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Projet d'exploitation éventuelle d'une
mine et d'une usine de niobium à Oka
Oka 6211-08-002

NIOCAN INC. MINING PROJECT

ENVIRONNEMENT ET FAUNE
REÇU LE

IN OKA

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DIRECTION REGIONALE
DES LAURENTIDES

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**A Critical Lack
of Radiological Hazards Assessment
on the Niocan Project**

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The Roche Environmental Study for the Niocan Mine Project was put together by a Working Group (Equipe de travail) comprised of two cartographers, a process engineer, a civil engineer, an urbanist, a geographer, a biologist, a specialist in architecture and landscape, and engineers specializing in hydro-geology, hydraulics, acoustics and vibrations.

There is no indication of any expertise in the fields of ionizing radiation, alpha emitting radioactive substances, radio-ecology, radio-biology, or radioactive waste management. This is a major oversight in any Environmental Study purporting to deal with the potential consequences of mining a radioactive ore body.

The absence of any detailed discussion of the short-term, medium-term, and long-term radiological implications of the project for workers, the residents of the area, agricultural activities, and the local ecosystems (including atmosphere, soil, surface waters, ground waters, flora, fauna, and fish) is remarkable.

Given the previous history of mismanagement of radioactive waste material from the St-Lawrence Columbiac mining operation, which led to considerable offsite radioactive contamination of homes and other public and private properties, it is imperative that the radiological aspects of the project be accorded the attention and care that they deserve, using the best expertise available.

Within ten years of the discovery of natural radioactivity in 1896 by Henri Becquerel, it had become clear that atomic radiation posed unique and serious dangers to those coming into contact with radioactive ores.

By 1898, Madame Curie had identified two new radioactive elements -- radium and polonium -- both of which emit a non-penetrating but highly dangerous form of radiation known as "alpha radiation". These alpha-emitting materials are among the most potent carcinogenic materials known to science.

Isotopes of radium and polonium exist in elevated concentrations in the ore body that Niocan proposes to mine. These and other radioactive materials will remain behind in the large volumes of low-level radioactive wastes left over from the mining operation, including both the slag and the sandy residues known as tailings. Unless properly managed for many thousands of years into the future, they will pose a permanent and potentially quite serious radiological hazard to human health and to the environment.

I have attached an exhibit entitled "Radioactive Decay Chain: Uranium-238" which illustrates one important family of radionuclides contained in the radioactive ore

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that Niocan proposes to mine. All these radioactive materials are natural radioactive byproducts of uranium-238, which has a 4.5 billion year half-life and which is present in elevated concentrations in the ore body. Thus all these radioactive materials will be either released into the environment or become part of a long-term radioactive waste management problem. The most dangerous of these materials are the ones that emit alpha radiation, such as radium, radon, and the various polonium isotopes. Lead-210 is important because it has a 21-year half-life and continues to produce polonium-210, a highly radiotoxic alpha emitter.

As early as 1931, the Government of Canada had identified the extraordinary danger to human health posed by these radioactive materials:

"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 [i.e. radon] over a long period of time will cause a building up of radioactive material in the body, which eventually may have serious consequences.

"Lung cancer, bone necrosis, and rapid anaemia are possible diseases due to the deposition of radioactive substances in the cell tissue or bone structure of the body. . . ."

"Precautions for workers in the Treating of Radium Ores"
by W. R. McClelland, Canadian Department of Mines,
Investigation in Ore Dressing and Metallurgy, Ottawa, 1931

Historically, the dangers of alpha radiation have often been underestimated because this kind of atomic radiation is quite difficult to detect; alpha rays have such a short track that they cannot even penetrate through a sheet of paper. Nevertheless it is widely acknowledged that alpha radiation is at least 20 times more biologically damaging (per unit of ionizing energy exposure) than more penetrating types of radiation such as x-rays, gamma rays or beta rays. Paradoxically, though it is completely harmless outside the body, alpha radiation is especially damaging when it comes into contact with living cells through ingestion, inhalation, or absorption.

Radium-contaminated wastes pose a serious environmental hazard because of the longevity of the problem (radium-226 has a 1600 year half-life) combined with the insidious nature of the hazard posed by chronic low-level exposure to radium. The longevity of the radium hazard is exacerbated in the case of radioactive mine wastes, because of the presence of thorium-230 (see the exhibit), which has a 76,000 year half-life. Thorium-230 continually replenishes the supply of radium-226 in the mine wastes. Thus, for example, there will be no perceptible decrease in the amount of radium-226 present in the mining wastes even after 10,000 years following the cessation of mining operations -- unless it escapes into the environment earlier.

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In Canada and around the world, the long-term management of radioactive tailings has been identified as one of the most serious unresolved problems associated with the long-term radiological protection of humans and other biota. In 1978, the Ontario Royal Commission on Electric Power Planning identified the long-term management of radioactive mine wastes as a problem of major concern:

"The decommissioning and abandonment of depleted mines and the long term management of the very large volumes of environmentally hazardous tailings, perhaps in perpetuity, represent extremely difficult issues...." (p.147)

"[These] tailings will constitute an increasing health and environmental problem. An independent review committee should be established to study the problem in depth and prepare a public report for the AECB and the Ontario Environmental Assessment Board. The future of the nuclear programme should be assessed in light of the committee's findings and progress in mill tailings containment technology." (Major Findings and Conclusions, p. xiii)

"At about two or three year intervals the nuclear power programme, and in particular the uranium mining and milling part of the fuel cycle, should be assessed in the light of the findings of this review committee." (p.73)

Excerpts from *A Race Against Time, Interim Report*,
Ontario Royal Commission on Electric Power Planning
Toronto, September 1978.

Although these passages refer to wastes resulting from the mining of uranium, the same basic concerns apply to the mining of radioactive ore bodies in general. Thus in Florida, the mismanagement of radioactive wastes resulting from the extraction of phosphate ore resulted in serious radon contamination problems in a number of communities. The resulting health problems sparked a national re-assessment of the extraordinary dangers associated with the chronic inhalation of radon, a radioactive alpha-emitting gas which is continually produced by the radioactive disintegration of radium.

It is somewhat misleading to describe these mine wastes as "low-level" radioactive wastes, because the phrase suggests to the uninformed that these wastes pose only a low level of risk to human health and to the environment and therefore require only a low level of consideration. Neither of these inferences is correct.

The designation "low-level" is justified on three grounds:

- (1) to distinguish these mine wastes from the "high-level" radioactive wastes produced by nuclear reactors as spent nuclear fuel;
- (2) to convey the fact that there is far less radiation of a highly penetrating nature than one finds in high-level and medium-level wastes from nuclear reactor operations or from the production and use of industrial radio-isotopes;
- (3) to acknowledge the fact the concentration of radioactive materials is very low because they are diluted in a very large volume of non-radioactive material.

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However the total inventory of alpha-emitting materials in radioactive tailings is typically very high, and the wastes themselves are generally much less well contained because of the huge volume involved and the milling process itself. Thus these "low-level" radioactive materials are much more available to the environment over the long run.

In 1978, the US Geological Survey pointed out that radioactive mine tailings from uranium mining (which are more radioactive than the Oka tailings, but involve the same family of radioactive contaminants) may be of even greater long-term environmental concern than the high-level wastes produced by reactors -- because, scientifically speaking, after about 1000 years of storage, the low-level mine wastes are actually more radio-toxic than the high-level wastes are.

By the 1930s it had been well established that chronic exposure to radon gas had been killing large numbers of underground miners for at least 400 years, mainly through the induction of lung cancer and other fatal lung diseases. It is now known that most of the biological damage to the lung is done by two isotopes of polonium -- polonium-218 and polonium-214 -- which are deposited in the lungs of the worker by the internal disintegration of radon gas atoms.

Despite these scientific determinations prior to WWII, forty years passed before more restrictive standards for occupational exposure to radon had been implemented for underground miners in Canada. (Even so, according to a 1980 report published by the Canadian Atomic Energy Control Board, the current permissible exposure levels for radon, if maintained at the maximum for a period of years, could result in a quadrupling of the lung cancer rate among miners so exposed.)

Until the Florida scandal erupted, which involved the mismanagement of radioactive tailings from phosphate mining operations, the effect of radon on the general public had been virtually ignored. Between 1970 and 1990, publications by the US National Academy of Sciences BEIR Committee ("Biological Effects of Ionizing Radiation") went from reporting no public health effects from naturally occurring radon gas to reporting that a very large fraction of all radiologically-induced cancer deaths are attributable to radon gas exposure. In fact, far more deaths are now attributed to radon exposure than to any other radiological source.

Radon emissions from mining operations involving radioactive ore bodies is a major concern, not only during the operational phase, but also in the very long term. Radon-222 has a short half-life (3.8 days) so that very little of it escapes from the undisturbed ore body. However when the ore is crushed the surface area is increased by many orders of magnitude, and the radon can escape at rates tens of thousands of times greater than from the original rock formation. Because the radon-222 atoms are continually replenished by the decay of radium-226 atoms, which in turn are replenished by the decay of thorium-230 atoms, the production of radon gas continues unabated for tens of thousands of years.

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All of this underscores the importance of doing a competent and thorough assessment of the radiological hazards associated with the Niocan project. The existing documentation for the project does not seem to address these radiological hazards in any meaningful way.

In a report on the evaluation of management options for the low-level radioactive wastes resulting from the Niocan operation, GSI Environnement Inc. reports a number of disturbing facts which are clear warning signs that the Niocan project should not be allowed to proceed at the present time due to inadequate consideration of radiological implications.

For example, the GSI report refers to low-level radium-bearing wastes from Port Hope Ontario which have been in search of an acceptable management option for many long years. I have personal knowledge of the Port Hope situation and can cast some additional light on the nature of the problem.

The Port Hope wastes were identified as a problem 25 years ago, when it was discovered that hundreds of homes and other buildings in Port Hope were badly contaminated with alpha-emitting materials, which also contaminated local ravines and the Port Hope harbour. Many of the contaminated structures had to be destroyed, while others underwent expensive decontamination work.

In St. Mary's elementary school, for example, the levels of radon in the cafeteria were found to be higher than those allowed in uranium mines. The school was promptly evacuated. The school's Parking Lot was found to be quite radioactive.

The Port Hope contamination problems were the result of inoffensive-looking sand-like tailings being used as "fill" in the construction of many buildings around town -- a practice which also took place in Oka in the east, as tens of thousands of tons of radioactive sand-like materials were sold and used for construction.

Even a cursory examination of Port Hope made it clear that the geology did not make it a suitable repository for some hundreds of thousands of tons of radioactive waste which will remain dangerous for hundreds of thousands of years. Accordingly, the Government of Canada established a Siting Task Force with the mandate to find a community somewhere in Ontario to accept these wastes for permanent disposal in exchange for various financial and other rewards that could be offered to any community willing to accept the wastes.

After four years of effort and several million dollars in funding, the entire attempt came to naught, as no suitable location was found for the long-term management of the low-level radioactive wastes from Port Hope. More than 25 years after the problem was first identified, there is still no acceptable solution that has been implemented.

The Niocan project inevitably poses the question as to whether or not the town of Oka is suitable as a long-term repository for long-lived radioactive wastes. Given

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the importance of agriculture in the area, the proximity to a major population centre, and the proximity to the most important fresh water system in Quebec, the answer to this question is far from obvious.

Atomic Energy of Canada spent \$700 million in federal taxpayers' money to study the concept of safe long-term underground disposal of radioactive wastes; even so, following an environmental assessment process that took ten years, the panel found that there are still many unanswered questions of a technical and scientific nature that must be resolved before any such disposal scheme could be implemented.

Has the Government of Quebec carried out detailed studies relating to the underground disposal of the long-lived low-level radioactive wastes from the Niocan operation? What assurance is there that serious groundwater contamination will not occur over the next few years, decades, centuries or millenia? Is there any detailed decommissioning plan for demolishing radioactive structures and disposing of the debris, or decontaminating radioactive sites left over when the mine shuts down? How exactly will the millions of tons of sand-like radioactive tailings be secured and safeguarded for millenia to come against unauthorized removal, or against seepage, erosion, or sudden catastrophic containment failure (e.g. large-scale dispersal caused by flood, tornado, etc.)?

Until these questions have received a satisfactory answer, and until the radiological impacts of the project have been addressed in detail, the project should not be allowed to proceed.

Gordon Edwards

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