

## Cameco License Hearing

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Radiation and Health Committee  
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The present submission is being made on behalf of Physicians for Global Survival, the Canadian affiliate of International Physicians for the Prevention of Nuclear War, recipient of the 1985 Nobel Peace prize for its work on the prevention of nuclear war, and the only international medical organization dedicated to preventing nuclear war.

We are also very aware that the radioactive contamination from all phases of the nuclear industry, from uranium mining to spent fuel disposal, is a global problem with medical consequences. We are aware that many of these contaminants can persist for a very long time, can travel, and may have as yet unrecognized consequences for the health of humans and the ecosystem.

PGS disparages the continued contamination of parts of the earth with radioactive material, rendering them unsafe and unfit for human use.

Exactly this situation is being allowed to arise in Port Hope. This may come as a surprise to those who are steeped in the myth of a safe nuclear industry. From the perspective of an outside observer, the town of Port Hope has indeed been compromised. Over two million cubic metres of low level radioactive waste lay distributed throughout the town, in ravines, in parks, in schoolyards and under buildings. Levels of gamma radiation in several parts of downtown, including the Waterworks Area, the CN/CP Viaduct Area and the Alexander St. Ravine, have been recorded at over 100 microRem/hr (1). This is sufficient to deliver a yearly dose of 8.76 milliSieverts/year, far in excess of the 1 mSv/year allowed for public exposure from nuclear materials.

Most or all of this waste is residue from the operation of the current licensee, Cameco and its predecessor Eldorado Nuclear. \$260 Million in public funds have been earmarked for a clean-up involving this material. There are many who feel it will cost much more than this, and many who feel it cannot be adequately done at all.

Since Cameco was formed from the amalgamation of Eldorado Nuclear and the Saskatchewan Mining Development Corp., and apparently accrued considerable assets from this merger, it might be argued that there is considerable responsibility as well for the contamination which existed at the time of the merger.

**Role of CNSC**

This contamination did not happen in a vacuum, it happened under the watchful eyes of its regulators, the CNSC, and its predecessor the AECB, both of whom ultimately answer to the Canadian government. Somewhere, a ball has been dropped.

The licensing process involves both licensor and licensee- both need to be functioning with honesty, transparency and integrity, and within mandate in order for the process and outcome to be meaningful. If CNSC has abdicated its role as regulator in favour of becoming a facilitator for industry, then its ultimate decision making will be flawed and may very well put Canadians at risk. Cameco, as a business, is naturally dedicated to producing a profit for its shareholders. Cameco, as a group of adult human beings, should be behaving in a way that is fair and ethical toward all members of society, including its employees, Canadians, and generations unborn. To the extent that it does not do this, the CNSC should step in and redirect it.

A competent regulator of the nuclear industry must be conversant with all aspects of the industry and all risks to the populations upon which that industry impinges. This requires an intimate knowledge of biology and medicine. Given that these areas of expertise are not represented in CNSC staff, our organization has grave concerns about the ability of CNSC to:

- 1) stay abreast of current research in these areas
- 2) properly evaluate the quality of this research
- 3) assimilate the lessons from this material
- 4) carry this forward appropriately into its decision making.

In licensing large facilities, such as those of Cameco, which collectively have such profound implications for human health, this is an unacceptable state of affairs. The mandate of the CNSC, as stated on its website, is to protect the health, safety and security of Canadians and the environment. It is not clear how it can do this if it fails to appreciate many new developments in the areas of biology and medicine.

A public hearing in this situation can be an important source of new ideas and perspectives, if it is properly handled. It is important to recognize that the Canadian public is not an amorphous mass of semi-literate, somewhat suggestible humanity, but rather contains some well-educated, articulate individuals in a number of specialties not represented on the staff of CNSC. Their combined wisdom, rather than being discounted, trivialized, ignored or actively censored, could form the basis of some major modifications in the activities of the CNSC and Cameco.

In order for a literate public to provide meaningful input, individuals must have access to sufficiently detailed, comprehensive and complete technical information to be able to perform an analysis of the situation in question, apply their own understanding and expertise and generate a response. In the absence of appropriate information, the whole exercise becomes a pointless sham.

The nine licensing documents provided to us by the CNSC as bearing on the subject of this hearing, that is the oral and written presentations of Cameco on each of its three facilities, and the responses of CNSC to each of these, were largely unhelpful in this context.

The documents were replete with references to programs, management plans and protocols for dealing with this and that issue, but these were not described in any detail. No data were presented to support the effectiveness of these. No data were given on emissions of uranium, fluorine and other substances to air and water. The data on human exposures were sparse and the categories vague. Reference was made on a number of occasions to the fact that these values were “within the standards”.

### Standards

It might be important to pause, here, and look at the question of standards. Just because something is “within current standards” does not mean it is safe. It may simply mean that certain hazards associated with that material are not known, or not fully appreciated, or were not addressed in setting the standard. There may have been political or economic considerations bearing on the matter. In the case of radioactive materials and radiation, standards have generally plummeted as we understand more about the hazards of these materials. From its discovery in 1896 to 1925, there was no standard for radiation exposure. In 1925 the standard was set at 500 mSv/yr, the dose that caused reddening of the hands in X-ray technicians. It has since come down in a series of steps to its current level of 1 mSv/yr for the public and 20 mSv/yr for nuclear industry workers, or 100 mSv in 5 yrs with a maximum of 50 mSv in any one year (2).

Is this protective? According to guidelines from the ICRP (International Commission on Radiological Protection), the cancer risk from radiation exposure is .04/Sievert (3). Over a 40 year career (age 20-60), at 20 mSv/yr, a worker will be exposed to 800 mSv, or .8 Sv. His odds of getting cancer are then  $.8 \times .04$  or .032, that is approximately 3 in 100. If 100 workers are so exposed, three of them will be expected to get cancer. The nuclear industry in Canada employs approximately 70,000 workers. Over a lifetime in the industry,  $70,000 \times .032$ , or 2,240 of them would be expected to get cancer as a result of this level of exposure. Clearly this standard is not protective.

In reality most nuclear workers are not exposed to anywhere near this amount of radiation, and relatively few of them get sick. But this exposure is allowed. Clearly this standard is unrealistic.

Similarly, the standard for tritium in drinking water was initially 40,000 Bq/L. Many European countries now have a standard of 100 Bq/L, and the Advisory Committee on Environmental Standards recommended to the Ontario government in 1994 that the Ontario standard be set at 100 Bq/L, with a 5-year target of 20 Bq/L. The

current Canadian standard for tritium in drinking water is 7,000 Bq/L. It is unlikely that this is protective (4).

The new uranium in air standard of .03 ug/m<sup>3</sup> (micrograms/cubic metre) is also not protective. According to material published in the CCME (Canadian Council of Ministers of the Environment) 2007 (5), soil levels of uranium can increase as a result of airborne deposition. In order to maintain a level they consider safe for residential soils, that is 23 ug/g (micrograms/gram), levels in air should not exceed .002 ug/m<sup>3</sup>. Appendix A contains a presentation given to the Uranium Science Discussion Meeting, Dec. 13, 2008 in Port Hope on the development of the Uranium in Air Standard, and it gives more detail on this calculation.

The uranium in drinking water standard of .02 mg/L is probably reasonable, although some would like to see it reduced to .01 mg/L. Australia allows .07mg/L, but Australia has large uranium mining interests, and many places are short of water.

So it is clear that standards need to be treated with thoughtfulness and examination. Hiding behind the assumption that because something is “within the standard,” it is safe is indefensible.

### Harm to Port Hope

Is there any evidence that there has been harm done to the residents of Port Hope to date through exposures considered by the nuclear industry to be safe? Let us look at the data.

Most of this is in the form of statistical surveys. Data in this form has a number of limitations. One is that there can be no information on causation given in such a study. Often the categories in which data are placed are broad, and they may not be appropriate for the questions being asked of this data. In the case of Port Hope, the population size is relatively small. It is currently about 16,000; it was 10,000 or less when some of these data were collected. Given that some endpoints, such as cancers of specific organs, are relatively rare and variable within a population, it is unlikely that many effects found in this scenario will ever reach statistical significance.

Apart from a very small number of more narrowly focused cohort and case-control studies which do not involve the townspeople of Port Hope as a whole, this is the data we have. This data will never fully answer the question: “Has there been or has there not been harm to the population of Port Hope as a result of the activities of the nuclear industry.” It can't.

What then can we learn from this data? If we are really serious about understanding what is happening in the town of Port Hope, we will look at the numbers for signs of trends and patterns. Any number by itself which does not reach statistical significance may be due to chance. A group of numbers which

follow a trend or pattern are much less likely to be due to chance, and more likely to reflect a process or influence that exists in reality.

Much of the health data that exists on Port Hope has been gathered into a report entitled "Synthesis Report: Understanding Health Studies and Risk Assessments Conducted in the Port Hope Community from the 1950's to the Present " put out by CNSC in April, 2009 (6). We will refer to this as it is easily accessible to those reviewing this material.

Firstly, let us consider cancers relating to the nose, sinuses, pharynx, trachea, bronchus and lung. Why this choice? Because much of the radiological pollution in Port Hope is in the form of airborne uranium releases from Cameco stacks, radioactive dust and radon gas. The body structures which would be exposed to this material first and most strongly are those listed above. These structures are also most likely to be affected by pollution resulting from the clean-up operations.

Table 1 (p. 32) shows mortality data for Port Hope as compared to Canada for the period 1954-78. There are no statistically significant effects, although very nearly significant increases in "all causes" and ischemic heart disease appear. There is no obvious elevation in cancers of the trachea, bronchus and lung.

In Table 9 (p. 42), which contains more recent data, there are significant increases in the incidence of cancers of the trachea, bronchus and lung in Port Hope as compared with Ontario for the period 1971-1996. (Recent improvements in the treatment of cancer make incidence rates more relevant than mortality rates for current data.) Table 8 (p. 40) shows increases in cancers of the trachea, bronchus, lung and pharynx for females only, for the period 1986-92.

Table 10 (p. 43) shows significant or highly significant increases in the incidence of cancers of the lung and pharynx for females, and the nose and sinuses for males within the period 1971-1996.

In summary, there are significant excesses of cancers of the trachea, bronchus and lung in Port Hope, as well as associated structures such as nose, pharynx and sinuses, which are more prominent in recent as opposed to earlier time periods.

This data, much of which is in fact statistically significant, should be a red flag to both regulators and industry that harm is very likely being done to the residents of Port Hope. In the absence of another plausible explanation for this configuration of findings, it is reasonable to suspect that inhaled contaminants from the nuclear industry are involved.

The fact that these cancers figure more prominently in the more recent data may reflect either a slowly increasing burden of contamination, or perhaps some excess exposures resulting from the 1976-1981 clean-up. This is not a question which can be answered from these data alone.

This has profound implications for both the proposed clean-up and the nuclear industry in Port Hope as a whole.

The data on childhood leukemia, presented on Tables 3 & 4, p. 34-35, show a very consistent excess of observed vs. expected cases and/or deaths in children living within 25 km of the Port Hope facility in all but one of the categories examined. While none of these excesses reached statistical significance, the chances of this configuration of data happening in the absence of any real effect are small.

A precautionary approach would dictate that these data be taken seriously.

There is a very real possibility that people in Port Hope have fallen ill as a result of exposures created to date by the nuclear industry. It is imperative not to create more illness in the course of the proposed upcoming clean-ups involving the downtown Cameco property and the town as a whole. It is at least as important to apply the precautionary principle in the prevention of future illness from the continued operation, and continued emissions and waste generation, of the Cameco facilities. This is the issue which this license hearing should be addressing, above all others.

This issue is not even mentioned in most of the material we have reviewed on the matter. It is our concern that the CNSC has failed to appreciate the significance of its own medical data on this population.

We are concerned that this failure, coupled with the internal lack of expertise, and the rather obvious pro-industry bias it has recently demonstrated, are not likely to result in decision making that will be in alignment with its mandate to protect the health and safety of Canadians and the environment.

Such a decision making may in fact involve the shutting down, either temporarily or permanently, of one or more of the nuclear facilities in Canada pending the collection and assessment of data pertaining to the question of possible harm to nearby residents. This much is demanded by the precautionary principle, and by the mandate of CNSC which is to protect the health and safety of the Canadian public, rather than that of the nuclear industry.

### International Data

Canada's population is small and often sparsely distributed. This makes it difficult to do meaningful studies into the effects of nuclear facilities and activities on surrounding communities as the results of these studies have difficulty achieving statistical significance and are therefore hard to interpret.

Larger centres, particularly in Europe, have generated data which we would do well to seriously contemplate in the relative absence of our own.

The CNSC is familiar with the German KiKK study (7) which shows elevations in childhood leukemia in the vicinity of all 16 German nuclear power installations. This study is considered very methodologically strong and well executed by the scientific community and its results reach statistical significance. Newly released German data

on gaseous radiation releases during refueling of reactors lend credence to this study by providing a possible mechanism for the observed effects, in the form of previously unreported bursts of higher exposure for surrounding residents (8). The CNSC, instead of attempting to trivialize and discount this data, would do better, as a regulator, to take it very seriously. The Canadian data on childhood leukemia around nuclear installations, including the facilities in Port Hope, as presented in the CNSC's Synthesis Report, show similar results (9). What should we make of this? Should we be allowing this to continue?

Sorting this out is going to require some very honest, transparent and thorough problem solving work. Do we allow production to continue while we do it? The Precautionary Principle would dictate that we do not. Protection of the health and safety of the Canadian people would require that we not.

A second area in which international data are highly relevant is the area of radiation and genetic effects.

### Genetic Effects

For some time, scientists working with in vitro systems such as cells in culture, or with experimental animals have been aware of a number of radiation effects not predicted by simple modeling of energy absorption by tissue and resultant damage to nearby cellular molecules.

In very low dose rate exposures, where only a small fraction of cells receive a direct hit to the nucleus, a large number of the surrounding cells show damage. This is known as the "bystander effect", and is believed to be mediated by intercellular communication pathways, of which there are several (10=b53-55). The exact nature of this process is under investigation. The implications, in a complex multicellular species, such as ourselves, are legion.

Genetic instability in cultured cells has been shown to persist for 25-50 population doublings after brief irradiation with either X-rays, gamma rays or alpha particles. This is characterized by persistent increased spontaneous mutation rates, ongoing chromosomal rearrangements and possibly increased sensitivity to external mutagens (L ,B47 ), even after the radiation exposure has long since ceased. There are a number of possible mechanisms for this phenomenon, including damage to some of the systems regulating DNA replication or to the DNA repair capabilities.

Many of these effects can be seen in vitro at doses as low as 1.6- 10 mGy of alpha radiation (L) and 50 mGy for low LET radiation (B63). These doses are in a range which might be relevant to the Port Hope population and/or Cameco employees. Whereas it is not possible to extrapolate directly from the in vitro data to living humans, we must recognize that we are made of rather similar biochemical material.

Is there any evidence that these effects do occur in higher organisms and in humans? Yes.

“Mutation rates in animal populations in contaminated territories are significantly higher and there is transgenerational genomic instability in animal populations, manifested in adverse cellular and systemic effects. Long-term observations in both wild and experimental animal populations in the heavily contaminated areas show significant increases in morbidity and mortality that bear a striking resemblance to changes in the health of humans.”()

These words introduce a chapter in “Chernobyl; Consequences of the Catastrophe for People and the Environment” (), a compendium of some 20 years’ work by eastern European scientists in the aftermath of the Chernobyl disaster, and a publication replete with the stark truth about radiation and its impact on natural systems and living tissue. This publication, in its entirety, should be considered required reading for CNSC staff.

In regard to the issue of persistent genomic instability, they report on several instances in which rates of chromosome aberrations, mutations, reduced reproductive success and embryonic death continued to increase in voles, mice and songbirds long after ambient radiation levels and absorbed doses had begun to decrease (p.265-268 ) Offspring of many of these organisms reared away from the contaminated areas continued to deteriorate genetically. It is too soon to reliably see this effect in humans; there is little doubt that it will occur. We share these genetic mechanisms with the rest of the living kingdom.

### Sustainability

\*\*\* There is nothing sustainable about taking an element, in this case U235, and destroying its very atomic structure so that it will never exist again in that form and cannot be replaced. \*\*\*

The Cameco facilities currently under license review exist solely to participate in this unsustainable and destructive activity.

Looking at the larger picture, in the course of this activity, from uranium mining through refining, processing and power generation to spent fuel disposal and decommissioning, not to mention through accident and mishap, large amounts of radioactive contamination are released into the world, and tracts of land in the vicinity of these processes rendered uninhabitable for generations to come. The diversion of some of this material to the production of nuclear weapons has obvious and devastating implications for continued life on this planet.

Sustainable? Not really.

### Conclusion

PGS has serious concerns about the level of radioactive contamination that has been allowed to develop in Port Hope, and the potential hazards of this material to the residents who live there, either in its removal or in its continued presence.

The continued production of this material in the downtown area by the facilities currently under license review is a given, should their license be renewed.

This is a very difficult and unfortunate situation.

As a group of physicians, conversant with the effects of radioactivity on biological tissue, we have no choice but to recommend that ongoing pollution of the town of Port Hope with radioactive material should cease.

We recommend that those residents who are employed by the plants, and those whose properties are contaminated be given fair compensation by the Canadian government, and that talks begin among the residents of Port Hope, the municipality and the Canadian government on future directions for the town.

This problematical situation did not develop by itself, and the chain of responsibility is complex. Rather than finger pointing, it would be important to bring the lessons forward and move on.

References:

## APPENDIX A

Submitted by:  
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Uranium Science Discussion Meeting:  
Port Hope, Dec 13, 2008

Uranium in Air Standard

I will cut to the chase. I would like to recommend a uranium in air standard of .002 ug/m<sup>3</sup> (micrograms/cubic metre).

I will explain to you, as carefully as I can, how I derived this, from Ministry of the Environment information. Then I will explain why I feel it is imperative, given the little we actually know about the behaviour of uranium in the human body, that the lowest possible modeled value should be taken as the standard. If anyone can cogently argue for a standard less than mine, I will support theirs.

In a document entitled "Canadian Soil Quality Guidelines for Uranium: Environmental and Human Health", prepared by the Canadian Council of Ministers of the Environment in 2007, and referred to in your Uranium Science Discussion Document as "CCME 2007", a standard for uranium in soil is developed. Their

guideline for residential areas, parkland and agricultural land, based on exposures experienced by, and presumably tolerable to, a toddler living in the area, is 23 mg/kg (=23 ug/g or micrograms/gram) in soil. The guideline for commercial land is 33 ug/g. The level for industrial land is 300 ug/g, provided that wind and water action do not carry contaminants onto adjacent lands in excess of their guidelines.

The USDD, on p. 47 indicates that a uranium level in air of .03 ug/m<sup>3</sup> has been determined to prevent build up of uranium by deposition in soil to levels in excess of 300 ug/g. They do not give a level in air which will prevent build up in soil in excess of the 23 ug/g level for residential areas. Given that deposition is likely to be roughly proportional to quantities in the air, this would give a uranium air standard of .0023 ug/m<sup>3</sup>.

The model used to develop the 23 ug/g guideline did not make provision for that toddler eating produce grown in local soil. This would represent an additional exposure for that toddler. In my community, an agricultural one living in proximity to proposed uranium mining, most of our food products are local. As uranium mining is contemplated or underway in many areas of southern Ontario, this is not a unique situation. In addition, wells in these areas will become increasingly contaminated and this water will be used for vegetable crops and livestock, as well as human consumption, as there is realistically nothing else available. These are two new sources of exposure which are not accounted for in the original model.

I would like to propose an extremely conservative correction of the air standard derived above from .0023 ug/m<sup>3</sup> to .0020 ug/m<sup>3</sup>. Proper calculation of the magnitude of the new exposures may lead to modification of this value, I suspect downwards.

Unfortunately, soil levels in much of downtown Port Hope are already much higher than the recommended 23ug/g. The USDD, on p. 79, indicates that, according to 1986 data, soil in approximately 1 square km of the town east and west of the plant has soil uranium levels of over 50 ug/g, and there are levels of over 100 ug/g immediately adjacent to the plant (hopefully on industrial land). It's not clear from existing data where in the town levels drop to 23 ug/g or less. Clearly the emission patterns of the industrial complexes in Port Hope have not resulted in soil deposition levels within residential standards.

(Even if standards were different or absent in the past, the lesson is this: there has been a failure, either in the area of providing standards or in enforcing them, to keep the residents of this town safe. Perhaps we didn't know as much then. Perhaps we don't know everything we need to know now either. Humility, honesty and conscientiousness are in order.)

We are left, now, with a plant that wants to emit uranium, and residential soils which are already overloaded. This is a very unfortunate situation.

In the USDD, on p. 93, an air standard of .06 ug/m<sup>3</sup> is proposed. This is already inappropriately high, given the above. In addition, if air exposure typically makes up 10% of total exposure to uranium, and air exposure results in a radiation dose of .1 mSv/yr to a hypothetical 15 yr old, that person's total uranium radiation burden

would be expected to be 1.0 mSv/yr. This is the total permissible non-background yearly dose for a member of the public. This child would then not be able to have a medical X-ray, or fly in at altitude in an aircraft, or visit us and drink our well water, without exceeding the limit. This is an unacceptable degree of risk for this person. If some of this uranium were enriched, or recycled (post-reactor) uranium, that would further increase the exposure.

Two other considerations arise in this situation. One is that uranium never travels alone. It is always found in some sort of equilibrium with its decay products, which are themselves radioactive and represent an exposure not accounted for in this model. The second is that 1.0 mSv/yr is not a safe dose of radiation, it is one which causes an "acceptable level of harm".

The lesson here is that all of our models are prone to flaws, and I would suggest we are more likely to overlook things or underestimate them than the reverse. We know what we know; it's what we don't know that will sneak up and bite us.

I am struck, in reading the material provided, by the large number of instances in which human data are lacking and in which, instead, animal data with an arbitrary correction factor or mathematical models replete with "estimates" are used. This tells me quite clearly that our understanding of the behaviour of uranium in humans is incomplete, and that if we are to effectively protect humans, we will need to use conservative standards rather than generous ones.

I am 57 years old; I grew up in the 50's and 60's to a litany of reassurances that pesticides, food additives, preservatives etc. were safe. Even after Rachel Carson's book *Silent Spring* came out and 'carcinogenic' became a household word, the story was- "there's not enough of it to do you any harm" "it can't possibly hurt you, there's so little". We have cancer rates of 42% now, and many of these substances have been removed from the market. Uranium, with a half-life of 4.5 billion years and a propensity to morph into over a dozen other elements and isotopes over time, will not be easy to contain or remove from our environment.

Uranium is radioactive. There is no safe level of radioactivity. Any ionizing radiation is capable of damaging genes if it reaches them inside the cell. A single alpha particle or gamma ray can alter a gene. Some of these defects can be fixed by the cell's repair enzymes, many of them can't. They're permanent. When that cell divides, it will either die, or it will pass on the flaw to its daughter cells. In the case of egg or sperm cells, the defect will be passed on to the next generation. And the next.

We have a very shaky understanding of what this means for a population (e.g. us) over time. We know some of these defects can be involved in the creation of cancers. We know some of these defects will remain hidden, sometimes for generations, until conditions are right for them to manifest. Not enough time has elapsed since the first atomic bomb blast at Hiroshima for us to have a handle on this process, and, quite frankly, we've done an abysmally poor job of even trying. The reasons for this are largely political.

Uranium is known to bind tightly to DNA, that's one of its chemical properties. Research is under way to see whether it does this in living tissue to any extent. I don't know what the answer is, yet, but if it does, it will have a point-blank shot at the cell's genetic material when it releases its alpha particle. There is also some evidence, still at the research stage, that uranium atoms can absorb gamma rays (we know they do this much) and re-radiate them in a form much more damaging to the cell. This could make the dose "estimates" used by the ICRP to determine safety way off base.

Given the difficulty, impossibility actually, of removing uranium from our environment once it is disseminated, a difficulty we see clearly when faced with the clean-up of Port Hope, and given the reasonable probability that we may yet discover something about the toxicity of uranium that we don't currently know, I would suggest caution.

Our regulatory system has allowed an unfortunate situation to develop in Port Hope; it did not happen by itself. Let's not repeat our mistakes.