the House of Commons Standing Committee on Environment and Sustainable Development has, for the first time ever, conducted hearings into nuclear waste governance, and has not yet filed its report. Would it not be wise to hear what they have to say before making irrevocable decisions?

In 2017 an Alliance on Radioactive Waste was formed by the Anishinabek Nation and the Iroquois Caucus. The alliance issued a Joint Declaration shortly afterwards, enunciating five principles for radioactive waste management from an Indigenous perspective. These principles have been ignored by both CNSC and CNL – not even acknowledged, in fact, as far as we know.

Here are the five principles:

*"1. **No Abandonment**: Radioactive waste materials are damaging to living things. Many of these materials remain dangerous for tens of thousands of years or even longer. They must be kept out of the food we eat, the water we drink, the air we breathe, and the land we live on for many generations to come. The forces of Mother Earth are powerful and unpredictable and no human-made structures can*

be counted on to resist those forces forever. Such dangerous materials cannot be abandoned and forgotten."

Yet the NSDF project is predicated on the ultimate abandonment of the wastes.

*"2. **Monitored and Retrievable Storage**: Continuous guardianship of nuclear waste material is needed. This means long-term monitoring and retrievable storage. Information and resources must be passed on from one generation to the next so that our grandchildren's grandchildren will be able to detect any signs of leakage of radioactive waste materials and protect themselves. They need to know how to fix such leaks as soon as they happen."*

Retrievability is not built in to the NSDF project, nor is there any provision for long-term monitoring or measures to cope with failures of containment. There is also no effort being made to use the museums, libraries, artistic and archiving facilities of Heritage Canada to preserve Records, Knowledge and Memory of the radioactive waste legacy for the benefit of future generations, along the lines of the RKM Project of OECD's Nuclear Energy Agency that was based on a nine-year effort involving 14 OECD member states. The RKM project was focussed on high-level radioactive waste (irradiated nuclear fuel) but the same concept is applicable to low and intermediate level wastes as well as other toxic legacies.

*"3. **Better Containment, More Packaging**: Cost and profit must never be the basis for long-term radioactive waste management. Paying a higher price for better containment today will help prevent much greater costs in the future when containment fails. Such failure may include irreparable environmental damage and radiation-induced diseases. The right kinds of packaging should be designed to make it easier to monitor, retrieve, and repackage insecure portions of the waste inventory as needed, for centuries to come."*

How does one rehabilitate a radioactive landfill that has been compromised or even devastated with no clear map-and-legend to show exactly what radioactive materials are where, what dangers they may pose, how they may be expected to behave, and what kind of package is most appropriate for each of them?

*"4. **Away from Major Water Bodies**: Rivers and lakes are the blood and the lungs of Mother Earth. When we contaminate our waterways, we are poisoning life itself. That is why radioactive waste must not be stored beside major water bodies for the long-term. Yet this is exactly what is being planned at five locations in Canada: Kincardine on Lake Huron, Port Hope near Lake Ontario, Pinawa beside the Winnipeg River, and Chalk River and Rolphton beside the Ottawa River."*

Is it really too much to ask, that radioactive wastes not be stored for the long term beside major bodies of water? How long did it take humans to learn not to dump their garbage where they draw their water? Or have we, in fact, learned anything of the sort? Water is sacred to Indigenous culture, and that scaredness is rooted in a simple scientific fact – for water is essential to all living things.

"5. **No Imports or Exports**: The import and export of nuclear wastes over public roads and bridges should be forbidden except in truly exceptional cases after full consultation with all whose lands and waters are being put at risk. In particular, the planned shipment of highly radioactive liquid from Chalk River to South Carolina should not be allowed because it can be down-blended and solidified on site at Chalk River. Transport of nuclear waste should be strictly limited and decided on a case-by-case basis with full consultation with all those affected."

This principle has been turned upside down with the importation of radioactive wastes in the form of disused cobalt-60 sources from a variety of other countries. CNL and CNSC have also ridden roughshod over this principle by trucking tons of radioactive wastes from Manitoba, from Kincardine, from Quebec, and from Port Hope, to Chalk River – without any public discussion, notification or consultation of any kind. Many shipping containers filled with poorly characterized radioactive waste brought in from other jurisdictions are now stacked at Chalk River, just waiting for the CNSC to approve the NSDF, whereupon those containers will most likely be driven into the body of the NSDF engineered mound, buried, and left there to rot.

Transport of radioactive waste is poorly and inconsistently regulated, and the contents of such transports are poorly characterized. We ask CNSC Commissioners to realize that when radioactive wastes are being secretly trucked through towns and villages, over highways and along city streets, it is alarming and disturbing to the residents. Without openness and transparency there can be no trust, and without trust, the legitimacy of nuclear regulation becomes more and more suspect.

Recommendation: The CNSC Commissioners should refrain from granting a licence for the NSDF project at the present time, pending a collaborative process characterized by mutual respect, complete openness, transparency, and a total lack of secrecy, to arrive at a mutually acceptable waste management scheme, involving CNSC and CNL along with Indigenous peoples, affected municipalities and interested non-governmental organizations.

Oral Presentation of CCNR to the CNSC, June 1 2022

Thank you for this opportunity to present the views of the Canadian Coalition for Nuclear Responsibility on CNL's request to CNSC to amend its Chalk River licence to allow for the construction of the Near Surface Disposal Facility.

We urge the Commissioners not to grant this licence on the grounds that the EIS is incomplete and misleading, the alternatives to the project have not been adequately delineated or discussed, certain claims that have been made about the project in the EIS and during these hearings are either untrue or deceptive, the ability of civil society to critically analyze the project has been severely curtailed to only five days of hearings with only 10 minutes each for oral intervention, and Five Algonquin Anishinabek First Nations have declared that they have not been adequately consulted so as to obtain their free, prior and informed consent, despite the fact that that obligation from United Nations Declaration on the Rights of Indigenous Peoples was clearly identified on Monday.

Our submission focusses on the fact that, if this facility is approved, it will be the first time in Canadian history that permission has ever been given for the industry to permanently disposition post-fission, human-made, radioactive elements that have been created as a byproduct of nuclear fission. In our view the NSDF is a relatively quick and dirty first step to dealing with a $16 billion radioactive waste legacy, and it will in any event accommodate only a very tiny fraction of that waste legacy. We fear that the NSDF concept may already have set a dangerous precedent that will contribute to an incrementally careless approach to radioactive waste disposal around the world. If Canada can dispose of radioactive wastet in this way, why can't other countries do it also, perhaps in a more slapdash fashion? Let's just pile the waste up in surface mounds right beside major bodies of water. What could possibly go wrong? Already we have seen other radioactive waste producers in Canada indicating that they would like to dispose of intermediate-level waste in similar surface mounds.

The same fear of setting a terrible example applies to CNL's determination to bury the radioactive entrails from two defunct nuclear reactors on-site (instead of dismantling the reactors as previously planned on and approved by the CNSC). This practice of "in-situ" decommissioning of reactors is completely opposed to IAEA guidance on this matter.

Our written submission focusses primarily on Table 3.3.1-2 of the EIS: NSDF Reference Inventory of Radionuclides for the NSDF, listing 31 selected radionuclides – a list which I am sure is far from complete. [see table below]

All but six of these 31 listed radionuclides are entirely human-made. Fifteen of them have half-lives of more than 100,000 years which means that their radioactivity will be undiminished on almost any time scale you care to mention. Of the remaining sixteen isotopes, eight have half-lives of more than a thousand years. Only 6 isotopes have half lives of less than three centuries, the expected time after which institutional control may be discontinued.

As an example, three of the four listed plutonium isotopes will be virtually unchanged (in terms of radioactivity) by the time the geomembrane begins to fall apart in 1000 or 2000 years — or even 3000 years. Afterwards, these long-lived radionuclides will unquestionably be entering the Ottawa River from the degraded NSDF not just for centuries, but for millennia. CNSC and CNL may say these levels are negligible, but why should any citizens of Ontario or Quebec be exposed to any amount of plutonium in their drinking water?

The word Negligible literally means, capable of being neglected. CNSC staff and CNL seem quite prepared to neglect these unnecessary and unjustified exposures to untold millions of our descendents over countless centuries. But CCNR maintains that the Commissioners have a legal responsibility and a moral obligation not to ignore these exposures which are unjustified, yet can be anticipated and are preventable.

To be specific: for plutonium-239 and plutonium-240, the reference inventory is 8.77 x 10^10 becquerels. (10^10 is 10 million million, or 10 trillion.) Now the maximum permissible body burden for an atomic worker

exposed to this material is 0.7 micrograms, total. And 0.7 micrograms of plutonium-239 corresponds to a radioactive measure of 1,630 becquerels. So by simple division, we see that the reference inventory of plutonium in the NSDF is enough, in principle, to provide the maximum permissible body burden to 52 million atomic workers. CNSC staff may be able to ignore this fact, but we do not feel that the Commissioners themselves, who are the decision-makers, are justified to ignore it, as their legal responsibility is not to protect the industry nor even to accommodate the industry but to protect the health and safety of Canadians and the environment.

One of the criticisms noted in the IAEA's previously mentioned IRRS Review of Canada's nuclear governance was the systematic failure of CNSC to address the question of justifying any unnecessary radiation exposures.

Incidentally, although the number of becquerels of plutonium-239/240 is almost exactly 10,000 times less than the number of becquerels of tritium in the mound inventory, the biological damage from each becquerel of plutonium-239 in soft tissue is approximately 20,000 times greater than the biological damage from each becquerel of tritium, because the inherent radiotoxicity of plutonium is that much greater than the inherent radiotoxicity of tritium. But neither CNSC staff nor CNL are keen to talk about radiotoxicity at all, or indeed of any kind of biological harm.

According to CNL's inventory table, 99 percent of the initial radioactivity loading is due to a single isotope, namely cobalt-60. We have often heard during these hearings that 99 % of the radioactivity will have disappeared in 300 years, but what this really means is only that the cobalt-60 will be gone. But In fact, the cobalt-60 should never have been included in the first place. If 80% of that cobalt is from disused sources, we will still have over 79% of the total radioactivity in the mound coming from outside Chalk River as commercial waste. That's not 10%, but 79% of the inventory. So the Pontiac county spokesperson who spoke previously, asking that no more than 10% of the waste in the mound should be from outside sources, should be asking to keep imports to 10% of the radioactivity, not 10% of the volume. Radioactivity is what poses the risk, not volume.

In any case, we have been told (and can easily calculate) that the entire cobalt-60 inventory in the mound amounts to about two kilograms. This small mass of Cobalt-60 sources does not have to be placed into a million-cubic metre waste dump. Instead, these sealed sources can and should be stored in the existing concrete above-ground MAGs – Monitored Above-Ground Storage facilities, or SMAGs – Shielded above-ground storage facilities — already existing on the Chalk River site. Due to the 5.3 year half-life of cobalt-60, these sources would have greatly diminished radioactivity within two or three centuries. Doing this — segregating the cobalt-60 from the other radioactive wastes — would instantly reduce the radioactivity of the NSDF by 99%, leaving only one percent of that presently-stated total as the initial radioactive loading in the mound. It would also prevent the shielding material such as lead (needed to protect workers from the intense gamma radiation of the cobalt-60 sources) from ending up in the NSDF. But it would take away from the proponent's rhetorical flourish that is designed to fool people into thinking that everything is very safe and very well in hand, because 99% of the radioactivity is gone by the time of closure.

After one removes the cobalt-60 from the inventory, as should be done at the outset anyway, we find that 98 percent of the remaining radioactivity in the mound inventory is from another single isotope, which is tritium. A lot of this tritium seems to be in the form of thousands of disused tritium light sources that have also been brought into Chalk River from outside, another type of commercial waste, like the cobalt-60 sources. These light sources are filled with tritium gas. And these many thousands of tritium lights represent an enormous inventory of tritium in a highly mobile form that is very easy to escape from the sealed glass vials when they break. Because tritium is one of the most mobile of radionuclides, easily escaping in the form of radioactive hydrogen gas, or as radioactive water vapour that can come back to earth as radioactive rain or radioactive snow, or leaking out as liquid radioactive water that is chemically indistinguishable from ordinary water, and which cannot be removed from ordinary water by any available water treatment facility including the leachate treatment system designed for the NSDF. If one is truly concerned about preventing unnecessary radioactive exposures, CNL and CNSC should do everything possible to prevent unnecessary tritium sources to be emplaced in the NSDF. They represent a relatively small fraction of the total volume. Like the cobalt-60

sources, this radioactive material with a 12.3 year half-life can also be stored in MAGS or SMAGS where it can be carefully monitored, and contained, far away from the Ottawa River. It undergoes a 1000-fold reduction in radioactivity in a century.

It is our firm belief that the cobalt-60 inventory, in terms of radioactivity, is almost entirely due to sealed sources – probably far more than the 80% mentioned previously. We also believe that the majority of the tritium intended for the NSDF mound is in the form of disused tritium light sources. The EIS is completely useless in confirming these numbers, because it gives no information whatsoever as to the origin of these radioactive components of the NSDF inventory — a fact which is in itself unacceptable. These sources can and should be removed from the NSDF inventory. In fact they are commercial wastes. All the costs of storing and maintaining these wastes should be borne by those who proftied from the use of the sources, according to the "polluter pays" principle. Why should the taxpayer be required to pay for corporate wastes? They should belong to the purchasers of the commodities that produced the wastes And why should the inhabitants along the Ottawa River, or the millions who draw their water from the Ottawa River, be subjected to these unnecessary radioactive insults? The Commissioners are urged not to grant a licence for unless the removal of sealed sources from the NSDF is carried out.

We also urge that a much more careful scrutiny of each of the long-lived nuclides in the Inventory be reconsidered on a case by case basis. The next isotopes on the list for reconsideration would be carbon-14 with its 5,700-year half-life (which represents almost 60 percent of the very long-lived waste) and plutonium with its 24,400-year half-life. Carbon-14 is very mobile in the environment — easily escaping as carbon dioxide, carbonic acid, and/or numerous other carbon compounds — and is incorporated into all organic molecules including DNA. An authentic environmental assessment process would take the time and trouble to go into these matters in detail, but instead we are facing a rush job. After 70 years of largely ignoring the radioactive waste problems at Chalk River, we are expected to hurry up and grant a licence for the NSDF so CNL can "clear the decks" and get on with the job of building new facilities that will produce even more radioactive waste.

Our reading of the IAEA guidance on landfill type operations is not that one should try to get away with whatever you can, as long as it meets the regulations, but that you should really and truly keep radioactive exposures AS LOW AS REASONABLY ACHIEVABLE by scrupulously avoiding ANY unnecessary radioactive exposures. If you are clearing a site for new buildings, you may indeed have a large volume of very slightly contaminated soil which is called VLLRW – Very Low Level Radioactive Waste, one category below the Low Level Waste category. IAEA says that this VLLRW is the only kind of radioactive waste that is suitable for a landfill type operation. Surface disposal is not to be encouraged or welcomed, but reluctantly undertaken, and it should not be taken as an opportunity to dump a bunch of other radioactive waste in with it. Anything else should be treated with much more care.

Many Canadians are deeply concerned about the NSDF proposal because they see it, rightly or wrongly, as representing an opportunistic philosophy rather than a fundamentally preacautionary philosophy. What you can get away with, rather than what is best. CCNR shares this view. We do not blame the CNSC staff for identifying with the proponent and working in tandem with the proponent to "sell" this project to the Commissioners and to the public. However we expect the Commissioners to adhere to a higher standard and not to be so easily persuaded that we know what will be safe for the next 100,000 years and more. The only reason CNL decided to remove intermediate level waste from the mound is because of a public outcry 5 years ago when the draft EIS was circulated for public comment. In the intervening years CNSC staff and CNL have been working very closely to get their act together, and here they are, shoulder to shoulder, promoting this questionable project which is without any precedent in Canadian history. Already other nuclear waste producers are saying that they want to put intermediate level waste into mounds in the future. Where is the caution? And who speaks for our great grandchildren?

Commissioners, bon courage.

Read our written submission: http://www.ccnr.org/CCNR_CNSC_NSDF_2022.pdf

Note: This is the complete text of Table 3.3.2-1, "NSDF Reference Inventory and Licensed Inventory"

Table 3.3.1-2: NSDF Reference Inventory and Licensed Inventory

Radionuclide	Half Life[a] (years)	Predominant Decay Emission	Reference Inventory		Licensed Inventory	
			Total Activity (Bq) at Emplacement	Total Activity (Bq) at Closure	Maximum Activity (Bq) at Placement	Maximum Activity (Bq) at Closure
Silver-108m	438	gamma	2.73×10^{10}	2.62×10^{10}	2.73×10^{10}	2.62×10^{10}
Americium-241	433	alpha/gamma	6.04×10^{10}	9.74×10^{10}	6.04×10^{10}	9.74×10^{10}
Americium-243	7,360	alpha	5.26×10^{7}	5.24×10^{7}	5.26×10^{7}	5.24×10^{7}
Carbon-14	5,700	beta	1.71×10^{12}	1.70×10^{12}	1.71×10^{12}	1.70×10^{12}
Chlorine-36	301,000	beta	3.97×10^{9}	3.97×10^{9}	3.97×10^{9}	3.97×10^{9}
Cobalt-60	5	beta/gamma	9.06×10^{16}	1.47×10^{16}	9.06×10^{16}	1.47×10^{16}
Cesium-135	2,300,000	beta	5.19×10^{8}	5.19×10^{8}	5.19×10^{8}	5.19×10^{8}
Cesium-137	30	beta/gamma	5.59×10^{12}	3.17×10^{12}	5.59×10^{12}	3.17×10^{12}
Hydrogen-3 (Tritium)	12	beta	8.91×10^{14}	2.79×10^{14}	8.91×10^{14}	2.79×10^{14}
Iodine-129	15,700,000	beta/gamma/x-ray	3.03×10^{10}	3.03×10^{10}	1.75×10^{10}	1.75×10^{10}
Molybdenum-93	4,000	x-ray	1.47×10^{5}	1.47×10^{5}	1.47×10^{5}	1.47×10^{5}
Niobium-94	20,300	beta/gamma	2.34×10^{10}	2.34×10^{10}	2.34×10^{10}	2.34×10^{10}
Nickel-59	76,000	x-ray	1.21×10^{9}	1.21×10^{9}	1.21×10^{9}	1.21×10^{9}
Nickel-63	101	beta	3.11×10^{11}	2.59×10^{11}	3.11×10^{11}	2.59×10^{11}
Neptunium-237	2,140,000	alpha/gamma	1.74×10^{7}	1.74×10^{7}	1.74×10^{7}	1.74×10^{7}
Plutonium-239[b]	24,100	alpha	8.77×10^{10}	8.76×10^{10}	5.07×10^{10}	5.06×10^{10}
Plutonium-240[b]	6,650	alpha				
Plutonium-241	14	beta	1.67×10^{12}	5.84×10^{11}	1.67×10^{12}	5.84×10^{11}
Plutonium-242	375,000	alpha	6.32×10^{07}	6.32×10^{7}	6.32×10^{7}	6.32×10^{7}
Radium-226	1,600	alpha/gamma	3.65×10^{10}	3.61×10^{10}	3.65×10^{10}	3.61×10^{10}

Table 3.3.1-2: NSDF Reference Inventory and Licensed Inventory

Radionuclide	Half Life[a] (years)	Predominant Decay Emission	Reference Inventory		Licensed Inventory	
			Total Activity (Bq) at Emplacement	Total Activity (Bq) at Closure	Maximum Activity (Bq) at Placement	Maximum Activity (Bq) at Closure
Selenium-79	327,000	beta	9.26×10^{7}	9.26×10^{7}	9.26×10^{7}	9.26×10^{7}
Tin-126	230,000	beta/gamma	1.24×10^{8}	1.24×10^{8}	1.24×10^{8}	1.24×10^{8}
Strontium-90	29	beta	6.05×10^{12}	3.35×10^{12}	6.05×10^{12}	3.35×10^{12}
Technetium-99	211,000	beta	3.16×10^{11}	3.16×10^{11}	3.16×10^{11}	3.16×10^{11}
Thorium-230	75,400	alpha	5.30×10^{9}	5.30×10^{9}	5.30×10^{9}	5.30×10^{9}
Thorium-232	14,000,000,000	alpha	2.70×10^{10}	2.70×10^{10}	2.70×10^{10}	2.70×10^{10}
Uranium-233	159,000	alpha	2.74×10^{8}	2.74×10^{8}	2.74×10^{8}	2.74×10^{8}
Uranium-234	246,000	alpha	6.88×10^{10}	6.88×10^{10}	6.88×10^{10}	6.88×10^{10}
Uranium-235	704,000,000	alpha/gamma	2.96×10^{9}	2.96×10^{9}	2.96×10^{9}	2.96×10^{9}
Uranium-238	4,470,000,000	alpha/gamma	7.57×10^{10}	7.57×10^{10}	7.57×10^{10}	7.57×10^{10}
Zirconium-93	1,610,000	beta	4.92×10^{11}	4.92×10^{11}	4.92×10^{11}	4.92×10^{11}

(a) Half-Lives are from the IAEA Live Chart of Nuclides (IAEA 2019).

(b) Reported as Pu-239/240 are these radionuclides are generally combined in laboratory analysis.

Bq = Becquerels; Bq/g = Becquerels per gram.