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Oral presentation

Submission from Michel Duguay

In the Matter of

Ontario Power Generation Inc.

Application to renew the Power Reactor Operating licence for the Darlington Nuclear Generating Station

Commission Public Hearing
Part 2

November 2-5, 2015

Exposé oral

Mémoire de Michel Duguay

À l'égard de

Ontario Power Generation Inc.

Demande concernant le renouvellement du permis d'exploitation pour la centrale nucléaire de Darlington

Audience publique de la Commission
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Canada

Prudent to phase out Darlington

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It is well known that Candu nuclear reactors are affected by a significant number of technical problems. These have been described in detail in numerous CNSC internal documents, but in general they have not been explained to the public to a significant degree.

Following the nuclear catastrophe in Fukushima in March 2011, the CNSC organized an important meeting on 3 May 2012 at their headquarters in Ottawa. At this meeting there were intense discussions about the possibility that a severe nuclear accident could take place in a Candu nuclear power plant. As a result, the CNSC has directed Ontario Power Generation (OPG), Bruce Power, and New Brunswick Nuclear Power to put in place new equipment and emergency procedures in order to mitigate the consequences of a severe nuclear accident. The CNSC has done a good job at setting in motion this new accident prevention and mitigation effort. Mitigation will include the distribution of potassium iodide pills in neighborhoods close to the nuclear power plants.

Why would someone from Québec worry about a severe accident in the Toronto area or in Point Lepreau? The reason has come to the fore with the nuclear catastrophes in Chernobyl in April 1986 and in Fukushima in March 2011. From Chernobyl the winds transported enormous quantities of radioactive fission products all over Europe. In some counties in the United Kingdom meat from sheep could not be consumed even 25 years after the accident. In the event of a severe nuclear accident in Darlington near Toronto, prevailing westerly winds would transport radioactivity to Québec and to New York State. Agricultural lands are especially vulnerable. A radioactive isotope like Cesium-137 is washed down by rain into the soil and enters the food chain. It takes more than two hundred years before the Cesium-137 radioactivity becomes relatively harmless.

There was a time when the nuclear power industry took refuge behind an allegedly low probability of a major accident. Many nuclear promoters used to talk about ''*once in a million years*'' for the occurrence of a major accident. After Three Mile Island in 1979, Chernobyl in 1986, and Fukushima in 2011, nuclear promoters have finally acknowledged that the nuclear power industry can have major accidents, just like other industries. Much of the debate about the possibility of refurbishing Darlington, and operating it for yet 30 years more, revolves around the probability of a severe nuclear accident with a large release of radioactive fission products.

In several collective letters to CNSC president Michael Binder and to Honourable Joe Oliver, I have documented how the annual probability of a partial core-meltdown in a Candu nuclear reactor in the greater Toronto area is 10 to 100 times higher than the annual probability of a frequent flyer dying in an airliner crash. This type of comparison had been used previously in federal court by the Weston Geophysical Corporation, Westboro, Massachussets (see Geological Survey of Canada, Open File 2929, dated 1994). Our collective letters can be consulted on my web site www.canadaval.ca.

A prominent nuclear engineer, **John Waddington**, expressed his opinion in a paper in October 2009 that the probability of a severe nuclear accident should be reduced **tenfold**. John Waddington had worked for many years at the Atomic Energy Company, Limited (AECL), and later as director at the CNSC. The second sentence of the introduction to his paper is this:

''*The paper presents the case that there are major deficiencies in the current regulatory scheme which, if not corrected, will likely prevent the achievement of the new safety goals that have been set for Generation III reactors and beyond, which is a reduction by a factor of ten in the expected frequencies of core damage and of severe accidents.*''

It is rather remarkable that the CNSC has never publicly contradicted this very strong statement by John Waddington.

Another nuclear engineer who has expressed an opinion of a similar nature is **professor John Froats** who has a considerable experience in CANDU technology. He was once the president of the *CANDU Owners Group* (COG), a group concerned with resolving CANDU safety issues through international collaboration. Professor Froats is now with the *University of Ontario Institute of Technology* and teaches nuclear engineering.

I have quoted him in our collective (51 cosignatories) letter to Michael Binder on 6 June 2012. The indented text here below is from this letter where John Froats's words are in italics, as taken from the CNSC transcripts of the 3 May 2012 meeting in Ottawa. Shawn-Patrick Stensil, referred to by professor Froats, had spoken before him.

> On p. 310 Professor Froats says this:
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> '' *I guess the question in front of us and about adequacy of the plan is that as we look at the major events that have shaped our industry, I'm struck by the fact, like earlier speakers, that the frequency of severe core damage is higher than predicted by our best analytical tools. IAEA NSR-1 and our own RD requirements demand designers use analytical tools to demonstrate a lower than 1 x 10 to the -5 severe core damage frequency for new facilities. Designs demonstrate that consistently, and yet the frequency of event, as has been pointed out earlier today, is different*.''
>
> [The core damage frequency quoted here, namely 10^{-5}, is the same as 0.001%/year, or 1 in 100 000 years.]
>
> Further down on p. 310 Professor Froats gives some support to Shawn-Patrick Stensil by saying :
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> '' *Each of the major events that we've seen has had a dominant element of some kind of organizational failure*.''
>
> On p. 313, Professor Froats confirms what Mr. Stensil had said earlier :
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> '' *The next slide shows some data that I pulled shortly after the event, from a public website, source being the U.S. government which clearly showed that there was data*

available that indicated that the challenges of tsunami height for the particular plant were known in advance of the event.''

On page 314 Professor Froats again brings support for the position taken earlier by Greenpeace:

'' *However, perhaps our follow-up emphasis should be adjusted to reflect the dominance of the organizational failures that appears to be at the heart of the Fukushima event*.''

In his recommendations regarding the *CNSC Fukushima Action Plan*, Professor Froats says this: '' *The plan is focused more on prevention, on mitigation, and could be augmented with some additional focus on organizational review*.''

Collaboration over the years with Chris Rouse of Saint-John, New Brunswick, has led me to examine the question of seismic hazards. One key lesson from the Fukushima catastrophe is that an earthquake can be stronger than expected and cause a lot of unexpected damage. OPG has submitted to the CNSC document # NK38-REP-03611-10072-R001, dated 31 July 2015. In Fig. 13 one can see that at the line for an annual probability of exceedence of 0,01 % (or 1.0E-04 on the graph) the peak ground acceleration (PGA) is close to 0.2g (g is the acceleration due to gravity, which will usually shatter a dropped glass). Seismic ground acceleration is what is responsible for damage to buildings during an earthquake.

When the Candu nuclear reactors were designed in the nineteen sixties and seventies, the expected PGAs were smaller than at present for Eastern North America so that robustness to a 0.15g was considered adequate for the Candus. This was the PGA that Candu was designed for. But the OPG graph, which is based on modern data, shows that a 0.2g PGA can occur in the Toronto area with an annual probability of 0.01%. When Candu tubes are weakened by a number of corrosion mechanisms that the CNSC has documented, one would expect that even a 0.1g PGA could cause serious

damage. There are six kilometers of high-pressure tubes in a Candu reactor. One is allowed to worry.

Furthermore, when we look at the 1.0E-05 line (0.001% annual probability), the graph shows a PGA of 0.8g, which, it is well known, will most likely demolish a Candu nuclear reactor. OPG will surely pump a lot of water from Lake Ontario to face up to such a situation, but what will be the consequences for Ontario, Québec and New York State?

The argument is often raised that refurbishing Darlington will save thousands of jobs. The French nuclear establishment has made a case for undertaking the decommissioning of nuclear reactors within one year or two after stopping them. The cost of such decommissioning is on the order of one billion dollars per reactor. Moreover the cost estimate for storing all the high-level radioactive waste in Ontario is 25 billion dollars. These multi-billion dollar sums will maintain thousands of nuclear jobs in Ontario for 25 years or more even if Darlington is shut down.

Where will the money come from? In October 2012 Hydro-Québec (H-Q) revealed the cost of the nuclear kilowatt-hour (kWh) that a refurbished Gentilly-2 nuclear reactor would have produced: approximately 12 cents/kWh. Since hydro-electric power is produced in Québec at 5 cents/kWh, Québec saved money by deciding not to refurbish Gentilly-2. In October 2012 H-Q estimated the cost Gentilly-2 refurbishment at approximately four billion dollars. In the last few years Québec has had the ‘’problem’’ of large surpluses of electric power.

In conclusion, I believe that refurbishing obsolete nuclear reactors at Darlington is not the most prudent choice for Ontario and for Canada as a whole, whose government provides most of the insurance to cover the consequences of a nuclear catastrophe.