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Human Health Implications of the Nuclear Energy Industry

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EXECUTIVE SUMMARY

Ever since the discovery of radioactivity at the turn of the last century, it has been recognized that ionizing radiation has a deleterious impact on human health. Radiation damage can affect any part of the cell and can interfere with many cellular processes. Most importantly, damage to the genetic material of the cell can lead to cancer, birth defects and hereditary illness. It is generally accepted by the scientific community that there is no safe level of radiation exposure, and that any amount of exposure to ionizing radiation is harmful.

Standards of acceptable exposure in Canada and elsewhere have been reduced many times over past decades, as evidence has mounted of more deleterious health effects. Effects of chronic low-level exposures are poorly understood, especially in children. All stages of the nuclear fuel chain have their associated toxicity. There is continuing risk of accidents or meltdowns, which could release large amounts of radioactivity, such as occurred at Three Mile Island and Chernobyl. Much of the long-lived radioactive contamination we are spreading into our environment now is essentially permanent and irreversible.

This paper will examine the health risks associated with the nuclear power industry at all stages - from uranium mining, to the fission process in reactors, to radioactive waste, and will comment on the risk of nuclear war, which we regard as the ultimate public health issue.

Uranium mining contaminates air, water and soil. Crushing radioactive rock produces dust, and leaves behind fine radioactive particles subject to wind and water dispersal. Radon gas, a potent lung carcinogen, is released continuously from the tailings in perpetuity. Drilling and blasting can disrupt and contaminate local aquifers. Water used to control dust and create slurries for uranium extraction becomes contaminated. Tailings containments can potentially leak, leach or fail, releasing radioactive material into local waterways. Various organisms can transport radioactive material away from contaminated sites. These sites remain radioactive for many thousands of years, and will remain unsafe for most human purposes, as well as being a source of continuing contamination for surrounding populations.

Uranium refining and enriching facilities release radioactive contamination which can impinge on nearby populations. These processes also necessitate transporting many

tons of radioactive material by rail or truck. This carries with it the risk of accidents or spills, with further risk of air, water and soil contamination.

All functioning reactors routinely release radioactive material into the air and into the water used to cool them. Tritium, a carcinogen, mutagen and teratogen, is given off in abundance by Canadian reactors because of their dependence on heavy water as a moderator. Several Canadian reactors, particularly those at the Pickering and Darlington facilities in Ontario, are located near large populations. Despite this proximity to large human populations, relatively few studies have been done on the health impacts of these releases.

One of the potential health risks of this industry is the highly toxic spent fuel produced by the reactor. To date there is no truly safe way to dispose of this spent fuel, which remains radioactive for hundreds of thousands of years. "Geologic storage" which consists of burying the waste deep underground, is being considered, but carries the risk of potential contamination of air and water, and other as yet unknown risks.

A number of health studies done worldwide and in Canada have uncovered links between chronic low-level radioactive emissions from nuclear reactors and cancer, especially childhood leukemia. Experts believe that the radioactive emissions are too low to explain these cases. In 2008 the German KiKK study provided compelling evidence of a positive relationship between a child's risk of leukemia, and residential proximity to a nuclear power plant. This effect was consistent across all sixteen nuclear power plants in Germany which met the researchers' criteria for size and duration of operation, and was detectable as far as 50 km from the nuclear facility. A number of studies of nuclear facility workers have shown elevated risks of cancer.

Though there are relatively few Ontario studies on this subject, the Atomic Energy Control Board of Canada (AECB) undertook several studies in 1989 and 1991 which found an increased prevalence of leukemia in children living near nuclear facilities. Another AECB study suggested higher rates of childhood leukemia corresponding to higher radiation exposure of fathers, the largest risk associated with fathers who worked in uranium mining. The small numbers of subjects in these studies may have contributed to the failure to reach statistical significance but this lack of significance should not be ignored until further larger studies are completed.

Other studies have found elevated rates of some congenital abnormalities including Down syndrome in proximity to some Ontario nuclear stations. These studies suggested a relationship to tritium releases from the plant during the prenatal period, and to paternal radiation exposure. However, because numbers were again small, most results did not reach the level of statistical significance. Again further studies are needed to determine if there is any detectable increased risk of congenital abnormalities. In the interim we suggest that the precautionary principle be considered. The Radiation and

Health in Durham Region Study, 2007 was an ecological study looking at a number of health outcomes in the vicinity of the Pickering and Darlington nuclear reactors. Authors found statistically significant increases compared to Ontario levels in combined cancers, breast cancer, thyroid cancer, bladder cancer, multiple myeloma, leukemia and congenital neural tube defects. Rates of several other cancers and congenital diseases such as Down syndrome were also elevated, though the increase was not found to be statistically significant.

There is mounting evidence that even very low levels of radiation exposure may have serious deleterious health effects over the long term. These are detectable in nuclear workers and in the general population in the vicinity of nuclear installations. Our understanding of the cellular processes affected by this damage, and the implications for the health of the affected individual and his/her descendents is far from complete.

Given that the dissemination into the environment of radioactive material, particularly long-lived radioisotopes, is essentially irreversible, and that such material will remain toxic for thousands of years, a precautionary approach is critically important. Since much genetic damage is permanent, and may be cumulative, this becomes even more crucial. We as family doctors are concerned about the public health risks of every stage of the nuclear industry.