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Supplementary Information

Written submission from the Port Hope Community Health Concerns Committee

In the Matter of the

Cameco Fuel Manufacturing Inc.

Application to Renew the Class IB Nuclear Fuel Facility Licence for Cameco Fuel Manufacturing Inc. in Port Hope, Ontario

Commission Public Hearing

November 23, 2022

Renseignements supplémentaires

Mémoire du Port Hope Community Health Concerns Committee

À l'égard de

Cameco Fuel Manufacturing Inc.

Demande de renouvellement du permis d'exploitation de l'installation de combustible nucléaire de catégorie IB pour Cameco Fuel Manufacturing Inc. à Port Hope (Ontario)

Audience publique de la Commission

23 novembre 2022

Canada

Preventing Unreasonable Risk

Supplementary Report on the CFM facility

Prepared by G. Edwards for PHCHCC

To:	Canadian Nuclear Safety Commission (CNSC)
Regarding:	Application for licence renewal of CFM Facility – Cameco Fuel Manufacturing
From:	Gordon Edwards, Ph.D. www.ccnr.org/GE_CV.pdf
On behalf of:	Port Hope Community Health Concerns Committee (PHCHCC)
Date:	November 9, 2022

This submission is supplementary to one filed earlier by PHCHCC entitled "Health Implications of re-licencing the Cameco Fuel Manufacturing Plant" .

Public Health and the CNSC Mandate

The Nuclear Safety and Control Act (NSCA) mandates the CNSC to "prevent unreasonable risk, to the environment and to the health and safety of persons" from any facilities that are licensed by the CNSC.

The same act compels the CNSC "to disseminate objective scientific, technical and regulatory information to the public concerning … effects on the environment and on the health and safety of persons"

The Port Hope Community Health Concerns Committee (PHCHCC, henceforth known as the Health Committee) challenges the CNSC to live up to its mandate. This will require regulatory action to prevent the unreasonable risk of lung cancer and other illnesses to the citizens of Port Hope caused by the ceaseless emissions of respirable radioactive particulates from CFM. Alpha-emitting uranium dioxide dust is dispersed into the atmosphere, in the midst of a quiet residential and retirement community, without any exclusion zone whatsoever.

It is disheartening to observe that human health is almost never discussed in any detail, neither in the licensing application documents nor in the CNSC staff responses. Although preventing unreasonable risks to the health and safety of Canadians and the environment is the primary legal obligation of the CNSC, such matters are almost never addressed directly. Instead of disseminating objective scientific information on human health considerations and environmental impacts, CNSC staff seem almost totally preoccupied with simply seeing that all the boxes are checked so that regulations are satisfied regardless of the health and environmental priorities that presumably gave rise to the regulations in the first place.

The Health Committee believes that ordinary citizens in Port Hope are at risk of radiation-induced cancer and other radiation-induced illnesses as a result of routine emissions from the CFM facility. In particular, inhaling alpha-emitting material deep into the lung is a known cause of cancer. Lung cancer is by far the leading cause of cancer death , making up almost 25% of all cancer deaths. Each year, more people die of lung cancer than of colon, breast, and prostate cancers combined. Unless it is caught in the very early stages, lung cancer is usually fatal. Is lung cancer a reasonale risk? or should it be prevented whenever possible? And is it not the job of the CNSC to prevent unreasonable risks?

It may be unlikely that any selected individual will get lung cancer from CFM, but that is not the point. CNSC staff have noted that lung cancer incidence is higher in Port Hope than it is in the province generally, and that the increase is statistically significant. They dismiss this signficant finding for spurious reasons. In a remarkably unscientific manner, CNSC staff has shown no curiosity as to what could have caused such a signficant elevation in a terrible disease.

If Cameco is allowed to increase its output by one-quarter, as requested, the public health risks will increase proportionately. Is it reasonable that ordinary residents of Port Hope should be chronically exposed to this risk, which is to be prolonged for 20 more years and increased according to the aspirations of the industry, but without any accountability as to why it is considered a reasonable risk?

There is no definition for the word "reasonable". Reasonable to whom? And for what reason? Should not the proponent or the CNSC itself be called upon to provide an explanation at least as to exactly why it is to be considered a reasonable risk?

All alpha-emitting radioactive materials are identified as Class 1 carcinogens by the International Agency for Research on Cancer (IARC), operating under the aegis of the World Health Organization (WHO).

The Agency says this about alpha-emitting materials:

> Internalized radionuclides that emit alpha-particles are *carcinogenic to humans (Group 1).* In making this overall evaluation, the Working Group took into consideration the following:
>
> • Alpha-Particles emitted by radionuclides, irrespective of their source, produce the same pattern of secondary ionizations, and the same pattern of localized damage to biological molecules, including DNA. These effects, observed *in vitro*, include DNA double-strand breaks, chromosomal aberrations, gene mutations, and cell transformation.
>
> • All radionuclides that emit alpha-particles and that have been adequately studied, including radon-222 and its decay products, have been shown to cause cancer in humans and in experimental animals.
>
> • Alpha-Particles emitted by radionuclides, irrespective of their source, have been shown to cause chromosomal aberrations in circulating lymphocytes and gene mutations in humans *in vivo*.

> • The evidence from studies in humans and experimental animals suggests that similar doses to the same tissues — for example lung cells or bone surfaces — from alpha-particles emitted during the decay of different radionuclides produce the same types of non-neoplastic effects and cancers.
>
> IARC Monograph 100D-9 (2012) p.275
> https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100D-9.pdf

The Health Committee believes that CNSC is legally obligated by NSCA to acknowledge these objective scientific facts, and to disseminate these facts in its documentation, in its reasons for decision, and on its web site. More importantly, the Committee believes CNSC is required by law to act to prevent the associated risks of cancer and other illnesses from being prolonged and magnified over time.

Alpha particles have a very short path in soft tissue, just a few tens of microns. Consequently, any alpha-emitting material must have very close contact with living radio-sensitive cells in order to cause the kind of damage that can lead to cancer. As it happens, very small respirable alpha-emitting particulates, one micron in diameter or less, are able to be inhaled into the deepest parts of the lung. And these are exactly the size of particulates that can esape through a HEPA filter.

In a scientific article having nothing to do with radioactivity, but only with the size of particulate matter, we read:

> PM (Particulate Matter) is strongly associated with negative health outcomes including strokes, heart failure, asthma and lung cancer (Lim et al., 2012). Size is an important property of PM with regard to its potential health effects. Therefore, PM is commonly categorized based on its aerodynamic diameter into the commonly regulated standards of <10 μm (PM_{10}), <2.5 μm ($PM_{2.5}$), and < 100 nm (UFPs). Smaller particle size fractions are able to penetrate further into the respiratory tract and are thought to have a higher toxicity per unit mass due to a larger surface area to mass ratio (Harrison and Yin, 2000, HEI Review Panel, 2013)
>
> *How efficiently can HEPA remove priority fine and ultrafine particles ?*
> https://www.sciencedirect.com/science/article/pii/S0160412020319565

HEPA filters are highly effective at removing the larger particulates and the smallest particulates (UFPs or ultrafine particulates) but there is a kind of "blind spot" where many respirable particles of a certain size are entrained in the exhaust.

From the same article, commenting on the functionality of HEPA filters, we read:

> Diffusion causes the smallest particles to be removed, whereas interception, inertial impaction and sieving processes are more effective at removing the largest particles (Yang, 2012). This means that particles of an intermediate size are the least efficiently removed (Kowalski et al., 1999).
>
> *How efficiently can HEPA remove priority fine and ultrafine particles ?*
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As noted in our previous submission to the CNSC, simple arithmetic shows that one gram of uranium dioxide dust escaping through a HEPA filter consists of about 175 billion particulates or more, each having a diameter from 0.1 to 1.2 microns. Since there are 100 to 200 billion stars in the Milky Way galaxy, we refer to these 175 billion particulates as one galaxy-worth of particulates.

Table 9: Total uranium discharged to the air from CFM in kilograms compared with applicable release limit (2012 – 2021)

	Release limit (kg/yr)[a]	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total uranium discharge through stacks (kg/year)	14	0.02	0.03	0.01	0.01	0.03	0.01	0.01	0.004	0.01	0.01
Total uranium discharge through building exhaust ventilation (kg/year)		0.57	0.48	0.40	0.45	0.70	0.57	1.25	1.09	0.92	0.89

[a] The current atmospheric release limit, effective March 01, 2022, is 10.5 kg U/yr, as discussed later in this section.

Since DFM discharges a minimum of 10 grams of uranium dioxide dust through its stacks every year, we have at least 10 galaxies-worth of particulates released into the atmosphere. Of course this number of particulates will be augmented by the respirable paticulates emitted through the ventlation exhaust – pehaps 10 percent of the total releases, that is an additional 60 or 70 grams, for a total of 70 or 80 galaxies worth of respirable alpha-emitting airborne particulates released annually. (By the way, this estimation overlooks the unmonitored "fugitive emissions" which are likely substantial, given the age of the plant.)

If the licence is granted for 20 years, these figures will have to be multiplied by 20 – and if Cameco is allowed to increase production by 24% we have to increase them all by a factor of 1.24, giving a grand total of 1736 to 1984 galaxies-worth of respirable alpha-emitting particulates (over 300 trillion particulates). Any attempt to calculate the radiation dose to members of the public is doubtful because it is impossible to know how many of these hundredss of trillions of particulates may be inhaled by a given individual. The dose itself is a highly erratic variable..

This thought is echoed in a CNL R&D Report entitled Characteristics of Alpha Radiation Hazards, treating uranium dioxide and other alpha emitters:

> The un-irradiated UO_2 [uranium dioxide] particles were found to have a geometric mean diameter of 0.70 ± 0.51 μm . . . . Despite increased research, little information is available concerning the fate of many radionuclide-contaminated materials after they are released and the radiological hazard they may pre[s]ent.
>
> Research and Development Report (153-121110-REPT-080 Revision 0)
> http://www.nuclearsafety.gc.ca/eng/pdfs/research-report-RSP531-1.pdf

Since uranium dioxide is a highly insoluble compound, respirable particulates of uranium dioxide discharged through the CFM stack (equipped with HEPA filters), when inhaled, will lodge in lung tissue and stay there for a long time, irradiating the delicate lung tissue with alpha particles. Half of the material will not be cleared for almost seven months (200 days).

As the Commissioners are well aware, the Bruce Nuclear Complex is the largest nuclear generating station in North America, with 8 operating CANDU reactors. In a private communication, Dr. Frank Greening, a well-known retired OPG employee with impeccable scientific credentials, has informed me that the total emissions of alpha-emitting radionuclides from all eight reactors at Bruce NGS is barely comparable to the alpha-emitting releases from the solitary Cameco Fuel Manufacturing plant in Port Hope:

> I have done some quick calculations on the [alpha] dose to the public for the Cameco Port Hope facility and compared the results to [alpha] doses to the public from Bruce NGS.
>
> Using appropriate data for these two sites, I have found the following:

Facility	Distance to Critical Recipient (km)	Annual Dose (µSv/year)
Cameco Fuel Manufacturing	0.4	30
Bruce Power NGS	1.6	2

> I was very surprised how much higher the Cameco facility dose to the public is compared to Bruce, but I have an explanation. The critical recipient for Cameco is a resident of a retirement home called The Tower that is just 400 meters from the facility. By comparison, for Bruce NGS, the critical recipient is about 1.6 km from Bruce B. Doses fall off roughly as $1/r^2$ so one would expect a ratio of about 1/16 between Bruce and Cameco which is close to the observed 1/15.
>
> It's a little scary that a small, innocuous facility, such as the Cameco fuel manufacturing plant, could give a much higher dose to the public than a monster nuclear power plant such as Bruce NGS, but that's what the data show!
>
> *Frank Greening, email communication, October 24, 2022*

These considerations, taken together, paint a picture of needless exposures to members of the public from a Cameco facility inappropriately located in a residential setting. If the CNSC is to be guided by its mandate to prevent unreasonable exposures to the public, and unreasonable insults to the environment, it would be well-advised to implement the recommendation of the Port Hope Community Health Concerns Committee (PHCHCC).

The Health Committee recommends:

> *"1. Cameco's request for a 20 year license term for the nuclear facility CFM with a 24% production increase involving natural, depleted and enriched uranium must be rejected by the Commission as unreasonable, unjustified and unacceptable in a community setting with no buffer zone whatsoever.*
>
> *"2. A two year license should be issued to Cameco Corporation for this facility with the condition that within this two year time period, Cameco will prepare and submit a plan to the CNSC, relevant government departments, the municipality and the public by December 31, 2024 to fully decommission all of its sites, including CFM, within the boundaries of Port Hope."*