



**Joint Federal Review of
Ontario Power Generation's Proposed Deep
Geologic Repository for Low and Intermediate
Level Radioactive Wastes**

Resumed Hearing – September 2014

**DGR Joint Review Panel Hearing Written Submission
in Support of an Oral Intervention**

Northwatch's General Written Submission

Prepared and Submitted by Brennain Lloyd



July 2014

DGR Joint Review Panel Hearing Written Submission in Support of an Oral Intervention

**Northwatch's General Written Submission
In Support of Oral Testimony
Resumed Public Hearing on
Ontario Power Generation's Proposed
Deep Geologic Repository for Low and Intermediate Level Radioactive Wastes**

Prepared and Submitted by Brennain Lloyd

July 2014



Prepared for Northwatch

1. Context

In 2011 Ontario Power Generation filed an Environmental Impact Statement and numerous supporting documents, tallying up at more than 15,000 pages in combination. In early 2012 a Joint Review Panel was appointed and in June 2013 a hearing was announced, to commence in Kindardine in mid-September. Twenty five days of hearings were held in Kincardine and Port Elgin in September and October 2013. After extending the hearing for several days, the Joint Review Panel adjourned the hearing, after signalling to Ontario Power Generation that there were remaining information needs. The Joint Review Panel then issued a series of Information Requests and in some cases received responses, reviewed them, and issued additional clarifying questions. On June 3 the Panel announced that hearing would be re-convening in Kincardine on September 9th, 2014.

As was introduced to the Joint Review Panel in earlier stages of this review, Northwatch is a public interest organization concerned with environmental protection and social development in northeastern Ontario¹. Founded in 1988 to provide a representative regional voice in environmental decision-making and to address regional concerns with respect to energy, waste, mining and forestry related activities and initiatives, we have a long term and consistent interest in the nuclear chain, and its serial effects and potential effects with respect to northeastern Ontario, including issues related to uranium mineral exploration and mining, uranium refining and nuclear power generation, including on the Bruce region, and various nuclear waste management initiatives and proposals. We have a longstanding interest in the management of nuclear waste, as well as other environmental and social impacts of using nuclear power for the purpose of electricity generation. Our interests are primarily with respect to the impacts and potential impacts of the nuclear chain on the lands, water, and people of northeastern Ontario.

Our interest in nuclear waste was initiated by proposals dating back to the 1970's to site nuclear waste "disposal" projects in northern Ontario. There have been numerous proposals over the last several decades, including proposals for the import and burial of high level waste in the 1970s and 1980s and for low level waste in the 1990s. Currently there are nine

¹ See www.northwatch.org

communities in northern Ontario being studied as potential burial sites for high level waste², and there is at least one unpublished proposal for the disposal of low level waste³.

The proposed geological repository for the disposal of nuclear wastes at the Bruce Nuclear Site is of interest both because of its precedent setting nature and because of its close proximity to Lake Huron, and the potential for adverse effects on the North Channel and North Shore of Lake Huron, Manitoulin Island, and the broader Great Lakes ecosystem.

For the first hearing phase in September and October 2013 Northwatch retained and presented six expert witnesses to assist the Joint Review Panel in evaluating the OPG Proposal, in addition to making a general submission and attending the hearing for the majority of hearing days. For this second hearing phase we have retained four expert witnesses to assist in the review of OPG's responses to Information Requests. The primary focus of the expert review is on responses to IR's 12-511, 12-512, 13-514 and 13-515. Primary areas of attention in the expert reviews are potential impacts on the effectiveness of the barriers and on the gas generating potential as a result of DGR expansion plans and changes to the waste inventory, and on evaluating recent events at the Waste Isolation Pilot Plant, an underground repository for U.S. weapons waste which OPG had previously presented as an example of international best practices, but which has experienced severe operating difficulties over the last several months.

² The Nuclear Waste Management Organization is currently studying the northern Ontario communities of, Ignace, Schrieber, Manitowadge, White River, Hornepayne, , Blind River, the Township of the North Shore, Elliot Lake and Spanish as part of their nine step siting process for a geological repository for high level nuclear fuel waste.

³ Transcript, Canadian Nuclear Safety Commission Public Hearing, 17 January 2012, see page 66-71

2. Summary of Northwatch's Key Findings

The key finding of Northwatch's review of the Environmental Impact Statement and supporting documents prior to the opening of the hearing in September 2013 was that Ontario Power Generation has not presented a complete application or presented a sound technical case in support of their proposed Deep Geologic Repository Project.

As summarized in our general and expert reports and in oral submissions, Northwatch and Northwatch's experts found that Ontario Power Generation's claims that their project is supported by "international best practices" and "international experience" was unfounded, and that OPG had not made an adequate technical case in support of their application. Key deficiencies related to shortcomings in the modeling which indicated a lack of fundamental understanding of the site; a failure to make a convincing safety case, including being unable to establish what the migration rates of the radionuclides to the surface would be and hence the danger that it would present; a failure to demonstrate the required "defense in depth" in that shaft seal partial breakdown would reach or exceed the dose criterion; a weaknesses in the presentation of the WIPP as a "successful" DGR; OPG's proposed packaging and other engineered barriers do not provide as great a safety function as is observed in proposals in other jurisdictions; and the OPG's proposal does not meet the IAEA safety case guidance.

In summary, Ontario Power Generation had not provided the Joint Review Panel with a basis for approving the Environmental Assessment, the Application for a License to Prepare the Site, or the Application for a Licence to Construct the proposed Deep Geologic Repository for low and intermediate level radioactive wastes at and below the Bruce Nuclear Site.

Perhaps for these reasons, or these reasons in combination with others, the Joint Review Panel has considered it necessary to extend the review process and make additional efforts to obtain information from Ontario Power Generation. Having now reviewed OPG's products of this additional year, we must communicate to the Joint Review Panel that our evaluation of the OPG proposal has not improved. In some respects, it has certainly worsened. For example:

- OPG's group of "independent experts" have confirmed that the DGR design will ultimately rely on dilution, using a combination ground water, rain water and surface waters, including the water of Lake Huron
- The uncertainties with respect to the waste inventory appear to have increased rather than decreased
- There are increased uncertainties associated with a generally held expectation that the addition of decommissioning wastes will increase the amount of gas generated within the repository, which in turn can be expected to have serious repercussions for the safe operations of the facility
- Issues persist with respect to the Geoscience Verification Plan and the functioning of the barriers, particularly the shaft seal

3. Comments on July 2013 Panel Member Documents

On June 3 the Joint Review Panel announced that the public hearing on Ontario Power Generation's proposed Deep Geologic Repository for radioactive wastes would reconvene on September 9th 2014 in Kincardine, and issued a revised procedural order which included a timeline related to the renewed hearing.

Written submissions were required from the proponent and government participants by July 7th. In addition to Ontario Power Generation (OPG) and the Canadian Nuclear Safety Commission (CNSC) the following government departments made written submissions:

- Natural Resources Canada
- Environment Canada
- Fisheries and Oceans Canada
- Health Canada
- Ontario Ministry of Environment and Climate Chang
- Ontario Ministry of Transportation
- Ontario Ministry of Natural Resources and Forestry

Panel Member Document 14-P1.1 by Ontario Power Generation

Ontario Power Generation's 30 page written submission was largely a repeat presentation of their responses to Information Request (IR) Packages 12 and 13, directed to them by the Joint Review Panel between November 2013 and May 2014.

Given that, for the most part Northwatch's comments on the Panel Member Document (PMD) 14-P1.1 would be the same as those made with respect to the Information Request responses, and we will not repeat their presentation here; please refer to the following sections commenting on the OPG's responses to the JRP's Information Requests.

The following comments are additional to any made in later comments on IR Responses.

Expansion Plans

In the discussion of expansion plans, once again “OPG emphasizes that it is only seeking regulatory approval for site preparation and construction of a DGR with a capacity of approximately 200,000 m³ (packaged volume) for operational and refurbishment L&ILW from OPG owned or operated reactors.

It is perplexing that - despite the repeated discussion of decommissioning wastes and the definite acknowledgement by OPG that they do intend to place decommissioning waste in the DGR - OPG persists in repeating statements that redirect the reader / listener back to the impressions created by the 2011 EIS, i.e. that decommissioning waste are not included.

In clear contrast, in her opening statement on Day One of the hearing in September 2013, Ms. Lauri Swami stated, on behalf of Ontario Power Generation:

*“While reactor decommissioning is not planned for several decades from now, it is expected that the DGR would be used for low and intermediate level waste arising from this activity”.*⁴

OPG also persists in making the point that the expansion to include decommissioning wastes need be considered only at a “high level” because that is all the EIS Guidelines required.

This argument needs to be placed into context, and the context is this: the EIS Guidelines were developed based on the Project Description (2006) and the Project Description did not include decommissioning wastes:

*“The Host Community Agreement makes provision for emplacement of decommissioning waste in the DGR however the environmental assessment (EA) for the proposed DGR would not seek approval for emplacement of that waste in the DGR.”*⁵

The PMD threw yet another OPG curve ball with the sideways announcement that the DGR is potentially to include new wastes:

For purposes of assessing the potential future effects on the environment, OPG assumed expansion of the DGR from the current planned waste volume capacity of 200,000 m³ to a capacity of 400,000 m³, with similar characteristics of the waste arising from operations and refurbishment. This additional capacity could account for the potential of future L&ILW such as from new build or decommissioning activities.”

⁴ Transcript, Day 1, Page 45

⁵ DGR Project Description 2005, Report Number: 00216-REP-07722.07-00001

Again referring to the 2005 Project Description upon which the EIS guidelines are based, we note that the Project Description did not include new reactor wastes:

“The DGR would be designed to receive L&ILW produced by OPG-owned nuclear generating stations through the remainder of their operating lifetimes as well as L&ILW currently in interim storage at the Bruce site”⁶

On Page 14 of the PMD, OPG states that *“the waste types arising from decommissioning activities are fundamentally the same as those arising from operations and refurbishment activities, but the amounts of the various wastes will be different”*

We consider the above statement to be very misleading. Decommissioning wastes is fundamentally different from operational wastes in a few key ways, each of which have direct bearing on the safety case for a DGR, namely the level of radioactivity, the ratio of highly radioactive intermediate waste to low-level waste, and the amount of metal content. It is also in conflict with the paragraph at the top of page 15 which describes how the two groups of waste differ.

OPG includes a curious statement at the bottom of Page 14 that the ILW is not expected to include significant amounts of ion exchange resins as these would have been removed at station shutdown. We are puzzled as to what the purpose of this statement might be.

Perhaps the most astounding statements in the entire PMD are those made under the heading “Gas Generation Implications” on page 16. In this section OPG acknowledges that there will be a higher proportion of metals in the decommissioning wastes, and that this higher proportion of metals will result in more gas being generated in the repository over time. These are important acknowledgements and directly relate to the safety case of the DGR. But OPG then goes on to say:

“Emerging decommissioning techniques are showing good potential, with some suppliers suggesting 90% metal decontamination is achievable. Since an OPG decision to emplace decommissioning waste into the DGR would not be made until 20-40 years from now, it is reasonable to assume that advancement in technology will contribute to a meaningful

⁶ DGR Project Description 2005, Report Number: 00216-REP-07722.07-00001

reduction in the volume of LLW metals currently anticipated to result from decommissioning activities.”

Is the nuclear industry again going to rely on future technologies or not yet discovered methods to address their waste problems? Maybe a “let’s just hope ...” strategy? While this may get them through the day on a solely personal level, “hoping” is insufficient in terms of gaining EA approval or demonstrating that the post-closure safety assessment is acceptable.

Panel Member Document 14-P1.2 by the Canadian Nuclear Safety Commission

We note that the CNSC staff conclusion that “the DGR Project is not likely to result in significant adverse environmental effects, taking into account implementation of mitigation measures, OPG commitments and CNSC staff’s recommendations as summarized in PMD 13-P1.3” is hugely conditional. It would be helpful to know if or when one or more of those multiple factors - mitigation measures, OPG commitments and CNSC staff’s recommendations including licensing conditions are not met – the “likelihood” shifts. Given that non-compliance with licence conditions are a fairly regular occurrence in other OPG operations, can staff hold a reasonable expectation that all the licencing conditions and other commitments will be met? And is there a discernible threshold which, when crossed over, the “likely” shifts to “not likely” or vice versa?

The discussion of the Geoscientific Verification Plan in section 2.2 of the CNSC PMD raises multiple questions, including:

- If “reaching a value” triggers a course of action, how is that trigger level set – what is the “value” - and by whom and on what basis is it set and what will the course of action be and who will determine it and what transparency will there be around this sequence of events?
- Excavation deformation, rockloading, geomechanical properties of the rock, and in situ stress are all to be measured, but measured against what? How are the measures set, with what transparency and on what basis?
- On page 15, does meeting the”preliminary trigger criteria” mean re-doing the safety case?

- The preliminary trigger criteria appears to be set at certain values – could a combination of two more of the values being deviant result in a combined pulling of the trigger?
- The preliminary trigger criteria on the bottom of page 15 appear to mix actions with measures

We are fascinated with the CNCS’s apocalyptic world view, as expressed on page 38:

CNSC staff consider the loss of institutional control not as a “pathway of harm” but rather as a future event with a high likelihood of occurring in a few hundred years. The loss of institutional control could in turn lead to three major pathways: enhanced transport of radionuclides by water and by gas due to the deterioration of containment structures, and inadvertent human intrusion. CNSC Regulatory Document G-320 [39] section 4.5.3 states that “as a result of the uncertainties associated with future human activities and the evolution and stability of societies, current international practice generally limits the reliance on institutional controls as a safety feature to a few hundred years”. This is corroborated by the IAEA’s SSG-23 [31] section 6.62 that states “the period over which credit can be taken for institutional control is limited to a maximum of a few hundred years in the regulations of many States”.

It raises several related questions:

- What is the basis for this belief system which reportedly is shared by CNSC staff?
- Does it have a basis in a qualitative or quantitative risk assessment? If so, who conducted the assessment?
- How does this belief system, seemingly broadly held by CNCS staff, factor into other CNSC decision making processes, such as licensing for new uranium mines or new reactors?

Section 2.5.2.1 on pages 46 and 47 includes an important description of potential impacts on workers:

For workers handling the retube waste packages, the potential external dose rates to which they would be exposed would increase by approximately four times. This would result in the allowed occupancy time for workers to be reduced by a factor of four, compared to the previous assessment, in order for OPG to ensure occupational doses remain below their occupational dose target of 10 mSv per year. For workers in the package loading area, for example, the allowable occupancy time would be reduced from 210 hours per year to 53 hours per year.

OPG stated that since the DGR Waste Acceptance Criteria would not be met by the revised retube waste package as-is, additional shielding or a longer decay time would occur before this waste could be transferred to the DGR, thereby decreasing the external dose rate to the workers.

It is not clear from this description what actually happens with a worker in this situation. For example, what happens to a worker when they hit their maximum dose? Are they re-assigned, laid off, or some other alternative? It is also not clear how this “dosing” of the work force would affect the staff complement. For example, if workers are reduced from 210 hours per year to 53 hours per year, will this result in an increase in staff?

A key issue throughout this review has been the lack of a reliable nuclear waste inventory. Certainly, this issue has received heightened attention because of the Frank Greening submissions and the CNSC, JRP and OPG responses to the submissions, as well as to the very obvious and greatly added uncertainty around the inventory if decommissioning is now to be rolled onto the project.

CNSC appears to hold to the view that later will be soon enough, i.e. that “*CNSC staff expected OPG to reduce the uncertainty in their radioactive waste inventory during construction and demonstrate that the maximum predicted doses in the preclosure and postclosure assessments remained essentially unchanged*”.

Now is late: the Joint Review Panel should not – cannot – make a responsible decision in the absence of a reliable waste inventory.

4.0 Comments on Topics for the Resumed Hearing Identified by the JRP

4.1 Methodology used to determine the significance of adverse environmental effects

Information Request 12-510 directed OPG to provide a detailed narrative to explain how the significance of each residual adverse effect on the biophysical environment and on Aboriginal Interests was determined. OPG was directed to provide a separate narrative for each residual adverse effect, with the narrative explaining the logic behind the significance determinations and is to use context-based reasoning with the context for the predicted measurable change explained in sufficient detail that the reader may understand the relative significance of that change in terms of the magnitude, geographic extent, timing and duration, frequency and degree of irreversibility criteria.

We have reviewed this IR response and have determined that we will adopt the submissions of other intervenors rather than submit additional comments, which we expect would be similar in overall assessment but less detailed or substantive than the submission of some others.

Primarily, we wish to adopt the submissions of the Canadian Environmental Law Association with respect to this Information Request response.

In addition, we wish to adopt the submissions of Eugene Bourgeois, made on behalf of himself and Anne Bourgeois, with respect to noise, dust, air quality and the waste rock piles and waste rock management more generally, The Bourgeois family are the closest neighbours to the DGR site.

And finally, we wish to defer to and adopt the submissions of the Saugeen Ojibway Nation with respect to the assessment of effects on Aboriginal interests.

4.2 Updates to the geoscientific verification plan

The Joint Review Panel directed OPG to provide an updated Geoscientific Verification Plan (GVP) that includes more details concerning specific methods, timing, and the sequencing of sampling as well as how Ontario Power Generation will develop triggers for changes to engineering design and benchmarks for verification of the safety case. The Panel was seeking additional detail and definition,

The following comments are summarized from the expert paper prepared by Steve Frishman on behalf of Northwatch.

The 2014 *Geoscientific Verification Plan* provides additional detail and methodology for characterization of the shaft EDZ, beyond that considered in the September 2013 DGR Hearing. But severe shaft seal failure remains a conspicuous failure mode for the repository.

In addition, the *Geoscientific Verification Plan* retains a design element that could contribute to radionuclide releases from the repository if the performance of the shaft seals and shaft EDZ is less than expected in the repository safety case. As designed, the highly damaged inner zone (HDZ) of the EDZ in the area of the planned cement monolith at the base of the shafts is not intended to be removed, but the HDZ is planned to be removed from the shaft wall because it would provide a high permeability zone for radionuclide transport adjacent to the shaft seal.

The 2014 *Geoscientific Verification Plan* does not describe a shaft seal performance testing program other than retaining the previous plan for *in situ* testing in the Cobourg Formation. It is implied that testing in other formations exposed in the shafts could be done, but there is no description of where such tests would be performed, and the overall testing rationale. The GVP should include a commitment to and detailed description of a robust and comprehensive shaft seal performance testing program that would be continued through the full period of repository operation if construction and operation are approved.

The Canadian Nuclear Safety commission, in its evaluation and submission, describes alternatives for testing in addition to *in situ* tests in the Cobourg Formation, but even this general description is not consistent with the test plan described in the GVP.

The shaft seal performance analysis is indispensable to the validity of the DGR safety case, and the safety case must be supported by site specific, comprehensive data collection and analysis.

In addition, the supplementary information provided by Ontario Power Generation in response to the Joint Review Panel Information Request Packages 12 and 13 does not adequately detail the Geoscientific Verification Plan and does not satisfactorily respond to design deficits identified in earlier stages of this review.

4.3 Expansion plans for the DGR project

EIS-IR-512 directs Ontario Power Generation to provide the existing Technical Assessment and all associated support documents for the expansion of the proposed DGR to accommodate the disposal of decommissioning waste, LLW and ILW, from the Pickering, Darlington and Bruce nuclear generating stations. The response must include plans for anticipated changes to both the physical layout of the subsurface (shafts, emplacement rooms, etc.) and surface (WRMA, SWMP, etc.) facilities and structures and their operational parameters. The anticipated timing of any expansion activities relative to currently proposed DGR phases must be included in this response. Followup questions from the Joint Review Panel required additional consideration of impacts on underground safety and short and long term safety implications of expanding the DGR.

As discussed above in Northwatch's comments on PMD 14-P1.1, it is interesting that despite the repeated discussion of decommissioning wastes and the definite acknowledgement by OPG that they do intend to place decommissioning waste in the DGR⁷, OPG persists in repeating statements about the Project being for only 200,000m³ of operational and refurbishment wastes.

We refer the reader to our comments on OPG's PMD 14-P1.1 and to the submissions of Mr. Pete Roche, retained to assist Northwach in this review. We adopt the submissions of Mr. Roche with regard to OPG's response to IR 512.

⁸ "Disposal of Radioactive Wastes by Slurry Fracture Injection", undated, as found at <http://www.terralog.com/article/Disposal%20of%20RA%20Wastes%20by%20SFI.pdf>

4.4 Relative risk analysis of alternative means of carrying out the project

As summarized by the Joint Review Panel in IR-12-513, the analysis of alternative sites in OPG's 2011 Environmental Impact Statement (EIS) was limited to locations within the Bruce Nuclear site and a very generic "off the Bruce nuclear site" location. In the IR, the Panel noted that the comparison of alternatives in the assessment was based upon a simple binary scoring system that involved a significant amount of professional judgment, and the rationale for the scores assigned to the alternatives was not presented in the EIS. The JRP observed that the reliability and defensibility of the score assigned to the "off the Bruce nuclear site" alternative, for example, cannot be assessed with confidence (the off-site alternative was assigned a score of 11 versus a score of 6 for the proposed on-site DGR), despite OPG responses to Information Requests such as EIS-03-49 which asked for a detailed description of the alternative means options analysis.

The Information Request summarized that previous OPG responses to information requests related to alternative sites placed emphasis on the importance of the results of the Independent Assessment Study (Golder 2004) and the Municipality of Kincardine's willingness to host the facility. OPG Response to EIS-02-40 relates that, "Based on the results of this assessment, and because the Municipality of Kincardine had approached OPG to initiate the study of the WWMF as a long-term L&ILW waste management facility and is therefore a willing host, OPG did not actively solicit other potential host communities or undertake geoscientific studies at other sites. According to the earlier OPG IR responses, the feasibility studies for the Independent Assessment Study (GOLDER 2004) were a very public process and during this process, no other municipalities approached OPG seeking to be considered as a potential host for a long-term L&ILW facility. Canadian and international experience at the time also showed that existing nuclear communities are more receptive to hosting waste management facilities, and recent experience shows that without a willing host municipality the siting of a deep geologic repository for nuclear waste is not feasible.

The Joint Review Panel directed OPG, via IR 12-513, to provide a renewed and updated analysis of the relative risks of siting alternatives under alternative means requirements Project of the EIS Guidelines, and indicated that the analysis should be undertaken by

independent risk assessment experts, and that the analysis should be qualitative, transparent, defensible, and repeatable.

Following receipt of OPG's response to IR 12-513, the Joint Review Panel issued an additional Information Request (EIS-12-513a) seeking additional details on the risk assessment conducted by the "Independent Expert Group" (IEG) retained by Ontario Power Generation for the purpose of responding to IR 12-513. A subsequent IR (EIS-12-513b) sought clarification of what appeared to be an inconsistency between two figures in an appendix to the second IEG report.

In response to each of the Information Requests OPG provided the Joint Review Panel with a report from the Independent Expert Group. An additional report, a "Risk Perception Background Study" was provided as an appendix to the IEG's second report.

Northwatch's review focuses primarily on OPG's response to the initial Information Request (EIS 12-513) with limited comment on OPG's additional filings.

Review of the "Report of the Independent Expert Group on Qualitative Risk Comparisons among Four Alternative Means for Managing the Storage and Disposal of Low and Intermediate-Level Radioactive Waste in Ontario"

Ontario Power Generation retained an "Independent Expert Group" comprised of four individuals to prepare a report in response to IR-12-513: Maurice Dusseault, Tom Isaacs, William Leiss (Chair), and Greg Paoli. Short biographies included as an appendix to the report summarize the expertise of each group member as follows: Maurice Dusseault's expertise is in geology, Tom Isaacs' expertise is described in being in "*the intersection of nuclear power, national security, waste management, and public trust and confidence*", and William Leiss and Greg Paoli are both described as having expertise in risk assessment. Only Tom Isaacs is described as having expertise related to nuclear waste management.

However, a cursory review of the literature identifies other members of the IEG as having not only previously worked in related fields, but also having taking positions with respect to nuclear waste burial. For example, Maurice Dusseault's bio refers - rather cryptically - to "novel deep waste disposal technologies", omitting the relevant detail that the "interest" is in

deep borehole disposal of nuclear waste, as evidenced by his published papers.⁸ Professor Dusseault has also made his support for nuclear waste burial known:

From a technical point of view, there's no reason such a facility couldn't be built in southern Ontario, said Maurice Dusseault, a geological engineering professor at the University of Waterloo.

And Dusseault said sedimentary rock especially rock with thicker sediments, like the type found in a line from Sarnia to Goderich may actually be a better choice than the granite of the Canadian Shield for safety's sake.

In the highly unlikely event that contaminants escaped into groundwater in sedimentary rock, they would flow through a porous medium that, in concert with surrounding clay, would act as a giant filter. Groundwater flows down in the thicker rock, not toward the surface, and if it eventually came up underneath the floor of one of the Great Lakes, any remaining contaminants would be diluted by the huge bodies of water, Dusseault explained.⁹

That the consultants retained by OPG have done previous work in this field is certainly not at issue – indeed, it was surprising that three of the four bios provided included no mention of expertise in the field of nuclear waste management or the nuclear sector. What is at question is why the very relevant work by Dr. Dusseault would not be identified, or that of Dr. Leiss, including such notables as his having been on the Scientific Review Group for the federal review of Atomic Energy of Canada Limited's Deep Geological Disposal Concept, or his extensive work for the Nuclear Waste Management Organization¹⁰ which includes multiple papers and presentations over a ten year period. Nor is Tom Isaacs association with the Nuclear Waste Management Organization identified, a “working” relationship that also spans a decade.¹¹ Both Dr. Leiss and Mr. Isaacs have been retained by the NWMO for numerous purposes on a variety of topics, and in the context of their having been retained by OPG on a project for which NWMO is the lead consultant this would have been relevant experience to include in their brief biographies.

⁸ “Disposal of Radioactive Wastes by Slurry Fracture Injection”, undated, as found at <http://www.terralog.com/article/Disposal%20of%20RA%20Wastes%20by%20SFI.pdf>

⁹ Waterloo Record, 2007, as found at <http://waterwars.wordpress.com/2007/03/27/no-plans-for-nuke-waste-in-southwestern-ontario-yet/>

¹⁰ <http://www.nwmo.ca/search?cx=005220920302353216078%3Atrcsowub1i&cof=FORID%3A10%3BNB%3A1&ie=UTF-8&q=leiss&sa=>

¹¹ <http://www.nwmo.ca/search?cx=005220920302353216078%3Atrcsowub1i&cof=FORID%3A10%3BNB%3A1&ie=UTF-8&q=tom+isaacs&sa=&siteurl=>

The report itself is 53 pages in length, with five appendices which combine to a similar length. Approximately half of the report is consumed by a narrative description of the four options, with the balance of the report focused on a risk comparison of the four options, and summarizing relative risk assessment results.

As noted by the Canadian Nuclear Safety Commission in the CNSC's July 7th Panel Member Document, the report is flawed in several respects.¹²

Our initial difficulty occurs in the first section, in the description of methods for comparing alternative management options. The paper states:

Whatever the method that is chosen, it should be capable of being explained and applied in such a way that others, who were not involved in the original exercise, can understand the reasons behind the judgments that were made and also repeat some form of the exercise or themselves.

In other words, the method should have the virtues of being transparent, defensible, and repeatable. These three virtues also encompass the requirement that the judgments that are made should be evidence based that is, arrived at with reference to a body of knowledge that is widely known and generally accepted as being reliable at the time when the decision exercise was carried out. The requirements for transparency and repeatability, on the other hand, reflect the legitimate expectation that judgments in such matters as these will have an element of subjectivity to them, and thus that another group of reasonable persons may very well come to different conclusions based on deliberations involving the same body of evidence.¹³

First, this statement self-contradicts, stating first that “repeatability” means that the exercise could be repeated by others and arrive at similar results. The next paragraph goes on to argue that “repeatability” means that conclusions are arrived at subjectively, and based on the same evidence a different group of people would come to different decisions.

Secondly, the interpretation that subjectivity trumps repeatability is inconsistent with the general practice and expectations of qualitative risk assessment.¹⁴

Third, the direction from the Joint Review Panel in IR 12-513 was that the risk assessment to

¹² CNSC PMD 14-P1.2

¹³ Report of the Independent Expert Group, Report 1, 25 March 2014, page 3

¹⁴ See, for example, “Multi-Attribute Risk Assessment”, Shawn A. Butler and Paul Fischbeck, Carnegie Mellon University, available online at <http://openstorage.gunadarma.ac.id/research/files/Forensics/OpenSource-Forensic/MultiAttributeRiskAssesment.pdf>

be undertaken was to be “qualitative, transparent, defensible, and repeatable”. This means, we believe, that the JRP expects that a reasonable group of people relying on similar evidence and using a similar method would arrive at similar results.

Section 1 of the report outlines the approach taken. In addition to the above noted matter, this brief section is flawed in its reliance on generalizations and assumptions. For example, it assumes that any event that could be categorized as a “terrorist attack” would be high consequence with “severe psychological shocks”, when in reality – while certainly they are acts to be avoided and prevented – such events could actually take place on a continuum, ranging from relatively individual and barely known consequences to large scale and fairly catastrophic events, which may, indeed have “severe psychological shocks”. But the imprecision of this description renders it more rhetorical than meaningful.

Section 2 of the report describes the four management options / alternative means compared in the risk analysis, which is described in Section 3 of the report as a “risk comparison”.

We offer the following comments on Section 2 of the report:

- It may have been helpful to require that the risk analysis be conducted at different time intervals, for example, at intervals of 100 years, 300 years, 1,000 years and 10,000 years; for example, by specifying a time frame of 100 or 200 years, it would have been more likely that the risk analysis would have been conducted – for example, by the Independent Expert Group – and reviewed – for example, by the CNSC staff – and that the risk analysis could have been undertaken relatively free of the apocalyptic assumptions that frequently divert the consideration of radioactive waste management options into a side-debate over the expected arrival of social collapse; this is a debate which is speculative and for the most part dominated by doomsday thinking which is not supported by evidence in either the physical or social sciences
- The report erroneously states that the Western Waste Management Facility was established in 1974; in 1974 Radioactive Waste Operations Site 2 (RWOS 2) commenced operations; the Western Waste Management Facility (WWMF) was established in 2001, further to the agreement between OPG and Bruce Power

- The report categorically states that buildings and containers must be replaced after fifty years; we question the accuracy of this statement, and would encourage the JRP to refer it to CNSC staff for verification
- The comment at the beginning of Section 2.2.2 that the expert group is “not aware of any definitive characterization of either an “enhanced” or “hardened” set of at-surface facilities” is interesting given a) the approach has been the subject of discussion in this review, and b) Section 1 of the report lists “internet searches” as one of information sources on which the report relies. In Section 2.2.2 (b) the experts describe the internet search they undertook and the lack of success they had using the search phrase “hardened surface storage for low-and intermediate-level radioactive waste”. To test the availability of information on this topic through an “internet search” we used two combinations of key words, and had multiple results in each case. The key word combination of “enhanced on site storage” yielded multiple results, with several documents providing technical and general descriptions of enhanced on-site storage. In fact, the search yield had as the topic document a notice for a U.S Environmental Assessment of a nuclear waste management option and had as an addendum document the evaluation of enhanced on-site storage as an alternative to the transportation of nuclear waste to off-site disposal facilities:

The Draft EA Addendum evaluates the potential environmental impacts associated with transportation of waste to disposal facilities at various locations throughout the United States. The Draft EA Addendum also evaluates the potential environmental impacts associated with the no action alternative and enhanced on-site storage alternative.¹⁵

The key word combination of “hardened on site storage” yielded multiple results, with several documents provided technical and general descriptions of hardened on-site storage. U.S. Nuclear Regulatory Commission (NRC) technical document was included in the first screen of results. The NRC referenced hardened on-site storage as follows:

¹⁵ “Notice of Availability of the Draft Environmental Assessment Addendum for Disposition of Additional Waste at the Paducah Gaseous Diffusion Plant”, Federal Register / Vol. 68, No. 83 / Wednesday, April 30, 2003 / Notices, as available online at http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/EA-1339-AdDEA-NOA-2003.pdf

“...the NRC is proposing to require ISFSI and MRS licensees to calculate potential dose consequences arising from certain security scenarios. If these results exceed the 0.05-Sv (5-Rem) dose limit, then a licensee could use engineered security features to fortify the ISFSI or MRS against attack, or implement a denial protective strategy. Consequently, while the use of HOSS could be an engineered security solution to the dose analysis results for a particular facility, the NRC has not concluded that the use of HOSS should be mandated at all ISFSIs or MRSs.”¹⁶

- The IEG provides no rationale for its selection of 100 years in the described 100 year cycle of replacing “more robust in-ground and above-ground storage containers” in Section 2.2; internationally there is an active discussion about extending on-site storage for used nuclear fuel, and the more common time frames are in the 100 to 300 year range; the IEG rationale for selection of the shortest of those time frames is unexplained’
- In Section 2.3.1 the IEG neglects the additional risks associated with a DGR, including risks related to loss of containment during transfer (for example, in the case of accidental drop during transfer through a single vertical shaft), premature container failure post-transfer to an enclosed underground environment resulting in radiological releases into the underground work environment, and the many different scenarios under which the release of radionuclides to the surface environment could be greater or earlier or more rapid than hypothesized during repository design and development; in essence, the IEG description overplays the risks of above-ground storage and underplays the risks of transferring the wastes into a deep underground environment
- In general, Chapter 2 of the IEG’s March report contributes very little to the discussion or evaluation of alternatives to the OPG undertaking. Given the direction from the Joint Review Panel that this analysis was to be undertaken by independent experts, it is surprising that the description of the options is so largely based on the descriptions provided by OPG, including the descriptions of the “alternative” options; the two paragraph discussion of the “reference case for ‘enhanced’ surface storage” provides only a minimal description identifying some elements commonly associated

¹⁶ “Draft Technical Basis for a Rulemaking to Revise the Security Requirements for Facilities Storing Spent Nuclear Fuel and High-Level Radioactive Waste, Revision 1” [NRC-2009-0558], available online at <http://pbadupws.nrc.gov/docs/ML0932/ML093280743.pdf>

with enhanced, extended and/or hardened on-site storage options. The discussion provides no reference to – or, in fact, even an acknowledgement of - the very active international discussion about enhanced, extended and/or hardened on-site storage.¹⁷

- We found it frustrating that Section 2.3.1 provided at points very general statements or descriptions and at times very specific and technical descriptions, but provided no references; instead, it was prefaced by a statement that the descriptions are “*based in part on the exposition and referenced materials in Appendix V, and also on a more general understanding of the characteristics of these geological formations that may be found in the available scientific and technical literature*”¹⁸ without any indication as to what aspects of the report were based on OPG materials, the opinion or generalized understanding of the IEG members, or on directly relevant technical reports; as a general statement, this failure to provide any technical references or supports to statement made is in and of itself sufficient cause give the paper no weight in the evaluation of the OPG proposal
- The IEG states in section 2.3.2 that the comparison between the Bruce site and a “granite” site is difficult because the Bruce site has been extensively studied and “there has been no similar level of characterization applied to a specific site in the Canadian Shield in Ontario”; we find it interesting that the IEG did not reference the exploratory work done by Atomic Energy of Canada Limited done during the 1970s and 1980s in Massey or Atikokan in Ontario or the Underground Research Laboratory in Manitoba (while not in Ontario, it was selected because it was purported to share characteristics with the Ontario portion of the Canadian Shield); while we certainly cannot vouch for the quality of the AECL data, it is interesting that so much of the IEG discussion is so similar to the AECL discussions of 20 or 30 years ago, but the IEG did not reference the extensive research by AECL
- A case in point of this similarity to the AECL views and descriptions of the 1990s is the IEG description of the General Geological Disposition of a Granite Site Repository, on page 14. The IEG writes:

The Granite DGR site would almost certainly be at a location where the

¹⁷ See Northwatch Backgrounder “Planning for Extended Storage”, 2013, online at http://www.knownuclearwaste.ca/uploads/Longer-term_approaches_June2013-2pager.pdf

¹⁸ IEG Report, May 2014, Section 2.3, top of page 9

granite is clearly exposed at the surface.

In other words, the granite would be available for direct geological and geotechnical examination in its natural state so that various factors could be estimated, such as fracture density and spacing at the surface, the heterogeneity, the presence of lithologically different zones or zones that are more intensely fractured. These various characteristics are not the same at the surface as at the depth of the repository; progression of a detailed site investigation program will provide for the collection of more information about the granite site, reducing the uncertainty to levels that can be deemed acceptable for repository advancement (development of shafts, adits and galleries). Because exposed granite is desired, there will be no recent sediments covering the entire site, part of it will be bare rock. Because of the glaciation history of the Canadian Shield, the sediments would be very young (on the order of 10,000 years of age), would fill in all the lower parts of the site (the wetlands and shallow valley bottoms), and would be much coarser-grained and permeable than the surficial sediments at the Bruce DGR site. “

This description is strikingly similar to those yearningly offered by AECL during their days at the helm of the nuclear waste burial site search, and one which earned the nickname “the perfect pluton” during the eight year federal environmental assessment review of Atomic Energy of Canada Limited Geological Disposal Concept. However, for better or worse, AECL was never able to actually locate such a rock formation.

- If the paper is helpful in any way, it is in its confirming the intended role of dilution in the DGR design:

In both Granite and Bruce site DGR cases, dispersion and dilution will take place in the subsurface ... so that any water exiting near the surface under a body of water will already be diluted by large factors.

Because groundwater exit points would be almost certainly under bodies of water, a further dilution will take place. For a comparison, assume that any plausible exiting flux of water that may have come into contact with radionuclide might be as large as 1000 m³/year (this is considered highly improbable). The average rainfall onto the 60,000 km² area of Lake Huron is more than 700/800 mm/yr, or about 42 billion cubic meters per year (not counting river water flowing into the lake). The amount of water already in Lake Huron, which has an average depth of 60 m, is 100 times larger than the annual rainfall on the Lake, over four trillion cubic meters. Hence, the volumes of the bodies of water available for dilution at the surface are either immense (Great Lake) or actively flowing (rainfall >700 mm/yr, active streams and marshlands), so the dilution capacity is significant.

The dilution capacity for a Granite DGR and the Bruce DGR are similar, as we were asked to consider a Granite DGR in a similar hydrological disposition. Differences in rainfall and snowfall exist, but these differences regionally are in the ranges of 10-50%, not orders of magnitude.

This, of course, confirms the concerns that have been expressed by so many residents of the Great Lakes basin in the course of this review (and would be expressed by residents of other watersheds if the site search was to simply shift elsewhere): dilution is not the solution, and water sources should not be impacted to any degree by radioactive releases as a result of OPG placing nuclear wastes deep in the earth

We have reviewed Chapters 3 and 4 of the IEG's March 2014 report; in the absence of any identified basis for the technical descriptions of the four options or any clear description of the basis for assigning risk or any clear rationale for the numerous exclusions in Table 1 we see no reason to provide any additional comment on these particular emperors' outfits.

4.5 Implications of revisions to the reference waste inventory

IR 13-514 directed OPG to provide additional information further to some substantive revisions to the waste inventory. OPG was to re-run the models for post-closure safety assessment, assess how pre-closure could be affected, assess how the revised inventories would affect the environmental effects of accidents, malfunctions and malevolent acts, with emphasis on the pre-closure phase.

The IR included the comment that “while the waste inventory is a work in progress and cannot be finalized at this stage of the Project, additional quality assurance would be provided by a Waste Inventory Verification Plan”.

In response, OPG filed three reports: a post-closure safety assessment, a summary of pre-closure safety implications, and a waste inventory verification plan.

In the case of both of the safety reports, the analysis indicated that the DGR proposal was even more problematic than had been initially thought, i.e. had been thought prior to the revision.

The most fundamental difficulty with the Waste Verification Plan is that at present there is still no reliable inventory, and the Waste Verification Plan will not address this, at least not in the near future.

We adopt the submissions of Mr. Pete Roche and Dr. Stuart Haszeldine as Northwatch’s additional comments on this topic.

4.6 Applicability of Recent Incidents at the Waste Isolation Pilot Plant (WIPP) to the Safety Case for the DGR Project

In their main evidence filed in 2011, Ontario Power Generation made numerous references to the Waste Isolation Plant (WIPP), located near Carlsbad, New Mexico and its relevance to their own proposed Deep Geologic Repository.

In their Environmental Impact Statement (EIS), OPG rationalized their proposal to inter low and intermediate level wastes deep in the earth as being “consistent with international best practice”, placing that claim as their top-bullet [EIS, page 1-2] reason for having proposed the DGR. In later sections of the EIS, they described site visits made by Kincardine and OPG representatives to the Waste Isolation Pilot Plant WIPP and select other facilities, explaining that “*these site visits confirmed that there were several feasible technologies for long-term L&ILW management*”. [EIS page 2-4]. In later sections of the EIS, OPG included Loviisa in Finland, Forsmark in Sweden, Waste Isolation Pilot Plant (WIPP) in New Mexico and the Konrad Mine in Germany as their examples of the use of the deep rock vaults technology for the disposal of L&ILW [3-10], and so presumably examples of that “international best practice” which was their top-listed rationale for having selected deep burial as the preferred option.

OPG further detailed the basis for selecting this option in the Preliminary Safety Report (PSR)¹⁹, again stating that the proposed DGR is “consistent with best international practice.” [P. 1 of 768] The PSR also stated that:

The DGR would be the first deep geologic repository for L&ILW in Canada and there are no directly comparable Canadian facilities. There is, however, in the U.S. and overseas, good operating experience with geologic repositories for similar wastes. Current repositories are listed in Table 14-1. P. 671 of 768.

¹⁹ Ontario Power Generation (OPG). 2011. *Deep Geologic Repository for Low and Intermediate Level Waste - Preliminary Safety Report*. 00216-SR-01320-00001 R000.

Table 14-1 lists five facilities: Forsmark (SFR), Sweden; Olkiluoto and Loviisa²⁰ in Finland; WIPP, and Konrad, Germany. The first three are less than 115 meters deep and should not be considered DGRs. The fifth is a DGR but is still under development and is not scheduled to begin operations until 2019. These factors effectively rendered the WIPP as OPG's sole candidate for demonstration of "international best practice". Consistent with that, The PSR further stated:

*The U.S. WIPP is particularly relevant as it is situated in a sedimentary setting at a depth similar to the DGR, and OPG has gained valuable insight into the construction and operation of its DGR through many visits to WIPP and interactions with WIPP staff.*²¹

CNSC staff appeared to concur with this view, as follows:

*Six repositories were examined by CNSC staff for their similarities and relevance to OPG's DGR project. On the basis of this review, CNSC staff has concluded that the WIPP site (for general operations) and the Konrad site (for general construction and proposed operations) have the most relevance to the DGR project based on their depth, general geology, and the volume of low and intermediate level waste for disposal. The FSR site would, in CNSC staff's opinion, be an alternate site from the WIPP to demonstrate operations.*²²

Presumably the Joint Review Panel also considered the WIPP site to be particularly relevant, selecting it for a site visit in November 2012.²³

Throughout the twenty-five days of public hearings in September and October 2013, the Waste Isolation Pilot Plant was referenced or discussed on several occasions, including by OPG consultant Frank King, with the Nuclear Waste Management Organization:

²⁰ Various documents provide different translations of the site names to English, but here the Finish translation is used, except when quoting from documents. http://www.stuk.fi/ydinturvallisuus/ydinjatteet/en_GB/jatteet/

²¹ Ontario Power Generation (OPG). 2011. *Deep Geologic Repository for Low and Intermediate Level Waste - Preliminary Safety Report*. 00216-SR-01320-00001 R000.

²² CEAR #521, page 3 of 8.

²³ CEAR #792

As of right now, there is only one existing in the world deep geologic repository. That's the WIPP facility.²⁴

Northwatch-retained expert Don Hancock provided an analysis of OPG's presentation of international experience as it relates to the proposed DGR, in both a written submission²⁵ and in oral testimony.²⁶

WIPP Events in February 2014

In February 2014, a truck fire and a radiological release brought increased attention to the facility which OPG had presented as its example of "best international practice", and subsequent to that the Joint Review Panel issued Information Request 13-515²⁷ to Ontario Power Generation and the Canadian Nuclear Safety Commission, directing them to:

- Provide a brief description of the recent incidents at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, including an explanation of the relevance of these incidents to worker and public health and safety (both occupational and health and safety and radiation protection requirements) at the proposed DGR under normal and accident conditions, and
- Describe how the consequences of such incidents might or might not fall within what OPG modeled for its analysis of accidents, malfunctions, and malevolent acts.

Ontario Power Generation responded with a five page table-format response to Information Request 13-515, and presented the same or very similar information in five pages of text included in their Panel Member Document (PMD) which is posted on the registry as having been filed on July 7th²⁸

The OPG PMD describes OPG's interest in the recent incidents at WIPP as follows:

OPG, as a nuclear facility operator, and NWMO both have ongoing processes to seek

²⁴ Transcript, Friday, September 20, 2013, Volume 5, page 47

²⁵ CEAR # 1526

²⁶ Transcript, Monday September 23, 2013, Volume 7, page 282

²⁷ CEAR # 1833

²⁸ CEAR # 1911

operational experience from other relevant facility operators worldwide. Consistent with the established management system, OPG carefully reviews the available information provided by these operators, and consider its direct and indirect application to our facilities. OPG and NWMO are also members of Canadian and international groups that consider best practices in operations, and develop standards, guidelines and reports²⁹.

Interestingly, the OPG discussion of the February incidents at WIPP and ongoing investigations and recovery efforts include no acknowledgement of the WIPP having been featured in OPG's 2011 filing and 2013 hearing presentations as OPG's best example of international best practices. The above noted description of OPG and NWMO's interest in the WIPP suggests a "neutral observer" status which we believe to be disingenuous.

Northwatch has again retained Don Hancock to provide the Joint Review Panel with an analysis of the information provided by Ontario Power Generation with respect to the Waste Isolation Pilot Plant. His report³⁰ is provided under separate cover, and Northwatch adopts his observations and conclusions, which can be summarized as follows:

- OPG's May 9 and July 7 submissions are incomplete; for example, OPG cites only one source of information; other organizations also provide relevant information, and OPG should have used additional sources
- OPG states that the "potential impacts to worker and public safety were assessed to be below criteria" but omits key facts and does not discuss why it considers such effects, including health impacts and ongoing treatment for smoke inhalation, to be "below criteria."
- OPG omits any discussion of the 22 workers who tested positively for internal radiation
- CNSC Staff submissions have some inaccuracies and are incomplete, including errors about how many workers treated following the underground fire and how many workers were determined to have been contaminated as a result of the radiological releases
- Five months after the event occurred, the cause of the release remains unknown.

²⁹ CEAR # 1911, page 24

³⁰ "Recent Events at the Waste Isolation Pilot Plant (WIPP) and Initial Questions and Lessons for the Ontario Power Generation Proposed Deep Geologic Repository", Report by Don Hancock, Southwest Research Information Centre, for submission to the Joint Review Panel on July 21, 2014

- Some WIPP control systems failed
- Radiation protection and notification for workers failed.
- Radiation protection and notification for the public failed.
- No effective WIPP decontamination procedures exist.
- A new exhaust shaft and new underground ventilation system will be required, if WIPP is to re-open for waste disposal.
- The incidents at WIPP raise numerous serious questions about the operations of the DGR proposed by Ontario Power Generation
- “Below criteria” events can have major consequences for a repository.
- In significant ways, repository operations are more complex than storing wastes on the surface.
- The WIPP incidents demonstrate that there are additional uncertainties regarding repositories than have not been adequately understood and analyzed in environmental analyses and nuclear safety requirements.

In responding to the Joint Review Panel’s direction that including they provide an explanation of the relevance of the WIPP incidents to worker and public health and safety at the proposed DGR, OPG discusses each of the incidents - the truck fire and the radiological releases – separately.

WIPP Underground Fire

As outlined in the above-noted SRIC report, Ontario Power Generation relies on a single source for their information about the WIPP truck fire, that being the U.S. Department of Energy Office of Environmental Management’s “Accident Information Report: Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant, February 5, 2014”.³¹

³¹ “Accident Information Report: Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant, February 5, 2014”, U.S. Department of Energy Office of Environmental Management, March 2014 as found online at <http://www.wipp.energy.gov/Special/AIB%20Report.pdf>

For the purpose of providing the Joint Review Panel an understanding how the underground truck fire at the WIPP is relevant to OPG's proposed DGR, we believe that OPG should have provided the Panel with at least a somewhat more detailed summary of the Accident Information Report (AIR) findings. We would summarize key findings of the AIR to include the following:

- the U.S. Department of Energy, Office of Environmental Management appointed Accident Investigation Board concluded that the truck fire "accident" was preventable
- The fire is believed to have originated in a haul truck's engine compartment
- the fire burned the engine compartment and consumed the front tires which contributed significantly to the amount of smoke and soot in the underground
- an evacuation "yelp" alarm was sounded for approximately two seconds and an announcement was made using the public address system (PA) announcement that there was a fire in the underground and for all personnel to evacuate
- the first instruction was to evacuate via the area egress stations, a subsequent announcement directed the workers to the waste hoist
- not all workers heard the evacuation instructions, some workers learned of the fire and need to evacuate through the "chatter" (discussions) on the mine phone, through co-workers, or through their supervisors
- a decision to switch the ventilation system from normal to filtration mode resulted in the flow of smoke into areas of the underground which the workers expected to have "good" air
- Workers had difficulty reaching the waste hoist due to poor visibility obscured evacuation route reflectors; this was compounded by a delay in activating the evacuation strobe lights
- Some workers also had difficulty opening and/or donning their self-rescuers or self-contained self-rescuers (SCSRs)
- the root cause of this accident to be the failure of management and contractors to adequately recognize and mitigate the hazard regarding a fire in the underground, including recognition and removal of the buildup of combustibles through inspections and periodic preventative maintenance (e.g., cleaning), and the decision to deactivate the automatic onboard fire suppression system
- The Board identified ten contributing causes to this accident or resultant response:

- Failures in the preventative and corrective maintenance program
- The fire protection program was less than adequate
- The training and qualification of the operator was inadequate
- The CMR Operations response to the fire, including evaluation and protective actions, was less than adequate
- Elements of the emergency/preparedness and response program were ineffective.
- A “nuclear versus mine culture exists where there are significant differences in the maintenance of waste-handling versus non-waste-handling equipment. “
- The NWP Contractor Assurance System (CAS) was ineffective
- The DOE Carlsbad Field Office (CBFO) was ineffective in implementing line management oversight programs and processes that would have identified NWP CAS weaknesses and the conditions associated with the root cause of this event.
- Repeat deficiencies were identified in DOE and external (i.e. oversight) agencies assessments
- There are elements of the Conduct of Operations (CONOPS) program that demonstrate a lack of rigor and discipline commensurate with the operation of a Hazard Category 2 Facility
- The Board visited the CMR and the underground, including the accident scene, on February 13 and 14, 2014. Numerous maintenance-related issues were identified, including:
 - Several mine phones were found to be inoperable; twelve of 40 phones tested were non-functional
 - Numerous components of the mine ventilation system were out of service or otherwise impaired for an extended period of time, some since installation
 - Numerous other pieces of equipment were out of service or otherwise impaired
 - witness statements and interviews from personnel reported that PA announcements were difficult to hear or understand, Pre-operational checks are not identifying equipment problems that need to be addressed other than light and horn issues, Some mine phones were reported as not working properly or difficulty in hearing was experienced, thirty-three emergency

lights in the Waste Handling Building have been inoperable for as long as two years

In their response to IR13-515, OPG provides a very brief description of the incident, references information they had previously provided the Joint Review Panel (i.e. previous to the WIPP underground fire) related to health, safety, environmental management, emergency response, and fire detection and protection. In terms of responding to the Panel's direction to describe the relevance of the incident to the proposed DGR OPG provides the following brief and very general response:

OPG has committed to the development of a Fire Protection Program prior to the start of site preparation and construction. This includes the development of Fire Hazard Analyses which support specific fire protection plans for the DGR activities. Plans include required elements such as roles and responsibilities, fire response, fire assessments, managing changes that affect fire protection, work practices and procedures, fire planning, inspection and maintenance of fire protection systems, housekeeping, storage and handling of hazardous goods, control of ignition sources, transient material, reporting and drills.

The fire protection measures and processes developed for the DGR project will be subject to regulatory oversight by the CNSC and other regulating bodies. The Fire Protection Program and Emergency Response Plan are licensing requirements and identified by the CNSC in their response to Undertaking No. 67 (CNSC 2013b) as hold points for regulatory review and acceptance prior to the start of site preparation and construction.

OPG is confident that these measures and processes will prevent or mitigate a similar event at the proposed OPG DGR. Documented programs will be translated thoroughly into training, field procedures and management expectations. Implementation of a common quality, safety and environmental management plans to all staff and contractors, and continued monitoring and improvement (i.e. Plan-Do-Check-Act), will help to ensure common understanding and testing of processes.

In summary, OPG's response seems to be that "we have programs, processes and plans, so it won't happen to us". Accordingly, in the presence of the failed track record at OPG's best example of "best practices", i.e. the WIPP, and in the absence of any track record for OPG with deep geological repositories, the programs, processes and plans and related outcomes at other OPG operations warrant scrutiny.

Our review is not comprehensive. We have examined the *CNSC Staff Integrated Safety Assessment of Canadian Nuclear Power Plants* for 2011, 2012 and 2013 (draft), and the S-99 reports for Darlington and Pickering for the same three years, selected on the basis of

being readily available information provided in a consistent format and reporting on OPG's current operations.

Findings from our review of the CNSC Staff Integrated Safety Assessment of Canadian Nuclear Power Plants are as follows:

- In the category of “emergency management and fire protection” both Pickering and Darlington Nuclear Generating Stations consistently received ratings of “satisfactory”, in no year did either of the stations achieve a “fully satisfactory” rating in this category
- The (draft) 2013 report briefing described a fire at Pickering Unit 1 in the lube oil purifier in the turbine hall
- CNSC staff have found that Darlington's Fire Hazard Assessment (FHA) required improvement related to documentation in 2013
- The site underground fire water distribution system experienced failures that affected the Pickering NPP and the Pickering Nuclear Waste management facility in 2013
- Compliance issues were identified during the Pickering B integrated safety review in the area of human factors in design relating to engineering change control in 2012
- Deficiencies were identified during an evaluation of the site assembly, accounting, and evacuation emergency exercise held at Pickering in 2011.

“S-99 Reports” are reports required under Regulatory Standard S-99, which outlines reporting requirements for operating nuclear power plants. The requirements are derived from the *General Nuclear Safety and Control Regulations*, the *Class I Nuclear Facilities Regulations*, and the *Radiation Protection Regulations*. A list of S-99 event reports that were generated is made available on the OPG web site, excluding those which contained confidential or security-related information.

For this review's purpose, the S-99 reports for the years 2011, 2012 and 2013 for the Pickering and Darlington Nuclear Generating Stations were converted into a single data base, and then sorted into five broad categories. Again, the purpose of this review of the S-99 reports is to evaluate the strength of OPG's argument that the underground fire at WIPP DGR

is not relevant for OPG's proposed DGR because of the programs, processes and plans that OPG has in place. The categories were selected on the basis of a possible co-relation to contributing causes and failures identified in DOE's Accident Information Report summarized earlier in this report. The categories are:

- communications, including related to public address system
- equipment failure, including related to improper maintenance or other causes
- fire protection, including related to fire protection equipment, fire routes,
- human resources, including related to personnel conduct, performance
- non-compliance events
- reporting / oversight, including to the Canadian Nuclear Safety Commission, and
- "other".

"Non-compliance events" in this summary include those incidents which were out of compliance but which did not fit within this report's other categories but could be deemed relevant to this evaluation. The remainder of the S-99 report subjects were categorized as "other" because a) the S-99 annual report did not include enough information to determine its relevance, or b) while not without interest, it did not appear, based on the available information, to have a direct relationship to what the AIR identified as contributing factors. Examples of incidents in the "other" category include reports of research findings, incidents of Acute Toxicity Failure at the sewage treatment plant, seismic events within 500 km, reactor trips, spills to Lake Ontario, dead fish observed at station outflow, and conditions observed during unit outages. With additional information, it is likely that many or most of these events could have been grouped under the categories of Communication, Equipment Failure, Fire Protection, Human Resources, Reporting, or Non-compliance events but for the purposes of this report were not. It should also be noted that some S-99 reports could have been categorized in more than one way, i.e. as a "communication" incident or as a "fire protection" incident. Each event was placed in only one category to avoid double-counting, but could have been otherwise categorized. Hence this is a generalized summary.

In total, there were 594 incidents reported in 2011 to 2013, with 396 of the reports related to the Pickering Nuclear Generating Station and 198 of the reports related to the Darlington

Nuclear Generating Station. Because the reports for Pickering A and Pickering B were combined for the 2013 reporting year, it is not possible to differentiate for the three year period how many reports were related to Pickering A versus Pickering B, but with Ontario Power Generation as the operator for Pickering A, Pickering B and Darlington Nuclear Generating Stations, this differentiation is not necessary for the purpose of this report. We also wish to note that this cursory review is intended to assist in understanding what commonality there may be between operations at the WIPP and Ontario Power Generation's nuclear generating stations in terms of those factors which the DOE AIR identified as being contributors to the "preventable accident", as the underground fire has been termed. Almost half of the incidents identified in the S-99 reports are directly relevant to an assessment of how much conditions that were at play at WIPP and are considered to be contributing factors to the February 2014 underground fire.

The full data base of S-99 reports is available on request. The following table summarizes the relevant findings.

Table 1: Summary of S-99 Reports from 2011-2013 and Relevance to WIPP Underground Fire

Category	#	Summary	Related Observations from WIPP AIR
Communication	20	Over half of the communication-related incidents related to the public address system, of which the majority appeared to be possibly mischief related: repeated reports of Foreign Material Placed In PA Speaker, the speaker blocked with materials, stuffed with appear, tampering or possibly tampering, missing assembly, or the system being unavailable. Other reports were of alarm switches not working, incorrect or "frivolous"	Communication failures were identified in the AIR. Not all workers heard the evacuation instructions, some workers learned of the fire and need to evacuate through the "chatter" (discussions) on the mine phone, through co-workers, or through their supervisors. Several mine phones were found to be inoperable; twelve of 40 phones tested were non-functional. Personnel reported that PA announcements were difficult to

Category	#	Summary	Related Observations from WIPP AIR
		signage, duct tape found on components of the emergency warning systems, and alarms unavailable or not working.	hear or understand.
Equipment Failure	56	Reports described equipment that was degraded or damaged, Late Preventative Maintenance, equipment or maintenance tests not being performed, equipment being “not available”, loss of lighting or surveillance cameras to areas of the station, the Site Electrical System Does Not Meeting Design Intent, Operating Policy and Procedures not being complied with due to Equipment, equipment or infrastructure not meeting code	Failures in the preventative and corrective maintenance was deemed to be a contributing cause. Numerous components of the mine ventilation system were out of service or otherwise impaired for an extended period of time, some since installation. Numerous other pieces of equipment were out of service or otherwise impaired. Thirty-three emergency lights in the Waste Handling Building have been inoperable for as long as two years.
Fire Protection	122	Incidents reported included in-station fires; numerous Fire Code violations, including Fire Doors being left or blocked open or found defective, Missed Fire Protection Tests, obstructions in areas designated as Fire Zones, combustible and explosive materials stored in Fire Zones, fire extinguishers which were unavailable, improperly stored, expired, obscured from view, or missing; Emergency water supplies being unavailable; batteries in Fire Panels not replaced on schedule; Exit Sign found Not Installed according to the National Fire Code; and	The root cause of this WIPP fire was deemed to be the failure to adequately recognize and mitigate the hazard regarding a fire in the underground, including recognition and removal of the buildup of combustibles through inspections and periodic preventative maintenance (e.g., cleaning), and the decision to deactivate the automatic onboard fire suppression system. The fire protection program was found to be less than adequate and the CMR Operations response to the fire, including evaluation and protective actions, was less than

Category	#	Summary	Related Observations from WIPP AIR
		instances of the Public Address System being unavailable or not audible in all locations of Penthouse (these were reported as Fire Protection violations and are in addition to those summarized in this table as “Communication” incidents	adequate. Elements of the emergency/preparedness and response program were ineffective.
Human Resources	23	The most common cause for a report in this category was “minimum complement violation”, meaning operations were short-staffed. Other incidents included employee becoming unconscious while at work, improper execution of duties, evidence of individual(s) smoking, and employee injuries at work.	Inadequate training and inadequate qualification of the operator was deemed to be a contributing cause of the fire and subsequent events. Staffing was found to not meet the staffing analysis and there is no structured surveillance/oversight program.
Non-compliance	83	Non-compliance events in this summary include those incidents which were out of compliance but which did not fit within this reports other categories of Communication, Equipment Failure, Fire Protection, and Human Resources. In the largest part, they were events which were outside of Operating Policies and Procedures and had the potential to adversely affect station operations. Report subjects varied greatly, but included: equipment not meeting design requirements, preventative maintenance incorrectly suspended, improperly	Procedural non-compliances could have endangered workers as they attempted to evacuate (for example, the unannounced change in ventilation to filtration mode). Also, the amount of combustible material accumulated underground was not in compliance with the limits. The WIPP emergency plan is not compliant with DOE requirements. Compliance issues with combustible loading issues had been previously identified in

Category	#	Summary	Related Observations from WIPP AIR
		<p>posted radiation hazards, equipment installed without an inspection and plan (itp) preventative maintenance missed, missed recertification of important station components, missed license hold points, required assessments and verifications not performed, defective emergency lighting, instrumentation not calibrated on schedule, inspections not performed on schedule, Non-Compliance to Operating Policies and Procedures, unposted radiation hazards, and misclassified radioactive material shipment</p>	<p>both internal and external reviews, but not addressed.</p> <p>Repeat deficiencies were identified in DOE and external (i.e. oversight) agencies assessments. The DOE Carlsbad Field Office (CBFO) was ineffective in implementing line management oversight programs and processes that would have identified NWP CAS weaknesses and the conditions associated with the root cause of this event.</p>
Reporting	15	<p>Incidents in this category included late reports, missing information on reports, incorrect information include in reports, variances in documentation, expired Certificates of Inspection, inadequate documentation, inadequate notifications to the CNSC, and tests not performed as reported</p>	<p>Inadequate reporting and notification was deemed to have been a factor. It was found that management did not have adequate communication processes to ensure awareness of issues that warrant attention from DOE; interviewed staff said they found the reporting process cumbersome and many do not use it.</p>

From the findings of our review of S-99 reports for Darlington and Pickering Nuclear Generating Stations for the period of 2011 through 2013 we draw two conclusions:

- 1) While the the *CNSC Staff Integrated Safety Assessment of Canadian Nuclear Power Plants*” for 2011, 2012 and 2013 (draft) Findings from our review of the CNSC Staff Integrated Safety Assessment of Canadian Nuclear Power Plants identified operational

issues, these reports – if read in isolation – would create a more favourable or positive impression of the station’s operations than is gained through a review of the same three years’ of S-99 reports; in particular, a comparison of the two sets of reports clarifies that there must be a very large gap – in real word terms – between the “satisfactory” rating and a “fully satisfactory” operation.

2) Having “programs, processes and plans” in place does not provide a defence against operational failure. We accept that Ontario Power Generation has programs, processes and plans in place. We accept that these programs, processes and plans are operationalized at their nuclear generating stations. But as even a cursory examination of only three years of operational reporting (i.e. the S-99 reports) demonstrates, the OPG operations are problem-plagued, and that there are many parallels between issues that become apparent in a review of the S-99 reports and issues that were flagged in the AIR report. For example:

- While it’s not clear that the deficiencies of the public address system at WIPP were mischief related, the communication issues related to the public address system, and emergency warning system more generally, are common between OPG operations and the WIPP
- Both OPG operations and the WIPP report equipment that was degraded or damaged, deficiencies in the maintenance of equipment and / or the equipment testing program, and inconsistent availability of surveillance or video cameras
- Numerous failures were reported related to adherence to the Fire Code and maintenance of fire protection equipment and systems at Darlington and Pickering as well as safe management of combustibles; the root cause of the WIPP fire was deemed to be the failure to adequately recognize and mitigate the hazard regarding a fire in the underground, and accumulation of combustibles underground was note as a serious fire code violation
- The S-99 reports identified issues with staffing levels and improper execution of duties, as well as other issues of poor employee conduct; the AIR report found that there was inadequate staffing was a contributing cause of the fire
- Non-compliance with code, standards or Operating Policies and Procedures were repeatedly identified for both the OPG operations and the WIPP

- Incidents in this category included late reports, missing information on reports, incorrect information include in reports, variances in documentation, expired Certificates of Inspection, inadequate documentation, inadequate notifications to the CNSC, and tests not performed as reported
- Inadequate reporting and notification was deemed to have been a factor in the WIPP underground fire; OPG reporting has also been incomplete and at times inaccurate, including misleading or incorrect information being included and inadequate notifications to the CNSC

Having vigorously put forward the Waste Isolation Pilot Plant as their example of the “international best practices” which had caused them to select a deep geologic repository as the preferred management option for their low and intermediate level radioactive wastes, Ontario Power Generation now appears to be attempting to distance themselves from this ill-fated operation. However, replying to the JRP’s Information Request with three paragraphs of generic program description cannot achieve this for them. It is not a matter of their having confidence in their programs and processes. It is a matter of their having put forward a proposal which is without precedent, having sought to draw a parallel to the Waste Isolation Pilot Plant in order to claim precedent, and now scrambling to erase those connecting lines now that the WIPP has become broadly recognized as a troubled and perhaps no-longer-operational facility. But the lines are drawn, the parallels between OPGs operational performance and WIPPs are identifiable. WIPP does, after all, provide an example that OPG and others can point to. Unfortunately for OPG it exemplifies failure.

Radiological Release Event

As outlined in the above-noted SRIC report, Ontario Power Generation relies on a single source for their information about the radiological release event at WIPP, that being the U.S. Department of Energy web site.

The Department of Energy Accident Investigation Board is conducting a two-phase investigation of the February 14 radiological event at WIPP. Phase I focused on the

release of radioactive material from the underground to the environment and the follow-on response to the release, and a Phase I AIB Report was released April 24.³² According to the DOE web site, the Phase 2 report will be focused on determining the direct cause of the release of the material and a report will be released at a yet-to-be-determined date.

The following summary of events and conditions related to the radiological release at the WIPP in mid February is excerpted from the DOE Accident Information Report (AIR)³³:

- the Board concluded that the unfiltered above-ground release was preventable and that weaknesses in missed opportunities to identify inadequacies in the safety basis
- The physical cause of the waste container(s) breach/failure has not yet been determined
- Events can be summarized as follows:
 - The morning of Friday, February 14, 2014, a radiation alarm was received in the Central Monitoring Room (CMR) at the DOE WIPP facility
- The alarm was triggered from an air monitor in the underground, monitoring exhaust from Panel 7, where waste was being emplaced
- The underground ventilation system automatically switched to HEPA filtration and the fan damper was manually opened and adjusted; this directed contaminated air from the underground up through the exhaust shaft, through the HEPA filter banks, and then to the environment from an exhaust duct.
- no employees working in the underground, 11 personnel were working on surface.
- the first indication that there was a release of contamination downstream of the HEPA filters to the environment was on Saturday, February 15th; on-site personnel were directed to shelter-in-place at 09:34; 153 people were working on the surface that day, no personnel were working in the underground; at 3:57 pm it was reported that site surveys were negative for radiological contamination and non-essential personnel were released

³² "Accident Information Report: Phase 1 - Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014" U.S. Department of Energy Office of Environmental Management, April 2014 as found online at http://www.wipp.energy.gov/Special/AIB_Final_WIPP_Rad_Release_Phase1_04_22_2014.pdf

³³ "Accident Information Report: Phase 1 - Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014" U.S. Department of Energy Office of Environmental Management, April 2014 as found online at http://www.wipp.energy.gov/Special/AIB_Final_WIPP_Rad_Release_Phase1_04_22_2014.pdf

- The emergency event was terminated at 5:17 pm on February 16
- On February 19, radiological results from the Carlsbad Environmental Monitoring and Research Center (CEMRC) high volume air sampling station located approximately 0.6 miles northwest of the site were reported
- On February 24, DOE reported additional environmental monitoring data from samples collected by WIPP radiological and environmental personnel on February 17, indicating slightly elevated levels of airborne radioactive concentrations consistent with the waste disposed of at WIPP
- On March 6, two ventilation system dampers were sealed with a high-density foaming material.
- On March 18, new air sample data indicated a small radiation release occurred on March 11
- The Board identified eight contributing causes to the radiological
- The Operations Program is not fully compliant with requirements
- NWP does not have an effective Radiation Protection
- NWP does not have an effective maintenance program.
- NWP does not have an effective Nuclear Safety
- NWP implementation of DOE O 151.1C, Comprehensive Emergency Management System, was ineffective
- The current site safety culture does not fully embrace and implement the principles of DOE
- Guide (G) 450.4-1C, Integrated Safety Management Guide
- Execution of CBFO oversight was ineffective. DOE Headquarters (HQ) line management oversight was ineffective.
- DOE HQ failed to ensure that CBFO was held accountable

In their response to IR13-515, OPG provides a one paragraph description of the radiological release incident. OPG then goes on to report that the Phase I AIR has been released, to comment that it “presents valuable insight and information surrounding the root and contributing causes specific to the surface release of radioactive material from underground”, to state that “the findings of this report are quite similar to those from the vehicle fire event”

and to observe that “there is a common theme that is largely related to a degraded safety culture, ineffective programs and program implementation as well as training.”

For the balance of this brief IR response, OPG “highlights the key aspects of the report and provides an OPG perspective of our practices in these same areas”. This consists of a one line summary of the “highlight” followed by a paragraph argument as to how or why this particular failing does not apply to them. For example, as the OPG “perspective of our practices in these same areas”, in reply to the “highlight” summarized by OPG as “Effectiveness of the WIPP Nuclear Safety Program, specifically related to the reduction in conservatism in the Documented Safety Analysis and corresponding Technical Safety Requirements” OPG writes:

OPG has maintained an effective nuclear safety program which has ensured safe reactor operations for several decades. The program is well guarded against degradation by OPG’s programmatic controls which not only monitor and measure its effectiveness, but seeks opportunities for improvement. OPG expects this level of nuclear safety program rigour will continue into future DGR operations.

As a conclusion to this IR response, OPG states:

OPG’s culture of safety, in its many forms, values the experience of the industry and continually seeks to learn and improve from it. This has been fundamental to OPG’s long history of high standards, performance and regulatory compliance in its nuclear operations. It is this deep rooted safety culture that OPG expects will continue to guide and develop the programs and processes for safe DGR construction and operations. There is still more to be learned from the experiences at WIPP and OPG remains committed under our current programs which assure they are valued and opportunities for improvement are sought. In summary, the DGR will be operated through a system of OPG governance including appropriate management systems, programs and plans, and subject to independent regulatory oversight. As demonstrated through its current reactor and waste facility operations, OPG has well developed programs in the areas of emergency management, safety culture, human performance, radiation protection, operations and maintenance.

Referencing their corporate “culture of safety” would generally not be considered to be a strong card when being played by Ontario Power Generation, particularly when stretched over time by statements of “several decades” and in reference to their nuclear program. In doing so, OPG is saying that an assessment of OPG’s reliability as an operator is linked to not only rather dubious performance record illustrated by

the above review of current operations via a review of S-99 reports for 2011 to 2013, but also to its earlier “decades” of nuclear operations, including as the predecessor organization Ontario Hydro.

If at any point Ontario Power Generation had a “safety culture” which they could lay claim to, certainly by the mid-1980’s this claim was bankrupt, as documented in numerous books, reports, and media coverage.

Given that this review is of a proposal by Ontario Power Generation to bury nuclear waste rather than to generate it (i.e. operate nuclear power reactors), our examination of the utility’s track record in operating its nuclear fleet will be limited, and is provided solely for the purpose of placing OPG’s claim to a “deep rooted safety culture” spanning “several decades” in an informed context.

The following excerpt from the June 2001 Interim Report of the Standing Senate Committee on Energy, the Environment and Natural Resources provides a summary review of the Ontario Hydro’s “safety culture” in the 1980s and 1990s:

Utilities that planned and built nuclear power stations three decades ago expected that they would operate safely for 40 years or more. However in 1997, Ontario Hydro, the forerunner to Ontario Power Generation (OPG), shut down its seven oldest reactors at an estimated cost of \$5 billion to \$8 billion. Simply put, the oldest plants had not been well maintained. They were performing at a minimally acceptable level – a rating that likely would have resulted in comparable stations in the United States being placed on the Nuclear Regulatory Commission’s watch list. According to Ontario Hydro’s chief executive officer of the day, management had lost its focus on safety and efficiency, and allowed a deterioration of standards.

Moreover, the Atomic Energy Control Board (AECB), the predecessor to the Canadian Nuclear Safety Commission (CNSC), had ordered Ontario Hydro to make a key safety improvement at Pickering Nuclear Generating Station A by the end of 1997. Unable to meet the deadline for an improved fast shutdown system for the reactors, Ontario Hydro took Pickering A out of service on December 31, 1997. The nuclear fuel was not removed...

Officials of the Canadian Nuclear Safety Commission told the committee at the outset that its role is to regulate nuclear power in a manner that does not pose "an unreasonable harm to health, safety, the environment and national security." The federal regulator is on record as not being fully satisfied with the present standard of

operation and maintenance at Canadian power reactors. A CNSC official told the Committee:

"I will say that the Atomic Energy Control Board is on record as being not fully satisfied with the present standard of operation and maintenance at Canadian power reactors. While we remain satisfied that the provisions for public safety, security, and environment are sufficient to allow operations in the short-term, we are determined that the Canadian safety philosophy of "defence-in-depth" not be eroded."

He further elaborated on this issue, commenting that: "We are not satisfied that the quality of operation and maintenance is adequate for the longer term -- which would be five to 10 years."

By 1997, the AECB was so concerned about the declining performance of Pickering Generating Stations A and B that it shortened the normal two-year term of the operating licence to six months. Four years earlier, the federal regulatory board had ordered that a second fast shutdown system be added to the Pickering A reactors by the end of December 1997. By November 1996 it was apparent that the deadline would not be met, and that dramatic action was needed to stop and to reverse the downward trend in performance and safety.

The president of Ontario Hydro called in experts from the U.S. to provide what he later described as a "brutally honest" assessment of their nuclear operations and to develop an improvement plan. The Committee heard testimony from Mr. Carl Andognini who headed the review team that prepared the Integrated Independent Performance Assessment (IIPA) and later served as Special Nuclear Advisor to the President of OPG. Mr. Andognini attributed the decline to the retirement of experienced staff, weak leadership, and decentralization of nuclear operations. More importantly, Mr. Andognini noted that "the organization (Ontario Hydro) never really shifted from a fantastic engineering and construction organization, to an operational and maintenance organization."

The IIPA report had concluded that:

"Long standing management, process and equipment problems in Ontario Hydro Nuclear plants are well known but have not been aggressively resolved. As a result, the overall performance of OHN is well below the level of performance typically achieved by the best nuclear utilities. Immediate attention is needed to improve performance so that the value of OHN's assets does not depreciate beyond recovery."³⁴

³⁴ "Canada's Nuclear Reactors: How Much Safety Is Enough?", Interim Report, The Standing Senate Committee on Energy, the Environment and Natural Resources, June 2001, as found at <http://www.parl.gc.ca/Content/SEN/Committee/371/energ/rep/repintjun01-e.htm>

Reports from major media outlets provide a complementary account, such as this 2004 report from the Toronto Star:

It took the board of Ontario Hydro a single afternoon in the summer of 1997 to consider and approve a \$1.6 billion plan to launch 66 projects that would supposedly fix Ontario's sputtering nuclear plants.

That plan, launched by then-newly hired executive vice-president Carl Andognini, continues to weigh down the financial performance of Ontario Hydro's successor, Ontario Power Generation...

When the plan to fix Ontario's nuclear plants was born in 1997, they were unquestionably in poor shape, with nuclear regulators even threatening to shut down some reactors.

Andognini, a U.S. nuclear expert, brought in a "Dream Team" of other U.S. nuclear consultants who set about diagnosing the problems at the reactors owned by Ontario Hydro inherited by its successor company Ontario Power Generation when Ontario Hydro was broken up in 1998.

The team's analysis was based on the experience of rehabilitating two under-performing reactors in the U.S. reactors that used a different technology than OPG's Candu reactors.

But only a cursory survey was done of the actual condition of the Ontario reactors. It turned out the plants were in much worse shape than the improvement plan had assumed. By mid-1998, the cost estimate had ballooned by \$600 million to \$2.2 billion...

Meanwhile, output from the nuclear reactors which was supposed to grow by 45 per cent over five years dropped 33 per cent.

When OPG began the task of bringing the mothballed Pickering A station back into service, the same problems reared their heads.

The project's costs originally thought to be under \$1 billion, then approved by the board at \$1.3 billion mounted steadily because of poor planning.

The latest estimate is that if OPG decides to complete the Pickering project now three years behind schedule and with only one of four reactors operating it could cost \$4 billion, or \$2.7 billion over the original approved budget.

The Dream Team also failed to tackle many problems they themselves had identified. A report released last year by current OPG chairman Jake Epp said the Andognini team had found in 1997 that managers weren't accountable for their actions, work goals were unclear, teamwork was poor and managers ignored subordinates.

In 2001, when Andognini and many of the team had left, all those problems remained unresolved.³⁵

³⁵ "OPG's viability is at risk: Review", Toronto Star, 2004

And in 2004 a report by the Hon. John Manley confirmed that the “culture” of OPG was still at odds with “safety”:

In sum, OPG looks, to people on the inside and outside, like a company that is neither well-run nor well-governed. It is not getting the value it could and should be getting from its assets – whether physical assets like generating plants, or the human capital of its workforce...

The Pickering A Review Panel cited work by external consultants that pointed to a serious lack of accountability throughout OPG. Many people do not appear willing to take responsibility for their poor performance.

On the other hand, some observers have noted that the company appears to have failed at times in its responsibility to give staff the training and systems needed to prevent mistakes. This may understandably have led to a culture in which avoiding blame is more important than admitting errors.³⁶

OPG’s claims of decades of being well-regarded for their safety culture compliance record are regrettably unfounded in reality. The similarities between the AIR accounts of poor governance and performance at WIPP are at points shockingly similar to reports of various reviews over the decades which have evaluated Ontario Hydro / Ontario Power Generation and also found the performance and governance to be sorely in need of improvement.

In summary, OPG’s response to IR 13-515 says so little because there is so little that OPG can say about the relevance of the WIPP accidents of February 2014 that would not be incriminating of their own operational challenges and history.

³⁶ Report “Transforming Ontario’s Power Generation Company”, March 2004, Hon. John Manley et al, as found online at http://www.cna.ca/wp-content/uploads/OPG_Review_complete_e.pdf, pages 2 and 16

5. Conclusions

Some may argue that this second hearing is providing OPG an opportunity to re-do a failed test – akin to allowing a Grade 12 science student to fail a term test the first time and then go back to the books, talk to their friends, and then try again. We have sympathy with this view. However, we accept the Joint Review Panel’s intent is to gather all the information they deem necessary in order to make their decisions on this proposal, and on that basis we very much support the Panel issuing the additional information requests and reconvening the hearing.

At this point in time, we believe that the conclusion of this extension of the review is clear: given more time and more opportunities to remake or restate their arguments in support of their burial proposal, Ontario Power Generation has succeeded only in demonstrating that the uncertainties persist, their technical case is incomplete, and the application remains so flawed that no approval can be granted.

Appendices

1. “Updated Review of Barriers”, prepared by Steve Frishman, July 2014
2. “Expansion plans for Ontario Power Generations Proposed Deep Geologic Repository Project and Implications for the Waste Inventory”, prepared by Pete Roche, Edinburgh Energy and Environment Consultancy, July 2014
3. “Recent Events at the Waste Isolation Pilot Plant (WIPP) and Initial Questions and Lessons for the Ontario Power Generation Proposed Deep Geologic Repository”, prepared by Don Hancock, Southwest Research and Information Centre, July 2014
4. “Gas Generation Pressures in the Proposed Repository Post-Closure Safety Case”, prepared by Professor Stuart Haszeldine, University of Edinburgh, July 2014