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Written Closing Remarks from Frank Greening

Observations écrites finales de Frank Greening

In the Matter of

À l'égard de

Ontario Power Generation Inc.

Ontario Power Generation Inc.

OPG's Deep Geological Repository (DGR)
Project for Low and Intermediate Level
Radioactive Waste

Installation de stockage de déchets radioactifs à
faible et moyenne activité dans des couches
géologiques profondes

Joint Review Panel

Commission d'examen conjoint

October 2014

Octobre 2014

From: [Frank Greening](#)
To: [DGR Review / Examen DFGP \[CEAA\]](#)
Subject: Re: Notice to interested parties - Deep Geologic Repository Project // Avis aux parties intéressées - le projet de stockage dans des formations géologiques profondes
Date: October 1, 2014 7:43:59 PM

To whom it may concern:

Please accept the following material as my closing remarks for the Public Hearings on OPG's proposed Deep Geologic Repository Project:

Dear Dr. Swanson and Members of the DGR Joint Review Panel,

Thank you for the opportunity to submit final comments on OPG's proposal to construct a Deep Geological Repository (DGR) at the Western Waste Management Facility (WWMF) near the town of Kincardine, Ontario.

Although many concerns over OPG's DGR proposal were raised at the October 2013 and September 2014 Public Hearings, there are important issues that have received very little attention that are crucial to a comprehensive environmental and safety assessment of the proposed DGR; it is these issues that I wish to emphasize in this my final submission.

An oft repeated mantra heard at the September 2014 Public Hearings - stated in unison by OPG and the CNSC after the issue of errors in the DGR radioactive inventory were raised by interveners - was that even if the DGR inventory was increased by a factor as large as 1000, "*the safety case still stands*". Whether or not this claim is in fact true - and in my mind it is a very dubious assertion - I will leave the JRP to ponder. However, a topic that has not been properly addressed and is of great concern to many opponents of OPG's DGR proposal is the issue of potential accidents and malevolent acts in the DGR, either during its construction or after it has been commissioned and is operating. And this concern is centered on the likelihood of an accident or incident causing serious harm, especially radiation exposure, to workers in the DGR and/or individuals living close to the facility.

Therefore I would like the JRP to consider two very important questions:

- (i) Is there any provable connection between "accidental" radiation exposure incidents in a nuclear facility and the state of the safety culture in the facility?
- (ii) Does the JRP agree with the CNSC's and OPG's assertion that Canada has such a robust safety culture at all of its nuclear facilities that, by extension, the possibility of a serious accident or incident of radiation exposure at OPG's proposed DGR is essentially zero?

Clearly, few would disagree with the notion that a facility with a very poor safety culture will be more accident prone than a facility with a "healthy" safety culture. However, the converse is not absolutely true because of the nature of what we call "accidents". Thus, in answering these questions, I would ask the JRP to consider the dictionary definition of the word *accident*. An *accident* is an unforeseen event, especially one causing injury or damage. And the key word here is "*unforeseen*". Therefore I would argue that if something is *unforeseen* it cannot be prevented; and this is a universal truth, even in the presence of a "healthy" safety culture. In other words, no matter how safe a facility is claimed to be, accidents can still happen.

In this review of my previous submissions I intend to reaffirm my contention that serious radiation exposure incidents and accidents can and do occur at Canadian nuclear facilities even when these facilities are supposedly fully protected from harm by safety rules and regulations and operate with well-trained staff steeped in a “healthy” safety culture.

Safety Culture and Accident Prevention:

Since the start of nuclear power reactor operations in Canada in the 1960s there have been many accidents and unplanned incidents of varying degrees of severity, ranging from the unplanned acute exposure of a single nuclear worker to the chronic mass exposure of many workers. Nevertheless there are two major examples of the second event category that are of particular interest because both involve the contamination of hundreds of workers through unplanned inhalation of radioactive particulate. In one case, in 1985, carbon-14 was the principle contaminant, and in the other case, in 2009, the alpha-emitting transuranic species Pu-239/240, Am-241 and Cm-244 were the radionuclides of concern. And please note: I was an active member of both of the investigation teams formed at the time of these events – The carbon-14 Task Force (formed in April 1985) and the Alpha Recovery Team (formed in February 2010).

The many similarities between the 1985 carbon-14 contamination incident at Pickering and the 2009 alpha-contamination incident at Bruce are remarkable:

- In both cases a large number of highly radioactive components were being removed from a CANDU reactor for the first time – pressure tubes at Pickering; feeder pipes at Bruce.
- In both cases the Health Physicists in charge of the project’s safety believed they had assessed the expected radiological hazards and deemed them to be acceptable and under control.
- In both cases the maintenance work responsible for the radiological releases continued for many weeks before the widespread internal contamination of workers was finally recognized.
- In both cases vital operating experience previously acquired at each station - OPEX that could have prevented the contamination event - was either totally forgotten or not used.

These contamination event commonalities suggest that a number of unacceptable behavioral traits pervade Canada’s nuclear industry, past and present:

1. A failure to recognize the nature and severity of potential hazards involved in a project.
2. An unjustified confidence in the efficacy of radiation protection measures.
3. A “can-do culture” leading to a “press-on regardless” work ethic in the face of problems.
4. A failure to learn from past experiences and mistakes.

But let’s consider what OPG and the CNSC have to say about workplace safety and accidents at nuclear facilities. The DGR Public Hearing documentation shows that OPG and the CNSC share the belief that accident prevention at nuclear facilities stems from a “a healthy safety culture”. Indeed, a check of the September Hearing transcripts shows that the term “*safety culture*” was repeated no less than 100 times in the first two days of debate

alone. And OPG and the CNSC evidently see “*a healthy safety culture*” as a universal panacea that protects nuclear workers from all possible sources of harm. And furthermore, OPG and the CNSC believe, and yet fail to prove, that the Canadian nuclear industry operates with an ideal, accident preventative safety culture.

But here we have a paradox, because the 2009 alpha-contamination event at Bruce occurred *in spite of an alleged healthy safety culture*. Nevertheless, Dr. Thompson, head of the CNSC’s Environmental and Radiation Protection and Assessment Directorate, apparently had no problem telling the world on day 2 of the September Public Hearings:

Bruce Power has a healthy safety culture for the following reasons: the alpha-event was unforeseen for reasons that I don’t have right now; there was no evidence that there was a potential for this event, so it’s not something that Bruce Power or its employees decided to ignore

This pronouncement demonstrates very dubious logic on the part of the CNSC – and certainly undermines the premise that a healthy safety culture can prevent accidents at nuclear facilities - because what Dr. Thompson appears to be saying, is that: (i) Accidents in a nuclear facility are generally unforeseen events, and (ii) Absence of evidence of a problem at a nuclear facility means there *is* no problem. (cf. the well-known dictum: Absence of evidence is *not* evidence of absence.)

Dr. Thompson’s analysis of the Bruce contamination event also means that many of the behavioral traits noted above - and in particular items (1) and (4) dealing with the Canadian nuclear industry’s failure to recognize hazards and its failure to learn from past mistakes – are apparently of no concern, or are not even recognized by the CNSC.

However, it is worth noting that the CNSC has also stated its belief that a degraded safety culture *was* responsible for the mass contamination of workers at the WIPP facility in New Mexico in February 2014. Indeed, OPG and the CNSC stated many times at the DGR Public Hearings their firm conviction that a degraded safety culture was to blame for the uncontrolled release of alpha-particulate at WIPP, *even though the physical cause of this event is yet to be determined*.

But blaming a degraded safety culture for the radiological release at the WIPP in February 2014, while denying a degraded safety culture was a factor during the Bruce contamination event of December 2009 is absurd, especially when the CNSC itself alleges that in both cases:

- These events were unforeseen
- These events were due to unknown causes
- There was no evidence that there was a potential for either event to occur

However, the story that is now emerging from the WIPP accident investigation is that the radiological release event was probably initiated at Los Alamos, the point of origin of the failed container, when an unapproved absorbent material was added to the waste prior to shipment to the WIPP. Clearly then, the unforeseen deleterious effects of this change in procedure was caused by a mistake at Los Alamos, not at Carlsbad, *and therefore had nothing to do with the safety culture at the WIPP*.

The revelation that the February 2014 WIPP release event was probably caused by inappropriate preconditioning of a waste also highlights the problem of preconditioning of chemically reactive wastes. Nevertheless, OPG has made it very clear that it does *not* intend to precondition or stabilize *any* of its intermediate level wastes, contrary to the practice in most countries, worldwide, dealing with similar nuclear wastes. This is curious because acid-stripping of spent ion exchange resins for carbon-14 removal was the subject of extensive investigations during my tenure at Ontario Hydro Research between 1978 and 2000. It was therefore quite surprising to hear OPG reveal at the September Hearings that the *real* reason for its decision *not* to precondition resin wastes is that any carbon-14 removal process “*would generate more secondary waste than the resins comprised to begin with*”. While this may be true, it hardly justifies OPG’s decision *not* to precondition resin waste prior to its emplacement in a DGR.

This disregard for the need to precondition ion exchange resin prior to storage in a DGR only serves to show OPG’s cavalier attitude to the potential hazards of its nuclear waste. It also demonstrates OPG’s inability to learn from the WIPP radiological release event which clearly demonstrates the potential consequences of the improper packaging of wastes slated for emplacement in a DGR. It is indeed unfortunate that OPG still doesn’t understand that it only takes *one* incorrectly packaged container (out of thousands of emplaced containers) to cause a significant radiological release that is capable of contaminating large areas of a DGR.

But there is another important lesson to be learned from the WIPP event related to the fact that a safety assessment of this facility was carried out by the U.S. DOE at the time of its construction. This assessment included an analysis of the possibility of the spontaneous ignition of a waste container after its emplacement underground. The resulting report (DOE/AL58309-75) concluded that the probability of sustained combustion in a waste container was 5.3×10^{-6} per year, or an underground fire once every 188,679 years. However, as we now know, the actual rate of occurrence of such an accident at the WIPP is 12,580 times higher than this estimate or an underground fire after only 15 years.

The fact that the DOE’s accident frequency prediction is so hopelessly in error shows that probabilistic safety analyses of something as complex and unknown as a DGR are essentially worthless as a means of predicting unforeseen events in such a facility. This failure is hardly surprising when most man-made catastrophes are “once in a lifetime events” with no frequency of occurrence statistic that could be used as a metric of the probability of its occurrence – the Space Shuttle Challenger explosion; the 9/11 World Trade Center collapse; the Lac Mégantic train derailment being similar “one-of-a-kind” disasters. Nicholas Taleb has called such disasters “Black Swan Events” after the title of his 2007 book which introduces the concept of rare events that have three defining characteristics: they are unforeseen; they have deleterious impacts, e.g. significant fatalities and/or property damage; and they are only deemed to be predictable *after* they happen. Black Swan Events teach the important lesson that *what we do not know* is more important than *what we presume to know*.

Conclusions:

What concerns me most about the proposed DGR is OPG’s level of *ignorance* about the magnitude of the project, about its radionuclide inventory, about how it will operate, about how it will accept future decommissioning waste and about the potential for things to go horribly wrong through unexpected synergisms, as in the tragic Lac Mégantic disaster where

a combination of relatively minor problems led to a major catastrophe.

It is quite evident that OPG's DGR proposal is based on only a *pretense of knowledge* of all possible *risks* within the proposed facility. And as a result, OPG ignores the project's *true uncertainty*, as defined by U.S. economist F.H. Knight, which is something that is not susceptible to measurement and can never be eliminated from human endeavor; or as J.M. Keynes eloquently described it: "... *matters where there is no scientific basis on which to form any calculable probability whatever. We simply do not know.*"

Therefore I strongly urge the JRP to reject OPG's DGR proposal. We know so very little about the long-term safety of a DGR and the American experience with the WIPP facility shows why we should err on the side of caution before proceeding with such a venture. After all, it took only *one* bad waste container to spoil an entire DGR facility! And besides, it is evident that a lot more research and development is needed before DGR technology could be declared to be safe and reliable.

But in the meantime, we certainly do not need the existing WWMF to become home to a deep underground nuclear waste disposal test-bed on the shores of Lake Huron. Only fools rush in where angels fear to tread....

Sincerely,

Dr. F. R. Greening

Hamilton, Ontario

October 1st, 2014