August 6 2019

Dear *****:

It was good to meet you last week – thank you. We discussed some issues surrounding the transport and long-term management of non-fuel radioactive wastes, for which there are no explicit government policies.

This letter provides references for certain points that were raised.

(1) "Canada does not yet have a federal policy for the long-term management of radioactive wastes." This quotation from then-Minister Jim Carr is from a 2018 letter sent to a fellow caucus member, Mr. Francis Scarpallegia, who has given us his permission to cite the letter. http://www.ccnr.org/Carr.pdf .

(2) I referred to the federal policy vacuum on non-fuel radioactive wastes in a 2017 one-page letter addressed to Prime Minister Trudeau. See http://www.ccnr.org/Trudeau_pack_5_e.pdf . This policy vacuum is clearly reflected in Canada's Radioactive Waste Policy Framework (143 words) that makes no mention of intermediate-level radioactive wastes. While the Policy Framework states that it is the responsibility of the federal government to "develop policy", little or no such development has occurred. See https://tinyurl.com/yyktnrvm .

(3) There also are no federal government policies explicitly related to the transportation of radioactive wastes. In their stead, policies and regulations developed for the transportation of radioactive commodities – such as medical or industrial isotopes from Nordion, or uranium concentrates (called yellowcake) from Saskatchewan, or uranium hexafluoride (for export to enrichment plants) from Port Hope – are utilized, resulting in mislabelling or incomplete documentation. Such mischaracterization of the contents of a radioactive waste transport is a disservice to drivers, first responders, the public, and all those who are concerned about the environmental and health hazards of radioactive wastes, especially in case of a severe unanticipated accident.

(4) A well-documented case in point is the mislabelling of a series of on-going shipments of highly radioactive liquid waste from Chalk River to

the DOE Savannah River Site in South Carolina. The liquid waste, left over from the production of medical isotopes, contains residual amounts of highly enriched weapons-grade uranium, originally purchased from the US and now being "repatriated" under an agreement between the two governments. However, the CNSC has consistently mischaracterized this Chalk River waste as "Highly Enriched Uranyl Nitrate Liquid" (HEUNL) when in fact the radioactivity of the Chalk River liquid in question is more than 16,500 times greater than would be the case if the liquid were in fact just uranyl nitrate liquid. Uranyl nitrate is a specific chemical compound having only one radioactive constituent, namely uranium. The Chalk River liquid contains many other radioactive compounds, involving radioactive isotopes of niobium, zirconium, rhodium, ruthenium, iodine, xenon, tellurium, barium, cesium, lanthanum, cerium, praseodymium, neodymium, europium, neptunium and plutonium, among others. Some of these are intense gamma emitters (unlike uranium), most of them are more radioactive by far than the uranyl nitrate in the liquid, and they are all more radiotoxic than uranium (whether highly enriched or not).

(5) The following data are taken from Table 2 of the relevant 2014 CNSC document, "Technical Assessment Report: NAC-LWT Package Design for Transport of Highly Enriched Uranyl Nitrate Liquid".

Data from CNSC's Table 2 in layman's language
Concentrations (per litre) of radioactive materials in the Chalk River liquid
(only materials giving off penetrating gamma radiation and those heavier than uranium)

Isotope	Activity in Becquerels per Litre
Niobium-95	6.63 billion
Niobium-95m	25.35 billion
Zirconium-95	23.35 billion
Rhodium-103m	18.13 billion
Ruthenium-103	18.13 billion
Rhodium-106	546 million
Ruthenium-106	546 million
Iodine-131	19.50 billion
Xenon-131m	19.50 billion
Tellurium-132	10.33 billion

Isotope	Activity in Becquerels per Litre
Barium-137m	70.19 billion
Cesium-137	70.19 billion
Barium-140	58.50 billion
Lanthanum-140	58.50 billion
Cerium-141	42.88 billion
Cerium-144	8.19 billion
Praedsodymium-144	8.19 billion
Praseodymium-144m	8.19 billion
Neodymium-147	15.80 billion
Europium-154	84 million

Isotope	Activity in Becquerels per Litre
Europium-155	195 million
Uranium-234	28.4 million
Uranium-235	559 thousand
Uranium-236	366 thousand
Uranium-238	5.59 thousand
Neptunium-237	4.51 thousand
Plutonium-239	1.3 million
Plutonium-240	89.9 thousand

The total radioactivity in each litre of liquid is reported in this table as more than 485 billion becquerels, whereas the radioactivity of all the uranium in one litre of the liquid is about 29 million becquerels. That is a factor of 16,500 difference. More than four orders of magnitude.

(6) One of the most dangerous radionuclides in the Chalk River liquid is cesium-137, a long-lived radioactive poison that concentrates in the food chain and accumulates in the flesh of animals, including humans. It is an intense emitter of highly penetrating gamma radiation, unlike uranium. Cesium-137 soil contamination levels are customarily used as markers for evacuation zones following a severe nuclear reactor accident. For example, the evacuation zone surrounding the destroyed Chernobyl reactor is defined by over 550,000 becquerels of cesium-137 per square metre. According to the CNSC Table 2 cited above, each litre of Chalk River liquid contains 70 billion becquerels of cesium-137. Thus one truckload of Chalk River liquid (carrying 232.4 litres of liquid waste) contains about 16.2 trillion becquerels of cesium-137. That is enough cesium-137 to create a radioactively contaminated evacuation zone of 30 square kilometres, using the Chernobyl evacuation criterion. So the cesium-137 in the liquid waste is a far greater hazard to drivers, first responders, the public, and the environment, than all of the uranyl nitrate contained in the same truckload of Chalk River liquid. So - why is the cargo mislabelled in such a profoundly misleading way?

(7) The previous paragraph focuses on potential soil contamination. Equally concerning is the potential for water contamination, especially since the radioactive cargo is in liquid form. According to the Guidelines for Canadian Drinking Water Quality published by Health Canada, the maximum allowable concentration of cesium-137 in drinking water is 10 becquerels per litre. Thus the 70 billion becquerels of cesium-137 in just one litre of Chalk River liquid waste would be enough to render seven billion litres of drinking water unfit for human consumption. That is about 1.2 percent of the annual drinking water consumption for the entire Island of Montreal in 2017 – reported as 567 billion litres. So the cesium-137 in one litre of the Chalk River liquid waste could ruin about five days' worth of drinking water for the Island of Montreal, if we were to use existing Canadian standards. The cesium-137 in a single shipment of Chalk River liquid (232.4 litres) would be enough, in principle, to ruin almost three years' worth of drinking water for the Island of Montreal. There are a total of 100 to 150 shipments scheduled, of which about half have been completed. This liquid waste is among the most dangerous materials ever transported over public roads.

(8) The decision of the CNSC to mischaracterize the Chalk River liquid as uranyl nitrate liquid has misled Ontario government officials and first responders throughout the province where most of the transport of Chalk River liquid takes place. The Government of Ontario has been tricked into disseminating misinformation on this very subject by repeating uncritically the misleading description provided by CNSC. Three documents were sent out to Emergency Management Officials throughout the province, describing the liquid being trucked over Ontario roads as Highly Enriched Uranyl Nitrate. Nowhere in any of these documents is there any mention of the preponderance of other far more dangerous radionuclides such as cesium-137. Uranium itself is mildly radioactive by comparison, and gives off very little penetrating gamma radiation. Calling the material "liquid uranium" (a description frequently used in the mass media) is completely untrue and mischaracterizes the nature of the risk altogether. The 3 Ontario gov't documents sent to Emergency Management officials are linked below:

1. http://ccnr.org/TRM_Transport_Ontario_ltr.pdf
2. http://ccnr.org/TRM_Transport_Ontario.pdf
3. http://ccnr.org/HEU_Fact_Sheet.pdf

You may note that in these documents, there is no effort to provide an accurate characterization of the hazards following a spill or leak of radioactive liquid from the shipment as a result of a severe accident.

(9) It is true that the packaging of the Chalk River liquid is robust and the probability of a spill is small. However spills are possible in a variety of circumstances, as described in a paper authored by myself & Dr. Marvin Resnikoff (see http://www.ccnr.org/MR-GE_2017_rev2.pdf). In fact CNSC admits that up to 0.033 percent of the contents of a given liquid waste shipment may escape into the environment, which corresponds to 76 cubic centimetres of radioactive liquid waste containing 5,320 million becquerels of cesium-137. That is enough liquid cesium-137 to contaminate 532 million litres of drinking water using the current Water Quality Guidelines for Canada. That much water would fill 2128 Olympic swimming pools. Given the radiotoxicity and intense gamma radiation, such a spill is hardly inconsequential – yet that is what CNSC implies in its 2014 document. One might also wonder why, if under such circumstances, 76 cc of liquid leaks out, what would prevent much greater quantities to escape simply by following the very same leakage route?

(10) Returning to the larger question of radioactive waste transport, we are now seeing thousands of shipments of federally-owned radioactive wastes of all kinds, ranging from low-level contaminated soil to highly radioactive tubes, pipes, bulky equipment and structural components, to the most highly radioactive material on earth – irradiated nuclear fuel. Existing classification of radioactive waste "low-level, medium-level and high-level" is woefully inadequate to deal with the enormous complexity resulting from the existence of hundreds of human-made radioactive varieties, most of which did not exist prior to 1939. The three classes described above are based on the relative safety of handling the materials rather than their long-term health and environmental hazards. Some radioactive materials, such as strontium-90, polonium-210, or pliutonium-239, are quite safe to handle without shielding when sealed in a container but exceptionally radiotoxic and environmentally hazardous when released. We need to develop classifications based on such considerations, and recognize that proper labelling is vitally important not only for safe transportation in adverse circumstances but also for long term management, so that future generations can grasp the nature of the radioactive legacy we are leaving them.

(11) We advocate an extensive public process involving serious consultations with First Nations and other Canadians to formulate acceptable policies and regulations regarding the entire subject of radioactive waste, including the characterization, segregation, packaging, labelling, transport and long-term management of such wastes. As the age of large nuclear power reactors is drawing to a close, the age of nuclear waste is just beginning. We feel Canada must be prepared with policies that will guarantee that good governance prevails. Future generations will depend on our performance today, and the world will look to Canada to set an example of responsible radioactive waste handling, transport, and long-term management.

Thank you very much for taking a personal interest in this matter.

Best regards,

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