The Health Dangers
Of Uranium Mining

a presentation by

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on behalf of

Physicians for Global Survival (PGS)

to the members of

Inuit Ataqatigiit

and the citizens of

Narsaq, South Greenland

See accompanying powerpoint at
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ADVICE TO THE READER

For maximum comprehension it is best to open the Presentation and the Slide Show in side-by-side windows on your desktop, so that you can view the slides that go with the talk, following the cues given in the text.

Gordon Edwards

[Slide 1] Hello. My name is Gordon Edwards. I live in the city of Montreal in the province of Quebec, and I am happy to be here with you today in Narsaq, Greenland. *[Slide 2]* We are actually not so far away from each other, as you can see by the map. I am not a medical doctor, but I am the scientific advisor to a group of Canadian medical doctors and health professionals who have sent me to share with you some information about the dangers to health and the environment from uranium mining.

[Slide 3] Canada is and always has been one of the biggest producers and exporters of uranium in the world. Nevertheless, three of Canada's ten provinces have outlawed uranium mining, and health professionals have played an important role in each case. *[Slide 4]* In this talk I will explain why these medical professionals are opposed to uranium mining. I have brought some booklets explaining why the physicians who have sent me here are against uranium.

[Slide 5] In 1980 the British Columbia Medical Association published a 400-page book entitled "The Health Dangers of Uranium", filled with scientific evidence. *[Slide 6]* The BC government responded by declaring a 7-year moratorium on uranium exploration and mining in the province. *[Slide 7]* Many years later, in 2008, BC declared a permanent ban on uranium mining.

The province of Nova Scotia, 4000 kilometres away from British Columbia, also declared a moratorium on uranium in 1982. Again the medical doctors played an important role by producing evidence of medical harm. *[Slide 8]* In 2009, Nova Scotia finally passed a law forbidding the mining of and exploration for uranium. If the Kuannersuit mine proposed for Greenland were proposed in Nova Scotia, it would simply be against the law. Nor would the Kuannersuit project be allowed in British Columbia, or even in Quebec.

[Slide 9] In my province of Quebec, a uranium moratorium was declared in 2012. One of the events that led to this moratorium was an open letter to the government signed by 23 medical doctors from the City of Sept-Iles. The letter said that if the government did not act to stop uranium exploration and mining in their region, these doctors were prepared to quit their jobs at the hospital, leave the City, and perhaps even leave the province.

The voices of health professionals, as well as anti-uranium resolutions passed by 400 Quebec municipalities, reinforced by the powerful voice of the Grand Council of the Cree Nations, made it very clear that uranium mining is not welcome in Quebec and led to the existing moratorium. A committee set up by the Quebec government will soon be recommending a course of action -- to ban uranium permanently, or to extend the existing moratorium.

Uranium is Special

[Slide 10] What is so special about uranium? *[Slide 11]* Uranium is a heavy metal. It is well known to the medical community that continual exposure to any heavy metal such as lead, mercury, arsenic or cadmium, is damaging to human and animal health. *[Slide 12]* If heavy metals are allowed to contaminate the food chain, or the drinking water, the contaminants will gradually build up in the bodies of men, women and children, who eat and drink every single day. Eventually this can cause crippling diseases affecting health and intelligence.

Like other heavy metals, uranium is dangerous. It is especially damaging to the kidneys. But unlike most heavy metals, uranium is also radioactive. *[Slide 13]* That means that its atoms are unstable. A certain fraction of uranium atoms are constantly disintegrating, *[Slide 14]* releasing a kind of invisible energy, called radioactivity. And nobody knows how to shut off the radioactive disintegrations or even slow down the rate at which they happen.

[Slide 15] Radioactivity cannot be seen, smelled, tasted, heard or felt. Without specialized equipment, like a radiation monitor, nobody can tell that radioactivity even exists. *[Slide 16]* A piece of uranium ore looks just like an ordinary rock. *[Slide 17]* But inside a "cloud chamber", you can see the tracks of the invisible radioactive emissions given off by uranium atoms.

[Slide 18] Radioactive energy comes directly from the core of the atom, called the NUCLEUS, so radioactivity is a form of "nuclear energy". *[Slide 19]* All scientists know that nuclear energy is millions of times more powerful than any other kind of energy found in nature. Non-radioactive heavy metals or chemical poisons do not emit any nuclear energy at all, because the nucleus never changes.

[Slide 20] A radioactive nucleus is like a miniature time bomb. When it suddenly explodes, it gives off a blast of energy that is very damaging to living cells. Cells that are damaged in this way *[Slide 21]* can grow into cancer cells many years later. In the case of reproductive cells, like eggs or sperm, the damage can be transmitted to future generations – to grandchildren, and *their* grandchildren. Individuals exposed to low-levels of radioactivity are also less resistant to contagious diseases, because the cells the body needs to fight infection are the first ones to be damaged.

Three things science has learned about health effects of low-level radioactive exposures:

(1) *[Slide 22]* there is a delay [latency period] between exposure and the disease that it causes;

(2) *[Slide 23]* infants and children are much more easily affected than adults;

(3) *[Slide 24]* there is no absolutely safe level of radiation exposure [the linear model].

Uranium is Never Alone

[Slide 25] One of the most important things to understand about radioactivity is this: when a radioactive atom disintegrates, *[Slide 26]* it becomes an entirely different kind of atom. And if that new atom is also radioactive, *[Slide 27]* then it too will disintegrate, changing into still a third kind of atom. *[Slide 28]* And so on, *[Slide 29]* and so on. In this way, *[Slide 30]* uranium produces about two dozen other radioactive materials called "uranium progeny" or "decay products of uranium".

[Slide 31] Each of these decay products is more radioactive and more biologically damaging than uranium. Three of them – radium, radon, and polonium – have killed many thousands of people.

[Slide 32] In 1896, in Paris France, a man named Henri Becquerel found that rocks containing uranium are radioactive, giving off a kind of invisible light that can expose photo-graphic materials. The unit of radioactivity is named after him. One Becquerel of radioactivity indicates that one radioactive disintegration is happening every second.

[Slide 33] Two years later, in 1898, Marie Curie separated the uranium from the crushed rock, and found that the sand-like residues are much more radioactive than the uranium itself. She showed that uranium is never alone, it is always accompanied by a whole family of radioactive byproducts. She discovered two new elements in the residues called radium and polonium. Every atom of radium or polonium starts out as an atom of uranium.

[Slide 34] Health Effects of Radioactive Exposure

In 1920 radium was the most expensive substance on earth, selling for $100,000 per gram. But in the first half of the twentieth century so many people died horrible deaths from handling this material, that radium is now discarded as a waste byproduct from uranium mining. *[Slide 35]* Young teenage girls hired to use radium paint to make dials glow in the dark suffered from *[Slide 36]* diseases caused by swallowing very tiny amounts of radium: loss of teeth, bone deformities, *[Slide 37]* fatal anemia, bone cancers, and head cancers, all radium-caused.

[Slide 38] The first uranium mine in Canada was on the shore of Great Bear Lake. It began as a radium mine in 1931. It was reopened to supply uranium for the WWII atomic bomb project. *[Slide 39]* Indigenous Sahtu-Dene men carried sacks of radioactive ore on their backs and were never told it was dangerous. Sacks would sometimes rip and the men would be covered with radioactive powder. *[Slide 40]* Women gathered the old sacks to reuse the material at home. So many people died

of cancer in later years that the community was called the Village of Widows. There were no grandparents to teach children the old ways. *[Slide 41]* The Government warned scientists in Ottawa of the dangers of radium, but not the workers.

[Slide 42] Polonium is another story. In 2007 a Russian named Alexander Litvinenko was murdered in London England. His tea was poisoned with polonium-210. Inside the body, polonium attaches to the red blood cells and goes to all the organs, damaging each one. *[Slide 43]* Polonium is the most toxic element found in nature. According to nuclear scientists at Los Alamos, polonium-210 is 250 thousand million times more toxic than cyanide, a powerful chemical poison often used in murder mysteries.

[Slide 44] The American Health Physics Society says that up to 90 percent of deaths blamed on cigarette smoking are actually due to very minute amounts of polonium-210 in the tobacco. This includes lung cancer, heart attacks and strokes. So polonium-210 is already killing over 400,000 Americans every year. And it is just one of the decay products of uranium.

[Slide 45] In 1899, an assistant to Marie Curie discovered that radium gives off a radioactive gas. It turns out that atoms of radium are continually disintegrating and changing into atoms of radon gas. Radon atoms in turn disintegrate to form atoms of solid polonium. By the 1930s it was known that radon gas is the leading cause of lung cancer among non-smokers, and that it has killed countless thousands of miners all over the world.

[Slide 46] The US Environmental Protection Agency estimates that 20 to 30 thousand Americans die every year from lung cancer caused by radon in their homes. *[Slide 47]* It is considered a top-priority health problem, as people are urged to have their homes tested for radon levels. I have brought some pamphlets on radon that I will leave with you.

[Slide 48] The reason why radon is so deadly is that it deposits polonium in the lungs of its victims. Indeed, the only source of polonium is radon; and the only source of radon is radium; and the only source of radium is uranium. So when you dig up uranium you are digging up all the uranium decay products. We don't have time to talk about the other uranium decay products, like radioactive lead-210, but you get the idea.

Non-Penetrating Alpha Radiation

[Slide 49] The most damaging atomic radiation is a non-penetrating type called alpha radiation. Alpha radiation is often difficult to detect with radiation monitors, because it has a very short path and little penetrating power. This can lead to serious misrepresentation of the risks. If it doesn't register on the equipment you think there is no danger. But there is.

[Slide 50] There are three types of radioactive emissions, called alpha, beta and gamma – the first three letters of the Greek alphabet. *[Slide 51]* A gamma ray is a highly penetrating bundle of pure energy, like an x-ray, but more powerful. The other two are material particles moving very fast, each with an electric charge. They are non-penetrating, or only slightly penetrating, and more difficult to detect than gamma rays. *[Slide 52]* An alpha particle cannot pass through a sheet of paper, and a beta particle can only go a few centimeters in soft tissue.

[Slide 53] When radioactive material enters the body by breathing, eating or drinking contaminated material, alpha radiation is the most dangerous of the three types. All of the deadly radioactive materials discussed earlier – uranium, radium, radon, and polonium – are alpha emitters. They are difficult to detect, but very dangerous. *[Slide 54]* Each alpha particle is 100 to 200 times more damaging than a beta particle or a gamma ray. For this reason alpha emitters are much more effective at causing cancer, genetic damage and other diseases, than beta or gamma emitters. Alpha radiation is most abundant wherever there is uranium mining.

Radioactive Tailings

[Slide 55] Uranium mining leaves behind enormous volumes of radioactive sand-like wastes called uranium tailings. *[Slide 56]* Here is a picture of one of the radioactive tailings deposits from Elliot Lake Ontario. Behind this wall of radioactive sand, 10 metres high, is an entire lake that has been filled in with 70 million tonnes of sand-like radioactive uranium tailings. Here in Greenland, if the Kuannersuit mine project goes ahead, you could have 15 times this volume of radioactive waste to store. In Canada as a whole there are about 220 million tonnes of radioactive uranium mine residues. In Greenland, you will have four-and-a-half times more than that volume of waste material. Even if we include the USA, the whole of North America would have less than half of the volume of uranium wastes that Greenland will have if this single project goes ahead: one thousand million tonnes of radioactive waste.

[Slide 57] The uranium wastes still contain about 85 percent of the radioactive material in the original ore body. All of the radium and polonium is still there. *[Slide 58]* Radioactive dust blows in the air and is washed by the rain. *[Slide 59]* Radon gas is constantly being produced, spreading radioactivity offsite by depositing radon decay products on the soil beneath. In Canada's north, the caribou have unusually high levels of polonium in their meat because of radon gas, depositing solid polonium on the lichen that the caribou love to eat. As a result of this, Inuit families that eat a lot of caribou meat have higher levels of polonium in their bodies than people from cities in the south. If not very carefully managed, uranium tailings will dramatically increase the amount of radon and therefore the amount of polonium near the tailings piles. *[Slide 59]* When the company is gone, the wastes will be deserted.

[Slide 61] The half-life of a radioactive substance is the time it takes for half of the atoms to disintegrate. For example, radon has a half-life of about 4 days, so it would all be gone in a few weeks if it wasn't for the fact that new radon is constantly being produced by the radioactive disintegration of radium, which has a half-life of 1600 years. *[Slide 62]* Most of the radium would all be gone in about 20,000 years, if it wasn't for the fact that new radium atoms are constantly being produced by the radioactive disintegration of thorium-230, which has a half-life of 76,000 years. *[Slide 63]* The bottom line is this: uranium tailings will remain dangerously radioactive for hundreds of thousands of years.

How do you safely manage 1000 million tonnes of radioactive sand for hundreds of thousands of years to come? Who in Greenland will have the knowledge and the money to deal with this problem for hundreds of generations, or to clean up the contamination when major spills occur, as they almost surely will? Who will prevent people from using the radioactive sand for construction work, to make cement or to use as fill material? This has happened in several cities in Canada and elsewhere, leading to unacceptably high indoor radon levels in homes, offices and schools.

[Slide 64] In the town of Oka, just outside Montreal, about 200,000 tonnes of radioactive mine tailings were used for construction purposes. The doctors in the medical health unit published a report expressing great concern and revealing that the legally permitted levels of radon in homes would lead to a shocking increase in lung cancer among the people living in those homes, if those limits were actually reached.

[Slide 65] In Port Hope, Ontario, extensive contamination has occurred due to mismanagement of uranium mining wastes. The most expensive environmental

cleanup of any municipality in Canadian history is currently underway in Port Hope. Hundreds of thousands of tonnes of uranium wastes have to be retrieved from deep ravines; the sediment in the town's harbor has to be dredged; some roadways and buildings have to be demolished and stored as radioactive waste in special facilities intended to last 500 years, although the wastes will remain dangerous for hundreds of thousands of years.

Who will pay the costs for maintaining a world-class radiation regulatory body in Greenland to enforce safety standards? Will those costs still be paid thousands of years after the mining company has gone out of business? These are questions Greenlanders should be asking themselves now. Once the mine opens it is too late.

Uranium Boom

[Slide 66] Although uranium was discovered over 200 years ago, it had no practical use until World War II. In 1938 scientists discovered that enormous nuclear energy can be released by "splitting" the nucleus of uranium atoms. It is called "nuclear fission". *[Slide 67]* The energy released by nuclear fission can be used to make an atomic bomb, or *[Slide 68]* to run a machine called a nuclear reactor. Without uranium, no nuclear weapons or nuclear reactors would be possible. There is no significant use for uranium that does not involve nuclear fission.

[Slide 69] This is a Russian monument to the splitting of the uranium atom. The semicircles represent the energy that is released, and the two balls represent the broken pieces of the uranium atom, called "fission products". There are hundreds of different kinds of "fission products", all of them highly radioactive – millions of time more radioactive than uranium. These fission products do not occur naturally, they are only created when the nucleus is "split". They are very dangerous materials; the gamma radiation alone can kill a human being in seconds.

[Slide 70] In 1943 Canada agreed to supply uranium for the World War II Atomic Bomb Project. *[Slide 71]* On August 6 1945, a single atomic bomb made form uranium destroyed the Japanese city of Hiroshima. It was clear to most observers that nuclear warfare has the potential to destroy human civilization and kill most higher forms of life because of the radioactivity.

[Slide 72] For 20 years Canada's uranium industry boomed, selling uranium to the US military for use in the nuclear weapons program. The Canadian government decided that after 1965 Canadian uranium would be sold only for peaceful purposes, as fuel for nuclear reactors.

But in 1974, India used a man-made substance called plutonium, produced inside a Canadian nuclear reactor, to explode its first atomic bomb. *[Slide 73]* Inside every nuclear reactor, some of the uranium atoms used as fuel are changed into plutonium atoms, and *[Slide 74]* plutonium is an even more powerful nuclear explosive than uranium. So even the peaceful use of uranium produces material that can be used for atomic bombs.

Doctors on Call

[Slide 75] The International Physicians for the Prevention of Nuclear War (IPPNW) is a global association of medical doctors that calls for the elimination of nuclear weapons. *[Slide 76]* IPPNW explains the catastrophic medical consequences that would occur following a nuclear war – there would be few doctors, no hospitals, few medicines, and no facilities to treat patients. IPPNW won the Nobel Prize in 1985 for their outstanding educational activities against nuclear war. Physicians for Global Survival is the Canadian branch of IPPNW.

[Slide 77] Uranium can be used, and has been used, to build tens of thousands of nuclear weapons. Uranium has also been used to fuel about 400 nuclear power reactors worldwide. It has also been used in nuclear reactors to make medical isotopes. But even when uranium is used for peaceful purposes, it creates plutonium that can be extracted and used to make nuclear weapons at any time -- even tens of thousands of years in the future.

[Slide 78] In addition, uranium fuel becomes “high level nuclear waste” containing all the fission products. These nuclear wastes remains highly dangerous for millions of years, because radioactivity is a form of nuclear energy that cannot be shut off. *[Slide 79]* Nuclear waste will be a threat to future generations for millennia, in exchange for 20 or 30 years of electricity.

There are many ways to make electricity that do not need uranium. There are ways to make medical isotopes that do not need uranium. The only thing for which uranium is absolutely needed is nuclear weapons. If we want our children to have a sustainable future, if we don’t want to increase the burden on future generations by creating more nuclear waste, and if we hope to eliminate nuclear weapons from the planet, it is best to just leave uranium in the ground. That is the view of the International Physicians for the Prevention of Nuclear War. In 2010, IPPNW called for a global ban on uranium mining.

A Final Word

[Slide 80] In the struggle to do what is right for Greenland, what is right for our grandchildren, and what is right for the world, let us not be discouraged by temporary setbacks. In 2006, the government of British Columbia told its citizens that it would never ban uranium mining completely. But the citizens did not give up. They increased their efforts. And in 2008, the government did ban uranium mining in British Columbia permanently.

In 2010, the government of Quebec approved the spending of billions of dollars to extend the life of its only operating nuclear reactor. But the citizens who wanted it shut down increased their efforts, and in 2012 the reactor was closed permanently. If the citizens provide sound leadership, a responsible government will eventually listen and act.

The government is there to serve the people. It is supposed to do what is best for all of its citizens, and to lay the groundwork for a sustainable future by ensuring a healthy and safe environment. Sometimes, when issues arise that go beyond the cycle of political elections, the citizens have to take the lead and tell their governments what must be done. *[Slide 81]*That is what IPPNW has tried to do – it has tried to provide leadership on the issue of uranium mining, by informing people that in the long run, uranium mining is not conducive to human health, nor to a healthy environment, nor to a safe & healthy planet.

At the World Uranium Symposium held in Quebec City last year, hundreds of organizations from more than a dozen countries endorsed a declaration calling for an end to uranium mining all over the world. *[Slide 82]* At that event, Matthew Coon-Come, the Grand Chief of the Grand Council of the Crees, said:

> *"Our opposition to uranium mining is not negotiable. Uranium mining is incompatible with the Cree way of life. We do not own the Land. We do not live on the Land. We are the Land."*

Thank you. *[Slide 83]*