November 8, 2013

Ms. Laurie Swami
Vice-President Nuclear Services
Ontario Power Generation
<contact information removed>

Subject: Information Request Package #12 from the Joint Review Panel

Dear Ms. Swami:

As indicated by the Joint Review Panel at the end of the public hearing session on October 30, 2013, the Panel has determined that Ontario Power Generation must respond to a short but substantive list of questions. Responses to the information requests in the attached table are required. Please provide the proposed response date for each information request and the Panel will determine if they are acceptable.

The Panel is continuing with its detailed review of the information on the record to determine whether it has everything needed to carry out its mandate under the *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act*. On or prior to November 29, 2013, the Panel will determine whether it has further information requests for your response.

Any questions that you may have regarding the attached information requests or the process may be directed to either of the Panel Co-Managers, Kelly McGee at (613) 947-3710 or Debra Myles at (613) 957-0626.

Sincerely,

<original signed by>

Stella Swanson
Chair, Deep Geologic Repository Joint Review Panel

c.c.: James F. Archibald, Joint Review Panel Member
Gunter Muecke, Joint Review Panel Member

Frank King, Nuclear Waste Management Organization
Allan Webster, Ontario Power Generation

/Attachment

Attachment 1
Deep Geological Repository Project
Joint Review Panel EIS Information Requests
Package #12 – November 8, 2013

IR#	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 12-510	• Section 11.3 Significance of Residual Effects • Section 2.6 Study Strategy and Methodology	• *EIS*: Section 7, Effects Prediction, Mitigation Measures and Significance of Residual Effects	**Significance Determination for Residual Adverse Effects** Provide a detailed narrative to explain how the significance of each residual adverse effect on the biophysical environment (Geology, Hydrogeology and Surface Water, Terrestrial Environment, Aquatic Environment, Radiological Conditions, Air Quality, Noise and Vibrations) and on Aboriginal Interests was determined. Provide a separate narrative for each residual adverse effect. The narrative must explain the logic behind the significance determinations and is to use context-based reasoning. Arbitrary category limits for criteria such as magnitude are not required. Rather, the context for the predicted measurable change should be 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. If the social/ecological context of the adverse effect was also assessed, the rationale for this criterion must be explained. Defensibility is to be provided by references to the literature (peer-reviewed and "grey" literature). Sufficient information must be provided to allow a third party reviewer to understand how the conclusion was reached. The narratives provided in the Socio-Economic Assessment are sufficiently clear and do not require further elaboration.	In Dr. Duinker's hearing submission (PMD 13-P1.175), he expresses concerns about the lack of transparency of the decision trees and the apparent arbitrariness in professional judgement used to determine significance (pages 5-7 of the PMD). The determination of significance of adverse impacts is fundamental to the environmental assessment. Therefore, the rationale for the determination of significance must be credible, defensible, clear, reliable, and appropriate. Narrative Requirements: • Clear explanation of the "measurable change" leading to identification of adverse effect in terms of comparison pre and post-impact, and the assumed measurement error. Would the change be detectable using standard monitoring methods? Have similar changes occurred in the study area and would these changes be described as "measurable"? • Avoidance of arbitrary low/medium/high categorization in favour of narrative reasoning that is well supported by literature citations and examples from comparable projects. For example, the context for magnitude may include references to the toxicological literature, risk quotients, or population and community monitoring and modelling from comparable projects which have similar effects on the biophysical environment or upon Aboriginal interests. • Avoidance of the "may not be significant" determination. Instead, explain the level of confidence in each of the significance conclusions. The level of confidence must be explained in terms of the precautionary principle; i.e. the application of risk avoidance, adaptive management and preparation for surprise requirements associated with each significance determination. For example, if the assessment team judges that the consequences of being wrong about the significance of a particular effect are such that explicit monitoring, contingency planning, or further risk reduction measures are required, then these measures must be described in association with the significance result.

IR#	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 12-511	• Section 16 Follow-Up Program	▪ *EIS*: Section 9.4.6, Uncertainties ▪ *Geoscientific Verification Plan* (NWMO DGR-TR-2011-08)	**Geoscientific Verification Plan** 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. Verification activities that are outlined in NWMO DGR-TR-2011-08 are generally defined and lack substantive detail as to the procedures that would be used, spatial locations of testing and timing of testing. An example deficiency is provided in the following paragraph, with more details being provided in the Context section of this IR request. A primary GVP activity that is critical to final repository siting design is in-situ overcoring stress measurement that would be used to verify regional scale stress magnitude and orientation assumptions. These assumptions will be utilized to direct repository layout design in order to minimize induced stresses about rooms and access drifts, thereby maintaining least excavation rock disturbance and damage. In the GVP, stress measurement activities are planned only to take place at the location of the shaft bottom and within the Cobourg Formation, and are indicated to occur only during the initial construction interval at the time of shaft sinking. It is not indicated whether such stress measurement activity will take place within the Main Shaft and the Ventilation Shaft, or at only one site. Inasmuch as stress conditions can vary spatially over short distances, limited site testing within only one shaft, or both shafts, at the depth of the Cobourg Formation may provide insufficient data to accurately confirm previous stress orientation and magnitude assumptions that were made based on regional scale approximations. It is also indicated in the GVP that no similar testing will be conducted to assess spatial variation of in-situ stress conditions (orientation and magnitude) over the full lateral extent of the repository horizon as drifts and rooms are developed. Justification for this lack of extensive stress monitoring activity, which is critical to room layout design and necessary for modeling performance verification, must be provided.	A Geoscientific Site Characterization Plan was initiated by OPG in 2006 to obtain regional data on relevant aspects of geology, geomechanics, hydrogeology, geochemistry and seismicity in order to provide evidence that the hosting rock mass environment would provide strong geosphere barrier-in-depth capability to provide safe, long-term containment and isolation of the L&ILW within the DGR. In its EIS submission, OPG provided a GVP in which procedures and plans for additional geoscientific study, to take place during construction and operations phases of the DGR, were outlined to provide support for engineering design decisions and the long-term safety case assumptions. Additional detail is required to provide assurance of the integrity and long-term stability of the site-specific geosphere and engineered barriers to safely contain and isolate L&ILW. To date, geoscientific information has been obtained either from regional studies (including seismic surveys) or from quantities of core material recovered from a total of eight boreholes, of which six were developed to the depth of the planned repository horizon. Accordingly, OPG has proposed a series of planned geoscientific investigations that would be conducted during vertical and lateral development, and operation, of the DGR to verify sub-surface geosphere conditions. During shaft sinking and lateral development, one geoscientific activity to be conducted for additional information gathering will be geological mapping. In the described mapping process, “imaging” would be conducted and “rock mass characterization” will be used for geosphere data verification. The manner in which image mapping data will be used to infer geosphere properties, what properties will be determined, and the specific procedures and outputs of rock mass characterization, are not, however, defined. It is unclear how, for this activity, information gained will be used to address design decisions and safety case assumptions. Additionally, under the activity defined as in-situ geomechanical testing, upscaling of geomechanical properties of the rock at the repository level has been presented in Tables 2.1 and 2.3 of NWMO DGR-TR-201138. The procedures for field scale sample acquisition, sample testing and the rationale for determination of field scale versus previous laboratory-derived rock properties, at smaller scale, are not described in this document and thus provide little justification for such activity planning. The geosphere will be subject to considerable change as the construction process proceeds and development activity will influence the pre-existing geosphere environment. For this reason, verification activities that may be applied to measure geosphere environmental conditions and their influence on design aspects of the

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				DGR over the long term should also be evaluated and described. The proponent, in its GVP submission, has also not provided sufficient detail to confirm that best operational practices and testing methods have been considered for information gathering. By way of example, consideration is given to, but no justification provided for, use of the United States Bureau of Mines (U.S.B.M.) deformation gauge overcore technology (used for biaxial stress condition measurement in multiple, orthogonal boreholes) versus use of triaxial gauge overcore technology (used for three-dimensional stress condition measurement in single boreholes) to assess in-situ stress conditions. Site characterization studies to date have relied on examination of only a limited number of core sample tests from a few boreholes, only one of which has been sited within the spatial boundary and depth of the proposed repository. Geomechanical characterization of actual repository site conditions is thus extremely limited and will require more extensive evaluation. Planning for verification work, in terms of core retrieval activities both along the shafts and within lateral development sites, the spacing and depth of boreholes within which core recovery will take place, the size of boreholes to be drilled, the number of samples to be recovered at each site, the types (and justification) of characterization tests, the number of each type of test and the application of information gained in verification of initial design assumptions, is not well described nor defined. The proponent, in its hearing submissions, has stated that detailed information concerning testing procedures, as partially described in the preceding paragraphs, would be submitted for licensing approval immediately prior to the start of the shaft construction phase of the proposed DGR project, should the project proceed.
EIS 12-512	• Section 14 Cumulative Effects	▪ *EIS*: Section 10, Cumulative Effects	**DGR Expansion Plans** 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.	The cumulative effects analysis presented in the EIS lists the emplacement of decommissioning waste from the OPG-owned and operated nuclear generating stations (Pickering, Darlington and Bruce) into the DGR as a reasonably foreseeable activity. The Hosting Agreement with Kincardine includes provision for accepting decommissioning waste into an expanded DGR (EIS, Table 10.4-3, item 31). An approximate doubling of the underground capacity was envisioned from ~200,000 m^3 to ~400,000 m^3 (IR EIS-04-145). Since the finalization of the EIS in 2011, the earlier than anticipated planned decommissioning of the Pickering Nuclear Facility has triggered the expectation from OPG that the L&ILW from that site would be placed into the proposed DGR. During the hearing OPG referenced the existence of an expansion Technical Assessment (Hearing Transcript Volume 23: October 28, 2013, p.121, l. 21) which details initial plans for the expansion and its impact on the proposed DGR.

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EIS 12-513	• Section 7.3 Alternative Means of Carrying out the Project	▪ *EIS:* Section 3.4, Alternative Means of Carrying out the Project	**Alternative Means Risk Analysis** Provide a renewed and updated analysis of the relative risks of siting alternatives under alternative means requirements of the EIS Guidelines. This analysis should be undertaken by independent risk assessment experts. The analysis is to be qualitative, transparent, defensible, and repeatable. Options to be analyzed: 1. "As is" facility at the WWMF (the status quo) 2. Enhanced surface storage at the WWMF (“hardened” storage) 3. Proposed DGR in the Cobourg Formation at the Bruce Power site 4. A conceptual DGR in granitic bedrock of the Precambrian Canadian Shield. Information required for the qualitative analysis of a conceptual DGR in granite bedrock should be based primarily upon the extensive data and analyses available within the environmental assessment performed by Atomic Energy of Canada Limited (AECL) for the Environmental Assessment Panel for Nuclear Fuel Waste Management and Disposal Concept (known as the Seaborne Panel). Analysis of risks to socio-economic factors (such as physical, social and financial assets) is not required because the conceptual DGR in granite is not located in a specific geographic location. The relative risk of each alternative should be assessed for normal operations and for selected accidents, malfunctions and malevolent acts. The accidents, malfunctions and malevolent acts that were assessed in the EIS can be used for the risk analysis. Effects of the environment on relative risk must also be included; specifically, the relative risk associated with severe weather events – particularly under climate change scenarios. The relative risk analysis should include the following: • Worker Health and Safety: construction, operation and decommissioning • Public Health and Safety: construction, operation,	The analysis of alternative sites in Section 3.4.2 of the EIS was limited to locations within the Bruce Nuclear site and a very generic “off the Bruce nuclear site” location. The comparison of alternatives in the assessment was based upon a simple binary scoring system that involved a significant amount of professional judgment. The rationale for the scores assigned to the alternatives was not presented in the EIS. 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. 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. 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. Recent experience shows that without a willing host municipality the siting of a deep geologic repository for nuclear waste is not feasible.”

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			decommissioning and post-closure • Risks to Safety Case: o advective water flow around and through the facility o gas generation o physical disruption ▪ seismic ▪ structural failures ▪ major fracturing o chemical/physical degradation of waste containers (assuming containers are as described in the EIS and further described in IR responses and during the Hearing) ▪ seepage ▪ release rates ▪ microbial activity o transport of released radionuclides ▪ sources ▪ travel times to nearest receptor (radionuclides and other constituents of concern such as metals) · near-field and far-field risks (including Lake Huron) ▪ air emissions · sources · near-field and far-field risks (including Lake Huron) o waste transportation to and on the site o requirement for institutional controls, short and long term ▪ passive and active o contribution to sustainability ▪ add the conceptual granite bedrock location to the results of Table 1 in the OPG response to IR EIS-06-273 and Table 1 of OPG response to IR EIS-06-278 o community acceptance ▪ in the Local and Regional Study Area ▪ Outside of the Regional Study Area	