Troubles with Tritium

from the Chalk River megadump

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January 11 2024

www.ccnr.org/Tritium_from_the_Megadump.pdf

The Megadump

On January 9 2024, the Canadian Nuclear Safety Commission (CNSC) approved a licence amendment to Canadian Nuclear Laboratories (CNL). The amendment allows for the construction and operation of Canada's first ever permanent dump to store human made post-fission radioactive wastes (so-called “low-level wastes”), along with other naturally occurring radioactive and non-radioactive toxic materials, for eternity. The proposed dump is conceived as a permanent waste disposal facility.

Despite its name, CNL is a privately-owned company that is publicly-funded. CNL belongs to a consortium of three multinational corporations – SNC-Lavalin, now known as AtkinsRéalis, in partnership with two Texas giants: Fluor and Jacobs. All three have been engaged in fraudulent and unethical business practices in recent years. CNL has been receiving almost a billion dollars annually in federal funding, transferred to it by Atomic Energy of Canada Limited (AECL), a publicly-owned corporation with only about 60 employees. Legally speaking, AECL still owns the waste; CNL is hired to do the job of “managing" it.

The CNL dump is euphemistically called a “Near Surface Disposal Facility” (NSDF). The dump will be an earthen mound 25 metres high, covering 14 hectares of land, holding up to one million cubic metres of waste, about one kilometre from the Ottawa River. We call it the Chalk River megadump. It is essentially a glorified landfill operation, open to the air for the first fifty years, with an operational lifetime as a licensed facility of about 500 years. After that CNL will be granted a “licence to abandon” the megadump. The megadumop will still exist, even if CNL does not.

Radioactive Content

Radioactivity is measured In terms of “disintegrations per second”, which are called “becquerels”. In units of becquerels, the activity of radioactive hydrogen – called “tritium” – to be stored in the dump initially, is second only to the activity of radioactive cobalt-60. Cobalt-60 is a commercial waste product imported into Chalk River as a service to profit-making companies in Canada and overseas, who presumably lack the ability or the will to safely store their own radioactive wastes. The disused cobalt-60 “sources" are compact, intensely radioactive, and must be tightly packaged in shielded containers to protect workers from a life-threatening blast of gamma radiation.

Radioactive hydrogen wastes, on the other hand, are voluminous, unshielded, and highly mobile in the environment. Tritium (radioactive hydrogen) gives off no gamma radiation but only beta radiation, which is mostly harmless outside the body but dangerous on contact with the eyes or when inhaled, ingested or absorbed into the body through the skin or otherwise. Tritium exposures are of particular concern for pregnant women and their unborn babies. In general, women who are not pregnant are approximately twice as vulnerable as similarly-sized men to any given level of tritium exposure.

In licencing the Chalk River megadump, it is well understood by CNSC and CNL that much of this radioactive hydrogen – called "tritium" – will escape into the Ottawa River in the form of radioactive water that cannot be removed from drinking water by any readily available water treatment technology. You cannot filter radioactive water molecules from non-radioactive water molecules, as they both both behave the same. Some tritium will also escape into the atmosphere as radioactive water vapour, which may eventually come to Earth as radioactive rain, radioactive snow, or radioactive condensation (dew).

Claims of 'Insignificance'

CNSC and CNL maintain that the leakage of tritium – and other radionuclides – into the Ottawa river is not "significant". CNL calculates that the radiation exposures to the millions of people who depend on the Ottawa River for drinking water will be "within regulatory limits". The same goes for the birds, fish and animals that are so exposed.

But who decides what is a significant amount of radiation-induced cancer? Or of other radiation-induced illnesses? CNSC does not have a health department and few if any staff members are trained in the biomedical sciences. Is CNSC qualified to make such a medical judgment?

Like all radioactive materials, tritium is a carcinogen – a cancer-causing agent. Cancer is the only health effect from tritium exposure that is considered by Canadian authorities, and it is the only health effect considered below. But animal studies have shown that tritium has many other adverse health effects: genetic damage that can be passed on to offspring, developmental defects in unborn infants, even behavioural problems due to subtle brain damage. Dr. Arjun Makhijani has recently written a book exploring the non-cancerous health effects of chronic exposure to tritium. These very important considerations will not be treated in this commentary, however.

Radiogenic Cancer

Medical professionals believe that there should be no "allowable" exposure of the public to any cancer-causing substance if it can be prevented. That's because there is no "safe" level of exposure to any carcinogen. Damage that is done to a single living cell by a cancer-causing agent can, in rare cases, turn that cell into a "rogue cell" that begins to multiply abnormally and develops into a cancer years later. Most radiation-damaged cells either die

or are unable to reproduce, but some do become cancerous. This unfortunate turn of events can happen even at the lowest levels of exposure.

Because of this “one cell at a time” mechanism, the number of induced cancers increases as more people are exposed to a given carcinogen. In a population of a certain size, each exposed to the same degree, one can predict how many cancers will occur. Not everybody will be so unlucky, most will escape that fate. But if the exposed population is ten times larger than before, even if the exposure level is the same for each individual, you will generally see about ten times as many cancers developing. If the exposed population is reduced, the number of cancers is also proportionately reduced. But only if the exposed population is reduced to zero will the number of expected cancers also be zero.

That’s why carcinogens should not be allowed to enter the drinking water, the atmosphere, or the food chain. Carcinogens can kill and/or ruin the lives of individuals, families and communities even at low chronic exposure levels.

Regulatory Limits

That’s why there is no “acceptable” number of cigarettes that you can smoke, and no “acceptable” level of second-hand smoke in public places. That’s why asbestos had to be completely eliminated from automobile brake linings, and why lead had to be completely removed from gasoline. From a health perspective, there is no “acceptable” level of chronic exposure other than zero for such materials.

When tritium or any other radioactive material is allowed to enter the source of drinking water for millions of people, as is the case with the Ottawa River, the number of expected cancers is magnified by the size of the population that is exposed. That’s why such releases should be prevented altogether. It is the scientific basis of the ALARA principle, to keep all exposures to radiation “As Low As Reasonably Achievable” — because there is no such thing as a “safe” dose - a dose that is guaranteed not to cause any cancers. Regulatory limits of acceptable exposure are not safe, they are arbitrarily set at a level of harm that industry and government are wiling to regard as “insignificant”.

As an industry-captured agency, the CNSC sides with the nuclear industry in saying that, as long as exposures are kept below a certain arbitrary standard, everything is OK. By definition, the health and environmental impacts are considered “insignificant”. They even call such exposures “safe”, but that is an incorrect statement according to science. It is not safe, nor is it insignificant, for the individuals who get cancer, or the families of those cancer victims. However, the industry and the regulator are united in saying that, from their point of view, such cancers are not significant. Because of this scientifically unjustified attitude, the British Columbia Medical Association (BCMA) declared in 1980 that Canada’s nuclear regulator is “Unfit to Regulate”. That was the title of Chapter 22 of a 477-page report by the BCMA entitled “Health Dangers of Uranium Mining”.

Tritium in Drinking Water

Those arbitrary standards of "acceptable" radiation exposure in Canada are often exceptionally industry-friendly and overly permissive. For example, CNSC uses a "permissible" exposure limit for tritium in drinking water that is 350 times more lax than that recommended by the Ontario Drinking Water Advisory Council (ODWAC).

In 2009, the Ontario government asked ODWAC to review Canada's existing tritium standard for drinking water. ODWAC concluded that 20 becquerels per litre is more appropriate than the current limit of 7,000 becquerels per litre, simply by comparing the tritium standard for drinking water with comparable exposure standards for other cancer-causing materials.
See www.ccnr.org/GE_ODWAC_2009_e.pdf [my commentary in English]
www.ccnr.org/GE_ODWAC_2009_f.pdf [my commentary in French]
www.ccnr.org/ODWAC_tritium_2009.pdf [the actual ODWAC report]

The ODWAC standard would disallow a litre of tritium-contaminated drinking water having more than 20 disintegrations of tritium atoms per second. That's 1200 disintegrations per minute, or 72,000 disintegrations per hour. Anyone who drinks such a litre of radioactive water would have 72,000 radioactive disintegrations per hour taking place inside his or her body. Current Canadian standards would allow that number to be 350 times higher – over 25 million radioactive disintegrations per hour.

So 20 becquerels per litre would be an improvement, but that does not mean that 20 becquerels per litre is "safe" or should be allowed under most circumstances. Indeed, it is a basic principle of radiation protection that every exposure to radioactive materials should be prevented if at all possible, because there is no "safe dose" for ANY carcinogen.

Recent Developments

So is tritium anything to be worried about?

1) You may remember that quite recently there was a worldwide controversy about Japan wanting to dump about one million tonnes of tritium-contaminated water into the Pacific Ocean. Both China and South Korea have banned imports of fish products from Japan as a result of that government's decision to go ahead with the dumping.

2) More recently in 2023 the Governor of New York banned the dumping of tritium-contaminated water into the Hudson River following a press conference in which I participated:

3) Prior to the shut-down of the Gentilly-2 nuclear reactor at Bécancour, an award winning film was made in both French and English called "Gentilly or Not To Be" which focussed a

great deal on the health hazards or tritium emitted every single day into the atmosphere and into the St Lawrence River from the Gentilly-2 reactor:

4) I first learned about the health dangers of tritium many years ago when the May or Ottawa, Marion Dewar at that time, asked me to provide some background on the issue so that she could respond to the Chalk River dumping of a large amount of tritium into the Ottawa River with no notice to the population. The dumping met with the complete approval of Canada's nuclear regulator (at that the time the Atomic Energy Control Board, the precursor of the Canadian Nuclear Safety Commission). I assembled a dossier of background scientific information on the health dangers of tritium for Mayor Dewar.

Multi-Millenial Health Risk

Tritium is the easiest radioactive material to escape from the Chalk River megadump but there are many much more toxic materials that are not as mobile as tritium. Unlike tritium, some radionuclides to be included in the dump remain dangerous for many millennia: Plutonium-239 (half-life of 24,00 years), Technetium-99 (Half-life of 210,000 years), Chlorine-36 (half-life of 301,000 years), Iodine-129 (half-life of 17 million years).

It is a fundamental fact that each radioactive element has a "half-life" – that's the time needed for half of its atoms to disintegrate. After ten half lives, the radioactivity (measured in becquerels) for any radioactive element is reduced by almost exactly a factor of 1000. So it takes that long for 99.9% of the activity to be gone.

Tritium has a half-life of 12.3 years, so it will be a health risk for a couple of centuries. But, as stated in CCNR's 2022 intervention on the megadump project, *"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 those radionuclides have half-lives of more than 100,000 years, so they will be around in the megadump for well over a million years."*

Leakage is inevitable. Eventually, through erosion, as well as human and non-human intrusions (e.g. digging, construction activities, excavation, or the actions of burrowing animals, tree roots, tornados, flooding, earthquakes, etc.) much of this toxic material will end up in the river.

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P.S. For additional resources on tritium see www.ccnr.org/#tr and tapcanada.org .