Uranium in Quebec:
Truth and Consequences

A critique of

a slide show presentation

by Patsy Thompson, Ph.D., Director General,
Directorate of Environmental and Radiation Protection and Assessment
of the Canadian Nuclear Safety Commission

to

The Inter-Ministerial Committee on Uranium in Quebec
on January 22 2016

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Canadian Coalition for Nuclear Responsibility

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ERRATUM

A representative of CNSC regularly attended the public hearings scheduled by the BAPE on the issue of uranium in Quebec, but that person was not always Patsy Thompson, contrary to what was stated on page 1 of the original text of this critique. That error has been corrected in the present text. CCNR apologizes for the error.

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1. The Canadian Coalition for Nuclear Responsibility (CCNR) takes exception to the January 22 slide show presentation by Patsy Thompson of the Canadian Nuclear Safety Commission (CNSC) to the Inter-Ministerial Committee. The presentation is biased and misleading to such an extent that the credibility of the CNSC is seriously compromised.

2. The Inter-Ministerial Committee was established to assess the 2015 BAPE report and recommendations regarding uranium mining and milling in Quebec. A CNSC person attended the BAPE hearings and had ample opportunity to make the views of the CNSC clear. CNSC was invited to offer rebuttal comments at the end of each day of BAPE testimony and took full advantage of that opportunity. In the context of all the evidence presented to the BAPE, the CNSC position did not prevail over other considerations. Now a CNSC official has been allowed to comment on the deliberations and conclusions of the BAPE panel in a session not open to the public. Is the inquiry still ongoing? The CNSC presentation would seem out of order even if it were reliable and accurate, which it is not.

This document flags some of the more serious shortcomings of the CNSC presentation. Page numbers refer to the pdf version of the slide show as posted on the CNSC web site:

English version *http://tinyurl.com/jx4mlkv*
French version *http://tinyurl.com/j87upxs*

3. Article 9 of the Nuclear Safety and Control Act stipulates that the CNSC has a legal obligation "to disseminate objective scientific, technical and regulatory information to the public concerning ... the effects, on the environment and on the health and safety of persons," of nuclear activities. In its slide show presentation, however, CNSC fails to display even a minimal degree of objectivity on such matters, as it ignores or dismisses virtually all of the health and environmental hazards associated with uranium mining.

Although the concluding slide in the CNSC presentation refers to providing "a better understanding of the risks to humans and the environment" [p.24] from uranium mines and mills, there is nothing in the slide show that provides even a basic scientific understanding of the unique risks that are associated with uranium mining. Only risks that are common to other kinds of mining are acknowledged. Indeed, the slide show declares that the risks associated with uranium mining and milling are "negligible" [p.13] without even describing what those risks are. The word "negligible" literally means "able to be neglected" and that is exactly what the CNSC presentation does: it neglects them.

4. For example, the CNSC slide show makes no mention of the fact that the voluminous sand-like tailings from uranium milling contain 85 percent of the radioactivity that was present in the original ore. Why is this essential scientific fact not stated by the CNSC?

The radioactive materials in uranium mill tailings – isotopes of radium, radon, polonium, and thorium, along with radioactive varieties of bismuth and lead – are all radioactive disintegration byproducts of uranium. Each one of them is far more radiotoxic than uranium – which is itself a dangerous material, being a radioactive heavy metal. Yet none of these byproducts is discussed or even mentioned by the CNSC. The fact that these radioactive contaminants remain in the sand-like tailings when uranium is extracted from the ore has been known since 1898, when this fact was discovered by Marie Curie.

5. Radon gas (radon-222) is the leading cause of lung cancer among non-smokers, and every atom of radon gas was once an atom of uranium. The US Environmental Protection Agency estimates that 20 to 30 thousand Americans die every year from lung cancer caused by inhaling radon in their homes. Radon emitted from radioactive ore bodies is a proven cause of lung cancer in underground miners, particularly uranium miners. Yet the CNSC slide show does not mention radon as a hazard associated with uranium mining.

6. The CNSC refers to a recent epidemiological study of Ontario uranium miners that, according to the CNSC slide show, "showed that their risk of lung cancer was no higher than for the Canadian population." [p.20] This statement is utterly untrue. The study, entitled "Ontario Uranium Miners Cohort Study", was published in February 2015. It was carried out by the Occupational Cancer Research Centre for the CNSC. The full report, on-line at http://www.nuclearsafety.gc.ca/eng/pdfs/RSP-0308.pdf , states: "This study confirms what is known about underground uranium miners, which is that they have an increased risk of lung cancer."

Specifically, the study notes there was a 34 percent increase in deaths from lung cancer and a 30 percent increase in incidence of lung cancer in the cohort of almost 29,000 Ontario uranium miners in question, compared with the general population. The direct cause of this dramatic increase in lung cancer, as identified by the study, is the miners' exposure to "RDP". RDP is an acronym that refers to radon gas and its decay products, which are radioactive isotopes of bismuth, lead and polonium.

The study documents lung cancer morbidity as well as mortality. It notes that "lung cancer incidence among male miners was increased relative to the Canadian population," adding that "consistent with previous analyses, significant lung cancer elevations were observed for mortality with 1230, and for incidence with 1291 lung cancers." The study observes that about 600 of those lung cancer cases are radiation induced. More than half of those 600 radiation-afflicted men have already died from the disease. It is expected that about 90 percent of the remainder will also die from the disease. The CNSC slide show misrepresents the findings of this study.

When truth is compromised, inconsistencies often appear. As already noted, the CNSC slide show states (incorrectly) that uranium miners have a "risk for lung cancer no higher than for the Canadian population" [p.20] In saying so, CNSC wants us to believe that for these miners, radiation adds no risk of additional lung cancers over and beyond the usual incidence of lung cancer. But, in very next paragraph, CNSC states (correctly) that when the miners' radiation exposures are reduced "their risk of lung cancer will also be lower" [p.20] That is, when radiation levels go down, lung cancer risk goes down as well. So, what is the message? Does radiation impose an added risk of lung cancer, or does it not?

7. The CNSC presentation states that "radionuclides released into the environment by uranium mines and mills are not toxic". [p.10] These radionuclides include radium, radon, and polonium. Let's take a closer look at these three radioactive contaminants from uranium mining and milling operations.

7.1. *Radium is well known to be a highly toxic radioactive heavy metal.*

The toxic nature of radium was described in 1990 by the *Agency for Toxic Substances and Disease Registry* (ATSDR, a federal public health agency of the U.S. Department of Health and Human Services) as follows:

> *"Radium has been shown to cause adverse health effects such as anemia, cataracts, fractured teeth, cancer and death…. Although there is some uncertainty as to how much exposure to radium increases your chances of developing a harmful health effect, the greater the total amount of your exposure to radium, the more likely you are to develop one of these diseases."* http://tinyurl.com/gsxlgnd

As early as 1931, the Canadian Department of Mines warned of the dangers of radium in a publication designed to instruct government technicians assaying samples of radium ore:

> *"Recent investigations in the field of radium poisoning have led to the conclusion that precautions are necessary even in the handling of substances of low radioactivity. The ingestion of small amounts of radioactive dust or emanation [radon gas] over a long period of time will cause a build up of radioactive material in the body, which eventually may have serious consequences; lung cancer, bone necrosis and rapid anemia are possible diseases due to deposition of radioactive substances in the cell tissue or bone structure of the body.*
>
> *"Precautions for workers in the treatment of radium ores" by W R McClelland*

7.2. *Radon is one of the most potent cancer-causing agents known to science.*

Prior to 2006 the Canadian standard for an "allowable level" of radon in homes was 800 becquerels per cubic metre (Bq/m^3). CNSC never warned the public that that level of radon exposure would pose a serious risk to human health, but in a 1998 report entitled *Le Radon à Oka*, la *Régie régionale de santé et des services sociales* sounded the alarm:

> "pour un fumeur le risque de développer un cancer du poumon relié à des niveaux d'exposition résidentielle au radon de 800 Bq/m^3 et plus . . . représente facilement un risque avec un ordre de grandeur 10^{-1}, c'est à dire 1 personne sur 10 et plus."
>
> *[For a smoker, the risk of developing lung cancer as a result of being exposed in the home to levels of radon of 800 Bq/m^3 or more . . . easily represents a risk in the order of 10^{-1}, that is to say 1 or more persons out of 10."]*

In our society, about 5 of 100 smokers end up with lung cancer, so the "permissible" level of radon can, over time, double that risk for smokers. The *"Radon à Oka"* report adds:

> ". . . une personne non-fumeuse exposée à 800 Bq/m^3 a une risque de développer le cancer du poumon environ 5 à 6 fois plus élevé que pour une personne non-fumeuse exposée à 25 ou 50 Bq/m^3."
>
> *[. . . a non-smoker exposed to 800 Bq/m^3 has a risk of developing lung cancer about 5 to 6 times greater than for a non-smoker exposed to* 25 or 50 Bq/m^3*."]*

In 2006 the Canadian standard for radon in homes was drastically reduced by a factor of 4 : from 800 to 200 Bq/m^3. Even this reduced radon level is far from harmless, as we shall see in what follows. It is surprising that the CNSC has never issued a public alert about the health danger of radon in homes, even at so-called permissible levels..

7.3. *Polonium is without question the most toxic element found in nature.*

Like radium and radon, polonium is created as an inevitable byproduct of the ongoing radioactive disintegration of uranium atoms. Polonium-210 is millions of times more toxic than hydrogen cyanide. It was the weapon used to murder Alexander Litvinenko in 2006.

The *American Health Physics Society* has declared that up to 90 percent of the 480 000 American deaths attributed to tobacco smoke each year are probably due to minute quantities of polonium-210 in the tobacco. That implies that polonium-210 kills about 430 000 Americans every year. The two other isotopes of polonium produced by uranium disintegration, polonium-214 and polonium-218, are even more toxic than polonium-210.

For the CNSC to imply that radium, radon and polonium are "non-toxic" is scientifically incorrect, inconsistent with its legal mandate. They are all extraordinarily toxic materials.

8. The CNSC slide show states "Uranium mines and mills are regulated throughout their life cycle, and financial guarantees are in place to cover the decommissioning of such facilities and ensure their safety in the long term." [p.24] CNSC does not explain that, for the radioactive contaminants in uranium tailings, the "long term" lasts thousands of years.

The inventory of radionuclides in uranium tailings will not diminish significantly for the first 10 000 years, and will only be reduced by half after 76 000 years. This is a scientific principle that applies to all the radium, radon and polonium isotopes mentioned above, as well as radioactive varieties of thorium, bismuth and lead that are byproducts of uranium. The slow disintegration of thorium-230, a radioactive material with a half-life of 76 000 years, continually replenishes the supply of all of those other radionuclides in the tailings.

Recall that the Pyramids of Egypt are only 5000 years old. It is an unprecedented task to keep over 200 million tonnes of radioactive sand out of the water supply and the food chain for 100 000 years. Who does CNSC suppose will "ensure safety for the long term" ?

9. The CNSC slide show lists financial guarantees totalling $568.5 million [p.18] to cover the cost of perpetual monitoring and maintenance of uranium tailings produced by five facilities in Northern Saskatchewan. The growing volume of tailings from those facilities is now about 22 million cubic metres, so these guarantees amount to $25 per cubic metre.

Bearing in mind that this fund "is calculated both to cover the costs of routine activities such as inspection and maintenance, and to allow for unexpected major events" [p.16], it is reasonable to ask whether the money set aside is adequate. How much will it cost to clean up after the widespread dispersal of these radioactive wastes into the environment due to such eventualities as earthquakes, containment failure, freak weather events, or human interventions within the next 100 000 years?

For the sake of comparison, consider the small town of Port Hope, Ontario, where the most expensive municipal environmental cleanup in Canadian history is currently underway at an estimated cost of $1800 million. About 1.8 million cubic metres of so-called "low-level radioactive wastes" from uranium and radium processing operations were dispersed widely throughout the town, some ending up in the harbour, dumped in open ravines, mixed in the local sandy beach, or used to construct homes, schools and roadways. They are radium-

contaminated wastes that continually release radon gas. The cleanup will move the wastes into engineered mounds designed to last 500 years. What happens after then is unplanned.

Let's compare the cost of the Port Hope cleanup with that of ensuring the long-term safety of uranium tailings. At Port Hope, the volume of radioactive wastes is 1.8 million cubic metres, and the estimated cleanup cost is 1800 million dollars. This averages out to $1000 per cubic metre. In contrast, the financial guarantees for uranium tailings cited in the CNSC slide show only amount to about $25 per cubic metre. It is unlikely that these funds will be enough to recover, decontaminate and clean up after uranium tailings are scattered.

In addition to the tailings at the five facilities mentioned in the CNSC slide show, there are another 125 million cubic metres of uranium tailings at other locations in Canada. At the rate of $25 per cubic metre, a contingency fund of about $3100 million would be required. Using the more realistic figure of $1000 per cubic metre, a contingency fund of $125 000 million would be needed. No fund currently exists for these abandoned radioactive wastes. The CNSC presentation makes no mention of this multibillion dollar liability.

10. The CNSC slide show states "international safety standards for radiation have been applied in Canadian uranium mines for more than 40 years". [p.20] While true, this is nothing to brag about. These international "safety" standards are quite unsafe – a fact that was known even 40 years ago, in 1976. Around that time a number of independent reports documented extensive damage to human health and the environment from uranium mining. What follows is a brief summary of three of these reports that are still pertinent today.

10.1. *The Ham Commission Report: Lung Cancers in Ontario's Uranium Miners.*

Forty years ago, the Report of the Ontario Royal Commission on the Health and Safety of Workers in Mines -- known as the "Ham Commission" -- revealed that radiation exposure had more than tripled mortality from lung cancer among Ontario uranium miners. "From a total of 41 lung cancer deaths observed in Ontario in a population of about 8000 miners in the years 1955-72, there was an excess of 28 over the 13 lung cancer deaths expected."

In an Appendix, Commissioner James Ham analyzed the mortality data to demonstrate that there is no safe level of radon exposure. Even if individual doses were to be reduced by some specified factor, he observed, the same incidence of radiation-induced lung cancer would occur if the work force were increased in number by that same factor.

The Commission's Report was also critical of the regulator's unprofessional behaviour:

> "At Commission hearings in Elliot Lake, union leaders alleged that the workers whose lives have been and are at risk have not been kept informed about the developing situation in Ontario. The following words convey the intensity of feeling: 'We have been led to believe through the years that the working environment in these mines was safe for us to work in. We have been deceived.'… The Commission sees no excuse for not telling working people the truth, however difficult and imperfect that may be."

The 1976 report noted that the regulator had recently reduced allowable radon exposures for uranium miners by a factor of 3, following recommendations that had been made 10 years earlier: "In the period 1972 to 1974, the allowed radiation exposure limit was lowered from 12 WLM per annum to 4 WLM per annum. But the delineation of the underlying

problem has been slow and remains incomplete." The WLM ("working-level-month") was at that time the standard unit for expressing radon exposure. The report noted that the stricter limit of 4 WLM reduces but does not prevent radiation-induced cancers. The limit of 4 WLM is essentially the same as today's regulatory limit, although expressed in different units. CNSC has had 40 years to make the limit tighter, but has not done so.

10.2. *The Thomas-McNeill Report): Estimating Lung Cancers.*

Six years later, the 1982 Thomas-McNeill Report *(AECB INFO-0081)* was commissioned by the Atomic Energy Control Board (AECB), the precursor to the CNSC. It was the first time that Canada's nuclear regulator ever asked for an independent review of its safety standards. Duncan Thomas, the principal author, was then a professor of epidemiology at McGill. He was later appointed to the US National Academy of Sciences' BEIR Committee (Biological Effects of Ionizing Radiation). He is currently Professor of Preventive Medicine at the University of Southern California. For the 1982 Report, he was asked by AECB to avoid using figures from the nuclear industry and instead to use the best health data available from Colorado and Elliot Lake uranium miners, South African gold miners, Swedish iron miners, and Newfoundland fluorspar miners – all underground hard-rock situations with radon-contaminated mine workings.

The Thomas-McNeill Report demonstrated convincingly that exposure to 4 WLM over a working lifetime would likely cause a tripling or a quadrupling – or at the very least, more than a doubling – of the lung cancer rate. Since about 55 out of 1000 men in the general population end up dying of lung cancer, the radiation standard in question could boost the toll to 110 to 220 deaths from lung cancer, per 1000 men so exposed. Since the actual radon exposures of miners are normally kept much lower than the limit, the incidence of radiation-induced cancer does not reach this appalling level. Nevertheless, it is sobering to realize that a so-called "safe" radiation exposure limit can be so dangerous to human health. Yet this is the "international safety standard" that the CNSC slide show refers to.

What about actual radiation exposures in underground uranium mines today? As the CNSC presentation observes, "the doses to which miners are exposed today are about 10 times lower than those to which Ontario miners were exposed in the past". According to CNSC publication INFO-0813, the average 2006 radiation exposure for Canadian workers in underground uranium mines was only about one-third of a WLM per year. Over a 50-year working lifetime, on average, such underground miners would accumulate a dose of 17 WLM. According to the Thomas-McNeill Report that exposure could cause 22 extra lung cancers per 1000 men, increasing the toll from 55 to 77 lung cancer deaths per thousand. That's a 40 percent increase in the lung cancer rate. Such a death toll is not negligible.

10.3. *The British Columbia Medical Association: Health Dangers of Uranium*

In 1980, the British Columbia Medical Association (BCMA) published a 470-page report entitled "The Health Dangers of Uranium Mining", based on extensive medical evidence presented to the BC Royal Commission of Inquiry on Uranium Mining. The report rejected as unsafe the "international safety standard" that is cited in the CNSC slide show. [p.20]

> "The 4 WLM annual maximum permissible exposure to radon . . . should be lowered to less than 1 WLM per year immediately, and serious consideration

> should be given to lowering it to 0.4 WLM per year. This *[level of radiation risk]* would still exceed risks for a safe industry."

The authors are medical doctors. They were seconded from their private practices by the BC Medical Association to attend the Royal Commission hearings on a daily basis and publish a report based on the medical evidence presented there. Their report documents the Atomic Energy Control Board's failure to analyze mortality data correctly, and the AECB's assertion that there is little danger from 4 WLM of radon exposure in uranium mines despite overwhelming evidence to the contrary. Such unfounded reassurance "would be irresponsible coming from the nuclear industry, let alone the regulatory agency of that industry," states the report, concluding that "the AECB is unfit to regulate uranium mining."

The report explains the inherent difficulty in measuring the full extent of the death toll because of the long delay between radiation exposure and subsequent development of cancer. It is similar to the situation with lung cancer caused by smoking:

> "Risk of lung cancer from radiation, although beginning after several years of employment, continues many years past termination of employment; thus a gradually flowering crop of cancers grows larger each year."

The BCMA report, written 18 years before the "Radon à Oka" report, also highlights the public health dangers associated with excess levels of radon in homes. Even a level of 200 becquerels per cubic metre in a residence, if uncorrected, would increase lung cancer rates among smokers and non-smokers alike. Chronic exposure to that level of radiation:

> ". . . could result in 200 to 300 extra cases of lung cancer per 10 000 people per lifetime. In light of current knowledge, this might be considered tantamount to allowing an industrially induced and publicly sanctioned epidemic of cancer."

The BC Medical Association concluded long ago that that radon limits in place today in Canada, both for workers and for homes, are *not* safe. Chronic exposure at these levels, over time, will cause a significant excess of radiation-induced lung cancers. Yet the CNSC slide show terms the discredited radon limit for workers an "international safety standard". [p.20]

11. The CNSC slide show states that harmful biological effects from uranium mines and mills "are not the result of radioactivity." [p.10] In fact nowhere in the CNSC presentation is there any indication of any special dangers attributable to the radioactivity of the ore body. The CNSC message seems to be that uranium mining is much like other kinds of mining, and uranium mill tailings are much the same as tailings left over from other hard-rock mining. If this were true, however, one would be hard-pressed to comprehend why uranium mines, unlike any other mines in Quebec, are placed under federal jurisdiction -- and in particular under the jurisdiction of the Canadian Nuclear Safety Commission.

11.1. Compare the dismissive tone about radioactivity in the CNSC slide show with the following passage from a 2004 International Atomic Energy Agency (IAEA) document entitled "The long term stabilization of uranium mill tailings" (IAEA- TECDOC-1403) [available on-line at http://tinyurl.com/hgubhpy] :

> "The particular human health risk that is associated with uranium mill tailings is the risk from radioactivity. . . . It is not possible to determine the actual risk or the level

> of harm caused by tailings distinct from other causes, because people affected by radiation in uranium mining districts are potentially exposed to radiation doses from mining, milling, transport of radioactive materials, radioactive dust and contaminated water and foodstuffs, and it is not practicable to distinguish between this mixture of point and diffuse sources. . . .The long half-life of radiation from uranium tailings and the demonstrated risks associated with them have given rise to levels of high concern in the general public and in government – in some places exacerbated by the high levels of secrecy and lack of data on health impacts . . . ."

The IAEA report also discusses the harmful effects of radioactive discharges into the environment. In particular, it cites a 2002 research paper dealing with "the impact of radionuclide releases from Canadian nuclear facilities on non-human biota." While radioactive releases from most nuclear facilities in Canada

> "are not entering the environment in concentrations likely to have a harmful effect, the same is not true for releases of radionuclides from uranium mines and mills and waste management areas. Releases from mines, mills and waste facilities are assessed as to be in sufficient quantities or concentrations or conditions that have or may have a harmful effect on the environment."

11.2. The CNSC slide show says "The tailings of abandoned mine sites represent only a negligible risk to human health, even when the site was used for traditional activities." One activity that is traditional and on-going is the construction of roads, homes and schools.

The sand-like nature of radioactive mine tailings makes the material attractive for use in construction projects, either as fill around and under the foundations of a building or as a constituent of the cement or mortar used in construction. The radioactive nature of the material is not evident. However, the use of this material results in high levels of radon gas inside the buildings, thereby greatly increasing the risk of lung cancer for the residents. In addition, residents are constantly being exposed to gamma radiation (similar to x-rays but more powerful). As the IAEA report cited in the previous paragraph points out:

> "Perhaps the most direct implication of tailings as a radiation source sufficient to cause human health impacts relates to the re-use of tailings for building materials. Whilst this has happened in many places around the world, it is best documented in Grand Junction, Colorado. . . . It became known in the mid-1970s that leukemia rates . . . were twice the average for the State. This fact, and the concern it caused, was the driver for the development of state legislation for radiation control and protection measures, which led to the development of the Uranium Mill Tailings Remediation Control Act of 1978 (UMTRCA). . . . The UMTRA programme serves to demonstrate that uranium mill tailings were identified in the USA as a significant health hazard."
>
> "The body of research which indicated that direct impacts on human health were resulting from exposure to uranium mill tailings gradually grew, with the realization that radon concentration in houses built with mortar sand derived from uranium tailings, or over tailings-derived fill, could reach dangerous levels (e.g. 200 000 Bq/m^3 at Schneeburg in Germany). Radon and dust derived from tailings were

> calculated to result in between 0.3 and 1.0 death per 2600 residents of Eleshnitza in Bulgaria, and radium concentrations were found in cereals being grown in tailings-contaminated soils."

In 1976, St. Mary's elementary school in Port Hope, Ontario, had to be evacuated because of exceedingly high radon levels in the school cafeteria emanating from radioactive fill used under the playground area. Today, some roads in Port Hope are being ripped up due to the use of radioactive waste from the town's uranium refinery being used in their construction, and homes are being condemned for the same reason. Regrettably, the CNSC slide show ignores the health dangers of inadvertent radioactive contamination through the misuse of radium-bearing tailings for construction, at some point in the next 100 000 years. But the public and decision makers need to be made aware of the insidious nature of these dangers. Constant monitoring and surveillance will be needed for thousands of years.

11.3. Although Quebec has had no prior experience with uranium mining, there have been some unhappy encounters with radioactive mine tailings. The St Lawrence Columbium Mine operated just outside of Oka from 1961 to 1977, leaving behind a large deposit of radium-bearing tailings that were abandoned, neglected, and ultimately exploited. (Columbium is an antiquated name for the metallic element now known as niobium.)

There were no signs warning people about radioactivity. There was no barrier adequate to exclude visitors. There was no impermeable cover to limit radon emissions or blowing dust. People often hiked and picnicked on the tailings. Kids played and rode bicycles on the tailings. A company named Oka Aggregates saw a huge reservoir of clean, fine sand, perfect for their purposes, and began carting away truckloads of the stuff. About 200 000 tonnes of these radioactive wastes were used in construction projects in Oka and in the Montreal area, including Highway 20. One property in Oka was so contaminated by the use of the radioactive tailings that, according to an inspector from the Quebec Government, a person could obtain an annual gamma ray exposure greater than the maximum allowed for members of the public by simply sitting in a chair on the front lawn the whole time. Not surprisingly, the radon levels in such homes were particularly high.

Meanwhile, a new housing subdivision was being built right beside the radioactive carbonatite formation. The radon levels in these new homes were alarmingly high. As awareness of the radon hazard grew, the government stopped issuing building permits. But the developer sued, maintaining that the government had no legal right to withhold the permits, and he won his case in court.

Forced into a corner, the Quebec government disbursed three million dollars of taxpayer's money to compensate the developer for agreeing not to build any further houses in the subdivision. In addition, measures were taken to stabilize the tailings, halt the use of such materials for construction, and make the tailings less accessible to intruders. However, no remedial work was undertaken with regard to the 200 000 tonnes of materials that had already been removed.

A similar situation was unfolding in Varennes, involving radioactive phosphate wastes from the Erco fertilizer plant. Phosphate ore from Florida is contaminated with uranium. Whether because of natural uranium levels in the soil, or the misuse of radioactive wastes

from phosphate mining, or both, radon is a major problem in the Florida housing market. In that state, radon-contaminated buildings are so common that no building can be sold without a certificate specifying the radon levels in the building as measured by a certified agent. Indeed, the extensive indoor radon problems in Florida are what galvanized the US government into making the radon problem a national priority as a public health issue.

Just as at Oka, an enterprising entrepreneur was helping himself to hundreds of truckloads of radioactive phosphate wastes at Varennes and using the radium-laced materials in countless building projects, mostly on Montreal's South Shore. Clifford Lincoln, who was then Quebec's Environment Minister, ordered the company to cease and desist, but the company ignored the order and continued to make off with radioactive tailings for use in construction.

It took several months before the Minister could get the needed legal muscle to force the company to comply. Again, no remediation work was undertaken regarding the large volumes of radioactive tailings that were used in construction. No doubt residents in many of these dwelling are still living in a radon-contaminated indoor environment with no understanding of the fact that their home has become a life-threatening radioactive hazard, or how this was allowed to happen.

Given the fact that millions of tonnes of radioactive sand will be produced in Quebec if uranium mining proceeds in this province, and that it will remain dangerous for tens of thousands of years, the task of guarding this material and preventing its use in construction is a formidable undertaking. Yet the CNSC does not even acknowledge the problem.

12. The CNSC slide show asserts that it is the "responsible authority" for environmental assessments that are "required for any proposed uranium mine or mill". Nevertheless the CNSC accepted without criticism or comment a non-compliant EIS in 2009 related to the Matoush uranium project in the Cree territory of Eeyou-Istchee in Northern Quebec.

The Guidelines that were laid down for the preparation of the Strateco EIS stated: "the impact statement must describe the radioactivity-related aspects that make this project different from other types of mining activities." More specifically, the Guidelines make it clear that the proponent has an obligation to explain the fundamental facts and risks associated with radioactive materials in terms that are understandable to the population likely to be affected by the project. These requirements were not met by the EIS.

According to the Guidelines, information about "radioactivity and the environment" should be sufficiently well understood by "elected officials, groups, organizations, land users and the general population" to allow members of concerned communities to foresee possible dangers and to express their concerns about them. Thus the nature of the communication should be "adapted to the cultural and social context" of the community.

The proponent ignored these requirements, and the CNSC – the "responsible agency" – did little or nothing to ensure compliance. In 2010 CCNR conducted an analysis of the EIS, entitled "Radioactivity is Invisible" [on-line at http://ccnr.org/GE_Critique_EIS.pdf]. The CCNR analysis demonstrates that Strateco made no effort to communicate the basic

scientific facts in simple down-to-earth language. Indeed the 4-volume EIS failed to address any of the following questions with any degree of clarity or competence:

Question 1: What is atomic radiation? What is radioactivity?
Question 2: What is a Becquerel? What is radioactive disintegration?
Question 3: What is the Half-Life of a Radioactive Material?
Question 4: What is a Decay Product? What is a Decay Series?
Question 5: What is a "radionuclide" ? What is an "isotope" ?
Question 6: What is "the Uranium Decay Chain (or Decay Series)" ?
Question 7: What is "Radioactive Equilibrium" ?
Question 8. How does one apply Quebec Directive 019 for radioactivity?
Question 9. Are radioactive materials carcinogenic?
Question 10. Is radon gas responsible for the deaths of miners?
Question 11: Do mining regulations make radon exposures safe?
Question 12: Is there a safe level of exposure to atomic radiation?
Question 13: What are the "delayed effects" of radiation exposure?
Question 14: What is "ionizing radiation" ?

13. *Conclusion*.

The Canadian Coalition for Nuclear Responsibility (CCNR) urges the Inter-Ministerial Committee not to be misled by one-sided and partial information communicated in the CNSC slide show. In 2008 the government of Canada fired Linda Keen, the previous Chair of the CNSC, simply for enforcing the CNSC reactor safety regulations. Since that time, CCNR has noticed that CNSC has become increasingly involved in disseminating information that is supportive of the expansion of nuclear power and uranium mining and dismissive of points of view that are critical of the nuclear option, thus aligning itself with federal government policy. However, CCNR feels that such behavior is inappropriate as it is in contravention of CNSC's legal obligation to maintain a neutral and objective stance.

It is certainly true that worker exposures have been greatly reduced over the years, and so the risk of radiation-induced diseases have also been reduced. It is also true that uranium tailings are much better managed now than they were in the past. These changes were brought about primarily as a result of workers and citizens demanding improvements – improvements that were fought tooth and nail by the uranium industry.

CCNR would be pleased to provide additional information or to answer any questions that the Inter-Ministerial Committee may have, related to this dossier.

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References

Patsy Thompson. "Regulation of Uranium Mines and Mills". Powerpoint presentation to the Interdepartmental Committee to Review the BAPE's Findings on the Uranium Industry. CNSC, February 2016. http://tinyurl.com/jx4mlkv

Gordon Edwards. "Radiation is invisible" Critique of Strateco's EIS of October 2009 for the Matoush Uranium Project. CCNR, November 2010. http://ccnr.org/GE_Critique_EIS.pdf

Agency for Toxic Substances and Disease Registry. "Public Health Statement for Radium". ATSDR, December 1990. http://www.atsdr.cdc.gov/phs/phs.asp?id=789&tid=154

Garthika Navaranjan, Colin Berriault, and Paul A. Demers. "Ontario Uranium Miners Cohort Study". Prepared for the Canadian Nuclear Safety Commission by the Occupational Cancer Research Centre. CNSC, February 2015. http://www.nuclearsafety.gc.ca/eng/pdfs/RSP-0308.pdf

James M. Ham. Report of the Royal Commission on the Health and Safety of Workers in Mines. Government of Ontario, 1976. https://archive.org/stream/reportofroyworkmine00onta/reportofroyworkmine00onta_djvu.txt

Duncan C. Thomas and K. G. McNeill. "Risk Estimates for the Health Effects of Alpha Radiation". (AECB INFO-0081) A report prepared for the Atomic Energy Control Board. AECB, 1982.
Excerpts: http://ccnr.org/thomas_report.html .

Robert Woollard, MD, and Eric Young, MD. "Health Dangers of Uranium Mining and Jurisdictional Questions". A summary of material before the BC Royal Commission of Inquiry on Uranium. BCMA. August 1980.
Excerpts: http://ccnr.org/bcma.html .

International Atomic Energy Agency, Waste Technology Section. "The long term stabilization of uranium mill tailings" (IAEA- TECDOC-1403). IAEA, August 2004. http://www-pub.iaea.org/MTCD/publications/PDF/te_1403_web.pdf