Doctors' Critique of Canadian Nuclear Safety Commission Study

Critique of the RADICON Study (Canadian Nuclear Safety Commission)

The stated purpose of this CNSC study was "to determine the radiation doses to members of the public living within 25 km of the Pickering, Darlington and Bruce NPPs and to compare cancer cases among these people with the general population of Ontario from 1990-2008." The CNSC describes this study on their website as "groundbreaking" and providing "science-based and conclusive evidence that children living nearby are as healthy as children living elsewhere in Ontario". These claims are false for the following reasons:

1) Poor design

An ecological study, a design which can give no information about causation of any effects found, will be of limited usefulness in answering the question "Are there health effects caused by radiation doses to the public from nuclear power plants?" In placing the population within 25 km of each nuclear power plant (Pickering, Darlington and Bruce) into a single category, it lacks the definition of the more skillfully executed studies already in existence, such as the German KiKK study (*Kaatsch P., Spix C., Schulze-Rath R., Schmiedel S., Blettner M. Leukemia in Young Children Living in the Vicinity of German Nuclear Power Plants. Int. J. Cancer 2008; 1220: 721-26*) and French GEOCAP study (*Sermage-Faure C, Laurier D, Goujon-Bellec S, Chartier M, Guyot-Goubin A, Rudant J,Hémon D, Clavel J.Int. J. Cancer 131 (12): 2970-1*) on childhood leukemia, case-control studies that examined risk as close as a 5 kilometre radius.

Unsurprisingly, it finds "no evidence" of increased childhood leukemia, or cancers in general, around Canadian nuclear power plants. However, absence of evidence is not evidence of absence. In other words, negative findings in a weak study such as this should not reassure the public that there is not indeed an increase in childhood leukemia near nuclear reactors in Ontario. One good quality, robustly designed and

meticulously executed study (such as the KiKK or GEOCAP study) which finds a clear positive result trumps any number of weak studies that fail to find anything.

2) Mathematical Models

Mathematical models were used to recreate the atmospheric plume and to estimate dispersion into the environment of “each nuclear substance”. The models were not described, nor were the “nuclear substances” in question itemized or named. The data used to develop these models were supposedly of recorded releases into the atmosphere from each of the plants for each substance. However, the data were never shown, nor were monitoring techniques, frequency, and calibration or other validation procedures described. Emissions to water were not considered at all in this paper.

The statement on p. 12 that, “Radioactive iodine, which is the primary cause of radiation-related thyroid cancer, was below detection limits of the in-stack sampling monitors at all three NPPs for the entire study period”, prompts the question of whether their sampling was adequately done. Information obtained from Ontario Power Generation (OPG) through Freedom of Information indicates that radioactive iodine is detected and measured now on a weekly basis. Clearly the measurements done previously underestimated the iodine present in emissions, making one question whether all other measurements done from 1990 to 2008 presented in this study are inaccurate and/or underestimated.

In addition, the emissions from Darlington and Pickering reactors are not all measured daily. (Bruce Power has refused to provide any emissions other than what is on their website which describe mostly annual averages or totals. It is unacceptable that they are allowed to refuse to release this data to the public). Particulates, iodine, noble gases and carbon 14 are only measured weekly, therefore daily spikes in emissions are not always evident. There are however some remarkably high levels on some weeks, some as much as 100 times the baseline weekly levels. Airborne tritium from Pickering reactor is the only radionuclide measured daily, and there were some spikes in 2012, as much

as ten times the baseline. In addition, the total yearly amounts of airborne tritium from Darlington and Pickering are extremely high, measuring about 7 X 10exp14 becquerels per year. This calls into question the small amounts of radioactivity found in the sampling done in this study and contrasts blatantly with the claims in the paper that doses to the public are “miniscule”.

The recent situation surrounding tritium sampling at the SSI plant in Peterborough does not instill confidence in the CNSC’s accuracy in measuring emissions. The stack sensor was found, after 18 years of operation and several CNSC inspections, to be under-reporting by close to a factor of 10.

From their environmental models, supposedly based on measured releases, further modelling was done to derive human exposure patterns. Exposures were modelled for various “critical groups” around each nuclear power plant. Details of these models were not given. Models in this situation can be quite complex, as the human body is complex, as are its interactions with the environment around it. The results of such modelling are only as good as the thoughtfulness and care that go into constructing the model. Small errors in assigning values can have quite a profound effect on the outcome of the modeling. These formulas are not described at all in this paper.

It must be understood that all measurements presented in this paper as to doses to the public are not actual measurements of actual people, rather they are hypothetical measurements of hypothetical people, and based on average weather conditions. In addition, this does not allow for individual differences in radiosensitivity, nor does it take into account other exposures to radioactivity such as medical imaging, that could further increase risk to some individuals. This does not measure spikes in emissions, that are occurring on occasion, and evident in the emissions levels provided by OPG mentioned earlier. If the wind blew towards the city instead of towards the lake on a day when the emissions were particularly high, a radiosensitive person could experience a high dose, one that could precipitate enough DNA damage to cause cancer.

Some of the human doses derived from these models are presented in Table 1 on p. 6. Without the explanatory material necessary to clearly understand where they came from and what they represent, they are essentially meaningless. While this position has been quite a typical stance for the nuclear industry over the years, this is not the customary way material should be presented in a well-written study.

3) Statistical Databases

As a source of cancer statistics for the time period under consideration, they used the Ontario Cancer Registry and Canadian Cancer Registry, and for population data, the Census of Canada.

In comparing cancer rates between populations, it is important to remember that cancer is multifactorial in origin, meaning a large number of agents or insults to the body can cause it to arise, and that each population, indeed each individual, has its own pattern of exposures. To compare a population exposed to radiation with one exposed to pesticides, for instance, and to find no difference in cancer rates is meaningless. This most certainly does not justify allowing either of these exposures to continue on the grounds that there is “no effect”.

The fact that background levels of cancer are very high in the Canadian population currently means that it will be more difficult to tease out an effect caused by any particular agent. Just because a given study (especially a weak study) does not show an elevated rate of cancer does not mean elevated rates of cancer are not occurring and does not justify continued exposure to the public of the suspected agent.

The population base in each of the study areas is small, and in a small population it is difficult to achieve statistical significance. In addition, for individual cancer types with an incidence of less than 6, an SIR (standardized incidence ratio, a measure of how often a cancer is diagnosed) is not calculated as it is deemed to be too variable in such a tiny sample. While statistically valid, this maneuver effectively removes rare cancers from

the full statistical analysis, and care is needed to make sure this data is not lost. It is not clear what steps the authors took to address this situation.

Though the full study is not provided on the website, and actual numbers are not presented, it is clear from the line graphs that there are a number of statistically significantly elevated rates of several cancers – lung, bladder, stomach, liver, colon, rectum, thyroid and leukemia. Others showed elevations that did not reach significance. These findings are dismissed because they follow “no consistent pattern”, the doses found are “miniscule”, and because there are other causes of cancer (obesity, diet, smoking). Of particular concern are the elevated rates of thyroid cancer and leukemia, both known to be very radiosensitive cancers. Even these alarming findings are dismissed, the authors claiming that because children under 5 years old did not show an elevation of leukemia (this could be due to small numbers, though this data is not presented), the findings of higher rates in adults could not be from radioactivity exposure. Also they say that because thyroid cancer levels are rising worldwide, their findings are in keeping with worldwide trends. Of importance, statistically significant elevations in thyroid cancer and leukemia were found in the Radiation and Health study done in Durham in 2007 of the same populations (*http://www.durham.ca/departments/health/health_statistics/radiationHealthReport2007.pdf*). Astonishingly, authors of the RADICON study conclude that the elevations found in their study of thyroid cancer and leukemia, both radiosensitive cancers, could not be due to radionuclide emissions from reactors. The conclusion for this study should be that the positive findings for thyroid cancer and leukemia are alarming and should be followed up with more definitive research. Instead, the authors claim that the most important finding is a lack of evidence linking leukemia in children under 5 years old to residence near a nuclear reactor, dismissing the concerning positive findings in the study, and attributing them to lifestyle issues such as smoking and diet. This is unscientific, illogical and misleading.

Analysis and Comment

As a regulatory agency, mandated to protect the health and safety of Canadians, the CNSC should properly be exercising the Precautionary Principle**,** which stipulates that where there is a suggestion, or serious suspicion, of harm to any segment of the human population by a given action or process or substance, the burden of proof must be on those wanting to continue the exposure to prove that it is safe, and that the exposure should cease until this is accomplished.

The second last paragraph on p. 5 of the their document begins, “Interpreting SIRs must be done with a great deal of caution…” and goes on to state, “Thus a high cancer rate in a given region is not sufficient evidence to implicate specific risk factors or require more epidemiological investigation to assess the relative importance of various factors.” A high cancer rate of a radiosensitive cancer in this study is exactly what should prompt more epidemiological investigation to ascertain whether radioactive emissions are causing the high cancer rate.

At no point do they discuss the fact that fetuses and young children are well known to be far more sensitive to ionizing radiation than adults, and that most or all of our standards for allowable exposure are based on adult data. The adult data also fail to take into account any transgenerational or hereditary effects of radiation, including subtle decreases in fertility and increases in defective recessive genes which can accumulate in exposed populations. Both of these are extremely difficult to detect, and have not been considered in the creation of standards.

Fetuses and young children, in forming their internal organs and growing in a coordinated manner to maturity, use parts of their genome that they will never call on again in their lifetime. Damage to these genes at this stage will cause deleterious effects that would not occur from the same damage happening later in life. Damage to germ cells (sperm and egg) will not become apparent until the next generation, and may not be visible even then, but may carry silently forward to succeeding generations, accumulating as long term exposures continue. Indeed, childhood leukemia may be the

tip of the iceberg in terms of genetic harm being caused to our children and grandchildren.

Nor is background radiation innocuous. It gives us ongoing background rates of cancer, miscarriage and of genetic or inheritable disease. We have evolved DNA repair mechanisms that allow us to be in equilibrium with this level of radiation. All human-made radiation is superimposed on background radiation, it does not replace it. Not quite 60 years after the inception of the Atomic Age, we are still experiencing exposures from the longer-lived isotopes released by the Hiroshima and Nagasaki bombs, all of the atomic testing on several continents, all of the operating and defunct nuclear reactors ever used, and the catastrophic disasters at Three Mile Island, Chernobyl, and Fukushima. It seems unsurprising that thyroid cancers are increasing worldwide, as stated in this study on p. 12. It also is unscientific to totally dismiss the idea that the nuclear industry could be contributing to this.

All of the above, and more, should have been discussed in a paper dedicated to furthering our understanding of the connections between the nuclear industry and the health of the Canadian public, both in the short and the long term.

Cathy Vakil MD (Board Member of CAPE, Physicians for Global Survival)

Linda Harvey MD (President of Physicians for Global Survival)