February 8, 2013

Mr. Albert Sweetnam
Executive Vice President
Deep Geologic Repository Project
Ontario Power Generation
700 University Avenue
Toronto, ON M5G 1X6

Subject: Information Request Package #9 from the Deep Geologic Repository Joint Review Panel

Dear Mr. Sweetnam,

In the attached documents, please find information requests from the Deep Geologic Repository Joint Review Panel (the Panel). The Panel has determined that responses to these information requests are required to ensure that the available information adequately responds to the Environmental Impact Statement (EIS) Guidelines issued for the project. As always, the Panel requests that the responses are provided in a complete and timely manner and follow the numbering system and framework as set out in the attached document.

As the Panel Members are approaching the end of their own review of the EIS, documents in support of the licence application and supplementary information, we expect IR Package #9 to be the last of the large information request packages that we provide to Ontario Power Generation. We will, of course, submit additional information requests to you as necessary through to the completion of our own analysis and our ongoing consideration of the submissions received in relation to the review.

If you require clarification with regard to these requests, do not hesitate to contact either of the Panel's Co-Managers. The Panel would appreciate receiving confirmation with respect to the anticipated date of your responses as soon as possible.

Sincerely,

<original signed by>

Dr. Stella Swanson
Chair, 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

/Attachments

Attachment 1
Deep Geological Repository Project
Joint Review Panel EIS Information Requests
Package 9 - February 8, 2013

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-401	• Section 2.5 precautionary approach • Section 8.7 Accidents, malfunctions and malevolent acts • Section 12 Accidents, malfunctions and malevolent acts	• *EIS:* Section 4.13.3, Malevolent Acts • OPG response to IR EIS-05-195 (CEARIS #793)	Provide a report of incidents that have occurred in the past operational history at the Bruce Nuclear site involving threats, theft and other malevolent acts.	The response to EIS 05-195 is incomplete. Further justification for the statement "…no potential to impact facility safety…" is required. The provision of past incident reports would add credibility to the above statement.
EIS 09-402	• Section 11.4.7, Atmosphere	• *Preliminary Safety Report:* Section 6.3.8.1, Ventilation System and Operation • *EIS:* Section 8.3.2, Potential Effects • OPG response to IR EIS-04-135 (CEARIS #759)	Provide the rationale in support of the selection of the two accident scenarios for comparison of emissions with and without HEPA filters (i.e. In Room Unshielded Waste Package Fire and Cage Fall). Explain how these two scenarios represent an adequately conservative evaluation of the full range of particulate and aerosol emissions and, thus, a fair and reasonable evaluation of the net benefit (to public safety) versus net risks (to worker safety) of HEPA filtration.	The response to EIS-04-135 does not include an explanation of how the two accident scenarios were selected for comparison of impacts with and without HEPA filters. The argument presented in the response appears to be that there is little to no net benefit to public safety and a possible increase in risk to workers. The basis for this risk-based conclusion requires further elaboration and clarity.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-403	• Section 8.2, Site Preparation and Construction	• *EIS*: Section 8.3.3, Preventive Measures, Contingency Plans and Emergency Procedures • Section 4.4.2.2, Underground Service Area • Section 4.7.4.1 Shaft Excavation • Section 4.7.5.2 Hazardous Materials • *Preliminary Safety Report*: Section 6, Figure 6-20 *Atmospheric Environment TSD*: Appendix I, Vibrations Assessment • OPR response to IR EIS-01-02 (CEARIS #363)	Provide an assessment of space and security requirements for above ground and underground explosives storage facilities that will address, at a minimum: • quantities of explosives to be stored on surface and underground over various time frames (daily, weekly or longer). • descriptions of explosives magazine and detonator/cap storage container physical features (such as size and construction materials to be used), siting locations and safety features necessary to prevent inadvertent intrusion; and • discussion of the impacts of potential losses of or damage to explosive material in storage, transport or handling during the interval between DGR site delivery and underground excavation development, and how damaged or unused explosive materials will be safely disposed. Describe how the control and safe handling of explosives will be integrated into Emergency Management (EM) or emergency procedure plans for conventional risk management at the Bruce nuclear site under OPG's Nuclear Waste Management Division Environment Health and Safety Program.	The response to EIS-01-02 is incomplete, lacks detail concerning anticipated volumes or mass quantities to be stored on a regular basis in order to accomplish stated operational goals, and neglects any assessment of potential hazard consequences or impacts associated with explosives storage.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-404	• Section 13, Long Term Safety of the DGR • Section 13.4, Confidence in Mathematical Models	• *EIS:* Section 9.4, Assessment Results and Comparison with Acceptance Criteria • *T2GGM Version 2*: Gas Generation and Transport Code • *Postclosure Safety Assessment*: Gas Modeling Report	Provide a proton mass balance in the repository by considering not only the waste inventory but also the presence of carbonate and sulfides in the repository rock wall. Discuss the implications of sulfide and carbonate dissolution from the repository walls along with the generation of sulfides from the waste in limiting methanogenesis, which could lead to higher pressure in the repository. In the context of higher pressure, discuss the possibility of H2, CO2 and CH4 becoming supercritical fluids during the post-closure period. Discuss the implications of the possible presence of supercritical fluids on the contaminant source term in the repository and subsequent migration out of the repository.	Hydrogen and carbon dioxide gases can be generated in the repository from the corrosion of steel and degradation of cellulosic and plastic materials. Subsequently, one molecule of methane and two molecules of water are formed by the reaction of one molecule of carbon dioxide and four molecules of hydrogen gas. These microbial mediated reactions require water which is present within the waste, particularly in resins. Methanogenesis (the formation of methane by microbes that produce methane as a metabolic byproduct in zero oxygen conditions) will limit the gas pressure build-up into the repository by consuming one molecule of carbon dioxide and four molecules of hydrogen. However, the presence of sulfides and carbonate in the rock wall along with the presence of sulphate and water in the waste could lead to hydrogen sulphide levels that may restrict methanogenesis and increase the concentration of carbon dioxide and hydrogen gas leading to higher pressures in the repository. Temperature and pressure within the repository will affect whether hydrogen, carbon dioxide and methane will be present as a gas, a liquid or a supercritical fluid. Past their critical points of temperature and pressure (i.e., CH_4 -82°C, 4.6MPa; H_2 -240°C 1.3MPa; CO_2 31°C 7.3MPa), gas can become supercritical fluid. These temperatures and pressure are plausible scenarios for the proposed repository. The current gas generation model approximates the behaviour of the gases using the equation of state for ideal gas. Supercritical fluids behaviour can deviate substantially from an ideal gas, and thus may significantly impact the release rates from the inventory at some time into the future. Additionally, the migration behaviour of supercritical fluids in the geosphere will also be different from an ideal gas. OPG calculated that the main gas to be generated would be

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
				methane, with some hydrogen and carbon dioxide. In order to calculate the types, amount and pressure of the gases generated, OPG uses the GGM model for gas generation and the TOUGH2 model for gas transport. In these models, the gases are assumed to behave as ideal gases. In addition, the presence of sulfides and carbonates on the repository rock walls was not taken into account. CNSC staff have recommended that the above two assumptions be justified, because of the following potential implications on long term contaminant release from the repository: The anticipated pressures at a predicted temperature of 22°C in the repository could exceed the supercritical point of H_2, CH_4.and perhaps CO_2 if the temperature in the repository reaches 31°C. The gases in that case become supercritical fluid, and their behavior would deviate substantially from an ideal gas. This may in turn impact the release rates from the inventory at some time into the future. Additionally, the migration behavior of supercritical fluids in the geosphere will also be different from an ideal gas.
EIS 09-405	• Section 11.5.6, Worker Health and Safety • Section 12, Malfunctions and Accidents	• *EIS:* Section 8.0, Malfunctions, Accidents and Malevolent Acts • *Preliminary ALARA Assessment:* Section 3.0	Assess the likelihood of pressure buildup and/or corrosion-induced container failure leading to gas releases and any potential consequences on worker exposures during operation of the proposed repository. Provide an evaluation of the use of container venting to prevent pressure-induced container failure in cases where high gas buildups may be anticipated.	In general, OPG predicts that the repository will remain relatively dry, which will impede microbial gas generation during the post-closure. Although it is likely that the repository will remain dry because of the tightness of the surrounding rock wall, it remains that in some wastes such as resins, water content ranges from 40 to 50%, which means that there is potential for gas generation through corrosion and oxidation of cellulosic material. These two microbial-mediated processes could lead to gas pressure build-up and container failure and expose workers to radioactive gas.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-406	• Section 8.1, General Information and Design Description	• *EIS Summary:* Waste Volumes, page 10-11 • OPG response to IR EIS-04-104 (CEAR #704)	Provide a detailed explanation of how air emissions from the incinerator operated by the WWMF under its current CNSC operating licence and Certificate of Approval from Ontario MOE were included in the baseline emissions used in the modelling of DGR air emissions. Include a discussion of the relative contribution of incinerator emissions to the baseline and compare incinerator emissions to the incremental emissions predicted from the DGR.	The response to EIS 04-104 did not provide the requested information on the potential effects of current air emissions from the incinerator operated by the WWMF.
EIS 09-407	• Section 7.3, Alternative Means of Carrying out the Project	• *EIS:* Section 3.4, Alternative Means of Carrying out the Project • OPG response to IR EIS-03-49 (CEARIS #608)	Provide a clear and complete explanation for the reasoning behind the scoring for each criterion used to evaluate alternative means.	The explanation of the scoring system in the response to EIS 03-49 is not adequate. Since professional judgement was a major component of the scoring exercise, transparency with respect to how each criterion was scored is necessary.
EIS 09-408	• Section 11.4.9, Effects of the Environment on the Project	• Modelling TIS, July 18, 2012 • Modelling TIS, July 18, 2012 (Undertaking #7)	Provide information on the possibility that flow in the aquifers below 200 metres will be influenced by climate change during the repository postclosure period.	Undertaking # 7 from the July 18, 2012 Technical Information Session requested that OPG provide information on the possibility that flow in the aquifers below 200 metres will be influenced by climate change. The implication of "climate change" applies for both the short term (for intervals of decades until the end of the preclosure period) and the long term (for postclosure intervals of several hundred to thousands of years). The response provided by OPG addresses only the effects of climate change on potential aquifer flow alteration during the preclosure period of the repository operation and provides no longer term assessment of climate change effects.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-409	• Section 8.1, General Information and Design Description	• *EIS*: Section 3.4, Alternative Means of Carrying Out the Project • *PSR:* Section. 6.2.2.1, Ventilation Shaft Headframe and Collar House • *OPG response to IR EIS*-04-117 (CEARIS #704)	Provide justification for assigning the transfer of waste packages to the shaft providing the intake air for the repository. Consider the alternative option of using the exhaust ventilation shaft for waste package transfer while leaving all other transfers in the other shaft.	The response to EIS 04-117 is incomplete. In the current concept the ventilation shaft, apart from exhausting the repository ventilation air, is primarily used during construction to remove waste rock generated during repository construction. Alternatively, this shaft could also be used to transfer waste packages to the repository during the operational phase. This would have the advantage that, in the event of a possible accident involving the transfer and breach of a waste package or a cage fall, the contaminated air would not be drawn into the repository. The latter concept is being implemented at the Konrad Mine repository in Germany,
EIS 09-410	• Section, 13.2 Selection of Assessment Scenarios	• *Post Closure Safety Assessment TSD*: Table 3.5: Confidence Building Measures and Attributes, page 23) • OPG response to IR EIS-04-117, CEARIS #704	Supplement the response to EIS 04-117 and provide additional detail as originally requested, including but not limited to: • Use and type of backfill; • Safety features; • Development technique; and • Community Engagement and Acceptance.	The level of detail provided in CNSC Memorandum 2.05/37-2-6-0 (CEARIS # 521) is not sufficient to provide the JRP with an adequate and meaningful comparison with other international L&ILW repositories.
EIS 09-411	• Section 2.5, Precautionary Approach • Section 16, Follow-up	• *EIS*: Section 12, Follow-up Monitoring Program • *DGR EA Follow-up Monitoring*	Explain how each contingency measure currently planned for the DGR Project either does or does not incorporate risk avoidance. Provide a detailed description of the planned annual assessment of the EA follow-up monitoring program, including the criteria to be used for identification of problems or gaps	The response to EIS 06-276 repeats generic guidance from CEAA and then reiterates the commitment to use adaptive management; however, no details are provided. There is a vague reference to risk avoidance for “some of the contingency procedures” described (also in a very cursory manner) in Chapter 13. The Program Assessment in Chapter

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
	Program	*Program TSD*: Chapter 13 Contingency Procedures • *DGR EA Follow-up Monitoring Program TSD*: Chapter 16 Program Assessment • *OPG response to IR EIS-06-276 (CEARIS #833)*	and the methods for developing triggers that would indicate the requirement for management action. If triggers have already been developed, provide them, along with the rationale that explains them. Provide the overall adaptive management plan and describe how it incorporates the design-implement-monitor-assess-respond cycle. Provide the critical assumptions used in the design of the follow-up monitoring program that ensure that the program will provide timely and effective feedback to the adaptive management cycle.	16 is very brief, with no specifics, even at a conceptual level, regarding how the assessment would ensure that the follow-up monitoring program would, in fact, contribute in a timely and effective manner, to adaptive management of the proposed DGR.
EIS 09-412	• Section 7.3, Alternative Means of Carrying out the Project	• *EIS*: Section 4.12 Abandonment and Long-Term Performance Phase, • *Postclosure Safety Assessment*: Section 3.8, Timeframes of Interest • OPG response to IR EIS-05-194 (CEARIS #776)	Provide the reasons, research, and justifications that have led SKB to adopt a 300-year period of institutional control after closure for a deep geologic repository. Explain why OPG has adopted the same reasoning. Provide evidence that the 300-year period of institutional control has been accepted by Swedish regulators and environmental agencies.	The OPG response to EIS-05-194 part (c) cites five other countries regarding the time-frame for institutional controls after closure of their repositories: 1. Sweden (SKB) has assumed a period of 300 years 2. WIPP proposes active control for at least 100 years after decommissioning 3. Finland has "precluded for 200 years at the most by means of land use restrictions and other passive controls." 4. France has taken the position for a surface facility (not relevant for the DGR) 5. Switzerland did not formally state a position Of the five, only Sweden has stipulated a 300 year time frame of institutional control for a geologic repository.
EIS 09-413	• Section 16, Follow-up	• *EIS*: Section 12.2, Initial Scope of	Provide a hydrologic study which explains the existence of the wetlands close to the boundary of the DGR site. This study should include the collected water level data, maps of water	An evaluation of the possible impact of DGR activities on the wetlands located near its borders requires an adequate understanding of their hydrology, including explanations for

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
	Program	the Follow-Up Program • *DGR EA Follow-up Monitoring Program TSD* • OPG response to IR EIS-05-173 (CEARIS # 793)	collection areas, water budgets for each wetland area, and any changes to the collection area due to DGR activities. Provide details of the follow-up monitoring programs planned for the wetlands.	why they have formed at these locations, how water levels are maintained and what the seasonal changes are. OPG's response to EIS-05-173 states “continued monitoring of water levels in the wetland and in the bedrock aquifer are planned as described in the DGR EA Follow-up Monitoring Program (NWMO 2011b)". Wetland monitoring does not appear to be mentioned in the Follow-up Monitoring Program.
EIS 09-414	• Section 11.4.1, Geology and Geomorphology	• *Outcrop Fracture Mapping Report* : Section 3.2.1,Joints	Although the presence of shearing with horizontal offsets along natural fractures in the stratigraphic column at the DGR site is not common, it does affect predictions about the integrity of the repository and its cap since it implies movement within the rock mass at some stage in its history. Provide evidence on the timing of this motion and an evaluation of its effects on the geomechanical integrity of the cap rock and repository. Provide the criteria used to conclude that joints in the deep boreholes lack measurable offset when most of the fractures are subvertical and the holes are vertical or steeply inclined	The natural fractures in the bedrock of the DGR site are characterized as joints and veins. Surface mapping (Outcrop Fracture Mapping Report, page 13) of these features shows that some of these features "display horizontal offsets of intersecting fractures. Horizontal offsets range from 2 mm to 15 cm." The same report records: "Contemporaneous, mutually cross-cutting joint sets with dihedral angles between 10° and 50° are considered to be conjugate hybrid joints, which are thought to form by shear failure under transitional-tensile conditions (Hancock 1985). However, this interpretation is disputed by some authors (Engelder 1999)." (page11)
EIS 09-415	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *PSR:* Section 4.1.2.1, Stratigraphy	Provide criteria (other than indirect evidence of selective salt dissolution) that were used to eliminate the possibility of tectonic origins of the brecciated and extensively fractured horizons in the deep drill cores.	The Amherstburg Formation is described as extensively fractured and vuggy. In the Salina Group brecciation is evident in the middle and lower part. (PSR page. 87 & 89). Both of these features are frequently associated with faulting.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-416	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *EIS:* Section 6.2.6.2, Predictability of the Ordovician Sedimentary Rocks and Lithofacies Analysis • *PSR:* Section 4.1.2.1, Stratigraphy	Provide an analysis of the scale and nature of microfacies and sequence stratigraphic variability (beds, bed-sets, parasequences) within the cap rock stratigraphic sequence of the DGR and quantitatively re-evaluate stratigraphic continuity in this interval..	The information provided in the EIS and PSR leaves considerable uncertainty about the scale and degree of sedimentological and stratigraphic continuity within the shale-dominated succession forming the 200m cap over the repository. Whereas two marker beds demonstrate site-scale continuity (by definition), the continuity of intervening sequences is much less certain. The accurate prediction of the lithologic composition of the rock mass over the site area, both vertically and horizontally, is of crucial importance. Only when correct lithologies have been determined can the appropriate geophysical, geomechanical, and hydrogeological parameters be assigned to units. The EIS and PSR rely on lithofacies analysis on the Upper Ordovician (cap rock) and on Middle Ordovician (repository) stratigraphic intervals to provide evidence on strata continuity. In the oil/gas industry such correlations are now usually done using sequence stratigraphic principles based on depositional environment models. The enhanced predictability achieved by this approach is generally accepted. Fine-grained organic carbon-rich sedimentary successions are being intensively studied because of their shale gas potential. It has been found that they are much more variable than most researchers had previously assumed and that the variability present is apt to be predictable using sequence stratigraphic principles. This arises because even in mud-dominated successions differences in relative sea level likely control grain size, mineralogical composition, organic matter content and subsequent diagenesis. Marker beds, by definition, are laterally continuous over considerable distances. However, their continuity by no means guarantees the continuity of the intervening beds.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-417	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• PSR: Section 3.2.2, Descriptive Hydrogeological Site Model	Provide the quantitative basis for the assertion that measured permeability is overestimated by a "factor of 10 to 100 for Ordovician limestones and 100 to 1000 for Ordovician shales." Provide information of the influence of stress relief on: a) measured effective diffusion coefficients b) any other physical parameter that may be affected	Laboratory tests of DGR core samples from the Ordovician limestones and shales are strongly influenced by the irrecoverable damage to the cores due to stress relief and microcrack formation. Page 63 of the PSR states: "For permeability this results in overestimates by a factor of 10 to 100 for Ordovician limestones and 100 to 1000 for Ordovician shales." Other properties measured on such core samples may also be expected to have been influenced by stress relief.
EIS 09-418	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *PSR*: Section 3.2.1, Descriptive Geological Site Model • *Descriptive Geosphere Site Model Report):* Section 3.12.2, Fracture Occurrence and Orientation	Provide a probabilistic analysis that relates observed fracture frequency/density in the drill holes to their absolute abundance in the rock mass (i.e., fractures per cubic metre) and quantify the associated uncertainties. Elaborate on the use of "Terzaghi correction" on contoured equal-area polar plots of fractures (Descriptive Geosphere Site Model TSD, Section 3.12.2).	The natural fracture frequency observed in the deep boreholes is used to reach the conclusion that " the deeper Silurian formations and the Ordovician shales and limestones (including the DGR host formation, the Cobourg Formation limestone) are very sparsely fractured to unfractured" (PSR, page 61). The validity of this conclusion is dependent on the probability that a borehole will intercept a fracture, taking into account the inclination of the fracture and that of the borehole. Also, fracture frequency in the boreholes is a relative measure and does not characterize the 3D properties of the rock mass. Fractures (joints) occur in sets of discrete orientation and inclination, not in random distributions. Therefore, even an inclined borehole may have a low probability of intersecting a subvertical set.
EIS 09-419	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *PSR:* Section 4.1.2.2, Predictability of the Ordovician Sedimentary Rocks	Explain why pyrite is considered a trace component in the Paleozoic rocks (< 2%) when semi-quantitative XRD analyses record values sometimes well above 2%. Provide the definitions of trace, minor, and major components used in all mineralogical, geochemical & petrological studies.	On page 98 of the PSR it is stated "Sphalerite (Lucas and Georgian Bay formations), marcasite (Kirkfield Formation and Cambrian), and **pyrite** (entire Paleozoic interval) are present in trace amounts within the host rock and secondary vein infillings." Semi-quantitative XRD analyses from the Georgian Bay and

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
		• Mineralogy and Geochemistry of DGR-4 Core		Blue Mountain formations commonly record values > 2%. E.g., samples DGR4-627.38 & DGR4-638.49 with 7.6 % pyrite (NWMO TR-08-23)
EIS 09-420	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *Descriptive Geosphere Site Model Report*	Provide quantitative information on how the geomechanical properties of core intervals that show disking vary from those tested. Explain how the derivation of average properties (e.g., Uniaxial Compressive Strength) of the cap rock units takes account of selective sampling arising from the avoidance of intervals showing disking.	Disking of the drill core is commonly recorded in the drill logs of the Upper Ordovician shale-dominated sequence and influenced core selection for geomechanical tests. For example, "Core samples of the Blue Mountain Formation exhibited significant disking of core following core retrieval and during core logging, photography and sample shipment to the testing laboratory." This sample disturbance resulted in several cores being unsuitable for testing upon examination at the laboratory and likely influenced the representativeness of the core rock strengths determined from laboratory testing for the Blue Mountain Formation." (Descriptive Geosphere Site Model Report page 350)
EIS 09-421	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *PSR:* Section4.1.2.3, Site-Scale Structural Geology • *Descriptive Geosphere Site Model Report:* Section 3.11.4, Inclined Faults	Explain the apparent contradiction that faults propagating through the Upper Ordovician cap rock seal do not breach it.	Section 3.11.4 of the Descriptive Geosphere Site Model Report notes:,: "...interpreted occurrence of two steeply east-dipping faults that propagate upward from the Precambrian to near the top of the Queenston Formation shale." In the PSR it is repeatedly stated that the interpreted faults have not breached the Upper Ordovician cap rock seal (e.g., PSR, Section 4.1.2.3 page107). "No seismically imaged faults are interpreted to have breached the Upper Ordovician shale-dominated sedimentary package."
EIS 09-422	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1,	• *PSR:* Section 4.2.2, Geomechanical Properties: Rock	Explain why samples of the Blue Mountain Formation were not tested more extensively for geomechanical properties and why lithofacies in the formation were not analysed. Since this formation is part of the cap rock seal, explain how the absence	To determine the strength of the cap rock only the geomechanical properties of samples from the Queenston and Georgian Bay formations were considered (PSR Section 4.2.2).

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
	Geology and Geomorphology	Strength and Deformation	of such data will affect predictions of the long-term evolution and integrity of the repository.	Similarly, lithofacies analysis of the cap rock excludes the Blue Mountain Formation.
EIS 09-423	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• PSR: Figures 4-34 & 4-36 • *Descriptive Geosphere Site Model Report*	Provide reasons why ten samples were not considered to be representative of pore water chemistry. Provide plots of pore water Total Dissolved Solids (TDS) and major ion concentrations that do not exclude samples "not considered representative of porewater chemistry and were not plotted in order to preserve resolution of data trends with depth." State whether these samples have been excluded from other plots, and, if so, indicate from which. State whether these samples have also been excluded from estimates of hydrogeologic properties of Bruce Nuclear Site hydrostratigraphic units. (Descriptive Geosphere Site Model Report, Table 4.17)	Pore water analyses are presented in profiles of TDS and major dissolved ion concentrations versus depth (e.g., PSR Figure. 4-34, 4-36 etc.). Page 214 of the Descriptive Geosphere Site Model Report states that the data set has been filtered to exclude samples with very high concentrations of Na, Cl and TDS that are suspected to be affected by halite dissolution. Furthermore, it is stated that "Porewater concentrations from sample DGR3-539.46 (Georgian Bay Formation) and ten samples from DGR-5 and DGR-6 (Pore Water Analysis in DGR 5 and DGR 6 Core Report) collected mostly from Silurian dolostones, were not considered representative of porewater chemistry and were not plotted in order to preserve resolution of data trends with depth."
EIS 09-424	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *PSR:* Section 4.3.2.3, Gas Characterization: Methane and Carbon Dioxide	Clarify how the discrimination diagram (PSR, Figure 4-41) of carbon and hydrogen isotopes demonstrates the origin of methane in the Cobourg Formation.	The assessment of the potential for future human intrusion relies upon the absence of processes leading to the creation of oil or gas deposits. The origin of methane in the Ordovician formations based on stable isotope data is discussed on p. 146 of the PSR. Figure 4-41, a discrimination diagram, is said to show that methane in the Middle Ordovician carbonate rocks is of thermogenic origin. In the diagram, the Cobourg Formation is grouped with the Blue Mountain and Georgian Bay formations. None of the values in this group appear to plot in the thermogenic region, but most fall into the biogenic region.
EIS 09-425	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1,	• *PSR:* Section 4.3.2.4, Solute Transport Mechanisms:	Justify the statement on Page.152 of the PSR, that "with the exception of just a few samples from the Upper Silurian, the De values measured from DGR drill cores are all less than 10^{-12} m^2/s" when ~30% of the points plotted on PSR Figure 4-45	The direction of diffusion is of considerable importance for modelling contaminant migration. 30% appears to be more than "just a few."

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
	Geology and Geomorphology	Evidence for Diffusion	appear to lie above 10^{-12} m^2 /s. Provide measures of reliability for the methods used to determine diffusion coefficients (sample duplicates, measurement errors). Clarify whether measurements parallel to bedding have the same reliability as those vertical to the bedding.	
EIS 09-426	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *Hydrogeologic Modelling TSD:* Section 2.2, The Geological Framework Model	A rationale for grouping the Collingwood with the Blue Mountain Formation is provided. Explain why the Georgian Bay and Blue Mountain formations are also grouped together. Explain how spatially averaging properties of the three formations will affect model outcomes and why these can then be considered to be conservative.	The shale-dominated Ordovician sequence overlying the repository is one of the primary barriers to contaminant release. Differences in lithology, chemical and physical properties, and structures of the formations in this group will affect the integrity of the shale rock cap. In the 3DGF model (and models using its output) three formations in this sequence are treated a single unit. Hydrogeologic Modelling TSD sec 2.2: "...the Georgian Bay, Blue Mountain and Collingwood were combined as the Collingwood was commonly not individually logged and more likely to have been logged as part of the Blue Mountain Formation shales." Grouped in this fashion, the resulting layer is by far the thickest uniform layer among the model layers.
EIS 09-427	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *EIS:* Section 6.2.6.3 Natural Resources: Oil and Gas • OPG response to IR EIS-02-38, CEARIS # 523	Explain the discrepancy of fluid inclusion temperatures cited for fracture-filling minerals. Provide the laboratory reports with the analytical results that were used to provide the responses to EIS 05-164 and EIS 02-38. Evaluate the impact of elevated temperatures from hydrothermal fluids on the generation of oil/gas in the DGR stratigraphic sequence.	The paleo-thermal regime of the DGR site is critical in determining the potential gas and oil generation in the sedimentary rocks. In the response to EIS-05-164 it is stated "preliminary fluid inclusion analyses indicate a hydrothermal (~70°C) origin for the fracture calcite." The response to EIS-02-38 states "inclusions exhibiting a wide range of high temperatures (ca. 80 to > 300°C)."

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-428	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *EIS:* Section 6.2.6.2, Site Study Area: Fracture Filling and Halite Occurrence • OPG response to IR EIS-02-37, CEARIS # 523	Provide the report(s), referenced in the response to EIS-02-37, on the radiometric age dating of fracture-filling mineral phases from the DGR deep holes.	The presence of fracture infilling by minerals, such as calcite, in the rocks capping the DGR site suggests that diffusion-dominated mass transport has not necessarily been the only solute transport mechanism in its geologic history. Absolute radiometric age dating on the mineral phases in the fractures are required to evaluate the time period over which other mass transport modes may have been operative (e.g., hydrothermal) The response to EIS-02-37 indicates such studies are in progress.
EIS 09-429	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *Geosynthesis TSD*: Section 7.2.2, Cap Rock Upper Ordovician Shales • *Hydrogeologic Modelling TSD*: Section 7.4, Confidence Assessment of the Hydrogeological Modelling Analyses	Provide an explanation for the contradictory statements in the Geosynthesis and Hydrogeologic Modelling reports regarding the level of understanding of the origin of under-pressures in the Ordovician sediments and the confidence associated with this understanding..	In the Geosynthesis report (p.371) it is stated that "the genesis of the Ordovician underpressures is ambiguous." In section 7.4, Confidence Assessment of the Hydrogeological Modelling Analyses of the Hydrogeologic Modelling Report, it is stated that "under-pressures were measured in the Ordovician sediments at the DGR boreholes. There is high confidence that these under-pressures are not caused by glaciation and deglaciation. There is high confidence that an immiscible gas phase and the physics of multi-phase fluid flow can result in under-pressures."
EIS 09-430	• Section 12, Accidents, Malfunctions and Malevolent Acts	• *EIS:* Section 8.2, Radiological Malfunctions and Accidents • Section 8.2.1.3, Potential Effects	Provide details of exposure and mitigation measures for members of the public in the accidents and malfunctions section.	Health Canada has noted that it is not clear why the 1 hour exposure period for a member of the public is considered appropriate. The EIS states that it is not likely that a member of the public will be exposed for more than 1 hour in the event of an accident and/or malfunction, however no information and/or discussion was provided to support this exposure level

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
				assumption. In addition, no mitigation measures (such as evacuation or long-term relocation) were provided.
EIS 09-431	• Section 10.1.6, Ambient Radioactivity • Section 5, Description of the Existing Environment	• *Radiation and Radioactivity TSD:* Section 5, Description of the Existing Environment • Table 5.12-1: Summary of Existing Radiation and Radioactivity	Revise the dose for non-Nuclear Energy Workers (NEWs) to the recalculated correct value.	The TSD states that for non-NEWs the current doses do not exceed 100 µSv/a. However, the highest dose rate measured at the perimeter fences was 0.16 µSv/h. Using the proponent's assumed exposure time for non-NEWs of 2,000 hours per year, this works out to a dose of 320 µSv/a. Although still less than the dose limit for non-NEWs of 1 mSv/a (1,000 µSv/a), it is not less than 100 µSv/a as stated.
EIS 09-432	• Section 11.4.8, Noise and Vibration	• *Atmospheric Environment TSD:* Appendix J, page J-10 • *OPG response to IR EIS*-06-255 (CEARIS #823)	In calculating %HA as per CSA (2005) adjustments are additive unless they pertain to the same type of adjustment in which case the highest applicable adjustment is used. The following clause explains this: *"If more than one adjustment applies for the source type or character of a given single sound source, only the largest adjustment shall be applied. However, time period adjustments are always added to the otherwise adjusted levels."* Add the nighttime adjustment used in calculating DNL to any other applicable adjustment (not limited to a potential 10dB adjustment for a quiet rural area).	Health Canada has suggested that the response to EIS-06-255 contains an incorrect interpretation of CSA (2005)
EIS 09-433	• Section 10.1, Biophysical Environment • Section 10.1.6, Ambient Radioactivity	• *EIS*: Section 6.6.6.1 Radioactivity in Surface Water, pages 6-148 and 6-147	Resubmission of EIS 05-210, Part b: Provide an explanation for why other radionuclides were not measured in the sites used for tritium and gross beta monitoring. Provide any data not reported in the EIS and TSD on other radionuclides at the sites used for tritium and gross beta monitoring.	From IR EIS 05-201: Cesium-137, cesium-134 and potassium-40 were measured in Lake Huron and cobalt-60, cesium-134, cesium-137, potassium-40, strontium-90, iodine-129, technetium-99 and chlorine-36 were measured in surface water samples from the railway ditches (TSD, page 81). However, no reported analyses were conducted on samples taken from the sites used for tritium and gross beta monitoring.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
	• Section 11.4.6, Radiological Conditions • Section 11.5.6, Human Health	• *Radiation and Radioactivity TSD:* Section 5.6, Radioactivity in Surface Water, pages 73-81 • *OPG response to IR EIS*-05-201 (CEARIS #776)	Include an analysis of the effect of no data for other radionuclides at the tritium and gross beta monitoring sites on uncertainty of the assessment.	The lack of data on other radionuclides from the tritium and gross beta sampling sites produces an uneven dataset with higher uncertainty than would have been the case had other radionuclides been analysed on a routine basis from the standard monitoring sites. An explanation for this situation, and an analysis of the effect the lack of data on other radionuclides on uncertainty is required for the evaluation of the reliability, appropriateness and scientific credibility of the assessment. The response to the first submission of this IR was not sufficient.
EIS 09-434	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *PSR:* Section 4.3.2.3, Gas Characterization: Methane and Carbon Dioxide	Explain the consistent difference in hydrogen isotope values between two boreholes (DGR-3 and DGR-4) over the same stratigraphic intervals.	The conclusion that mass transport in the Ordovician and Silurian is diffusion-dominated is fundamental to much of the safety case for the proposed DGR. PSR Figure.4-39 shows hydrogen isotope values in methane for the Cobourg to Georgian Bay stratigraphic interval that are distinctly different in DGR-3 and DGR-4. For all equivalent depths where measurements are reported for DGR-3 and DGR-4, the delta ^{2}H values are lowest in DGR-4 samples. This difference appears to be inconsistent with the characteristics of a diffusion-dominated system.
EIS 09-435	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *PSR:* Section 4.3.5 Hydrogeochemist ry Summary	Resolve the apparent contradiction that the Cobourg Formation is a barrier to solute migration, when methane and helium are considered, but presents no barrier to the downward flux of salts by diffusion.	The conclusion that mass transport in the Ordovician and Silurian is diffusion-dominated is fundamental to much of the safety case for the proposed DGR. On the basis of thermogenic vs biogenic methane occurrences and He isotope ratios, it is concluded "that there is a barrier to vertical solute migration within the Cobourg Formation." (PSR, page 163) On the other hand, the downward depletion trends of natural tracers (Cl & Br) and TDS show smooth trends (PSR Figures 34 & 36) through the Cobourg Formation into the older Middle

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
				Ordovician limestones. These trends are explained by a downward mass flux of salts by diffusion (i.e. Diffusion From Above Conceptual Model). This appears to be inconsistent with the characteristics of a diffusion-dominated system.
EIS 09-436	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *PSR:* Section 4.3.2.3, Redox Conditions in the Ordovician Shale and Carbonate • *Descriptive Geosphere Site Model Report*: Section 4.6.8, Estimated Porewater pH and Redox Conditions	Provide an Eh - pH diagram(s) illustrating mineral stabilities and porewater compositions encountered in the stratigraphic sequence of the DGR site.	The redox conditions of porewaters at various stratigraphic levels have been defined using a variety of redox couples and mineralogical and geochemical evidence (PSR page.150 & Descriptive Geosphere Site Model Report, Section 4.6.). Eh - pH diagrams (or pe - pH) are commonly used to visualize mineral stabilities and formation water compositions.
EIS 09-437	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *PSR:* Section 4.3.5, Hydrogeochemist ry Summary	In the context of oxygen isotopes: • Quantify what is meant by a "long period" in the statement on page163 of the PSR.. • Substantiate this argument using reaction rates available from the literature.	The residence time of chemical species in the cap rock is used to strengthen the case for retention of radioisotopes for extensive time periods. Page 163 of the PSR states: "^{18}O enrichment with respect to the GMWL in the majority of the Ordovician porewaters suggests long periods of water rock interaction (i.e., long residence times in the sedimentary system)." The kinetics of oxygen isotope exchange between minerals and an aqueous phase have been studied extensively and could be used to predict equilibration periods.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-438	• Section 10.1.1, Geology and Geomorphology • Section 11.4.1, Geology and Geomorphology	• *PSR:* Section 4.3.2.3, Natural Tracers	Explain the groundwater flow regime that would allow Pleistocene melt waters to recharge the Salina A1 aquifer at the site, given the elevated density of the original formation waters.	The baseline proposed for Silurian and Devonian formational waters is evaporated sea water with Cl concentration of 6 to 7 mol/kgw (PSR, page 140). The oxygen and hydrogen isotopic signature of the thin aquifer of the Salina A1 unit is explained as the result of mixing with glacial melt water through recharge from subcrops east of the site (PSR, pages 141 - 142).
EIS 09-439	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *PSR:* Section.4.4.1, Conceptual Model, pages 168-169 • *Hydrogeologic Modelling TSD,* Figure 2.18, Profile of Test Interval Hydraulic Conductivity Estimates Determined from Field Straddle-Packer Testing in DGR Boreholes	Explain the derivation of horizontal hydraulic conductivities (K_H) in PSR Table 4-4 from the DGR borehole testing results. Specify the contributions of measurement errors versus formational heterogeneity to the variability found among the boreholes. Explain how the variability of measurements affects the site-scale numerical and computational models.	The confidence in hydrogeological models on a local, regional and basin-scale is strongly dependent on the choice of hydrogeologic parameters. More detail and justification is needed regarding these choices. The horizontal hydraulic conductivities (K_H) reported for DGR boreholes generally vary by between 2 and 4 orders of magnitude within the same unit (Hydrogeologic Modelling TSD, Figure 2.18). The base-case hydrogeological parameter values used for regional-scale and site-scale modelling are discrete values without a measure of variability (PSR, Table 4-4). The hydrogeologic parameters used are based on the DGR borehole investigations (Descriptive Geosphere Site Model Report) and are applied to both the regional-scale and site-scale numerical models. Field straddle-packer testing intervals in the DGR boreholes vary from hole to hole and frequently cross formational boundaries.
EIS 09-440	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *PSR*: Section 4.4.1, Conceptual Model • *Hydrogeologic Modelling TSD,* Figure 2.19, Liquid Porosity	Explain the derivation of liquid porosity values in PSR Table 4-4 for the cap rock sequence (Blue Mountain, Georgian Bay, Queenston) from the DGR borehole testing results.	The confidence in hydrogeological models on a local, regional and basin-scale is strongly dependent on the choice of hydrogeologic parameters. More detail and justification is needed regarding these choices. In the cap rock sequence (Blue Mountain, Georgian Bay, Queenston) liquid porosity measurements show a bimodal distribution (Hydrogeologic Modelling TSD Figure 2.19). The

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
		Profile for DGR Cores Showing Point Data and Arithmetic Formation Averages		base-case hydrogeological parameter values used for regional-scale and site-scale modelling are discrete values without a measure of variability (PSR Table 4-4).
EIS 09-441	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• PSR: Section 4.4.1, Conceptual Model • *Hydrogeologic Modelling TSD:* Section 6.2.2, Base-Case Analysis of Michigan Basin Cross-Section	Explain how a possible groundwater velocity of up to 100 km/Ma in the Cambrian formations predicted by the base model is consistent with the hypothesis in the Hydrogeologic Modelling TSD that for " all units/ formations beneath Lake Huron either a divide for groundwater flow occurs or horizontal flow is negligible."	In the Hydrogeologic Modelling TSD, Section. 6.2.2, it is stated that "the horizontal pore water velocity data for the Michigan Basin base-case cross-section analysis confirms the hypothesis of this study that at a point in all units/formations beneath Lake Huron either a divide for groundwater flow occurs or horizontal flow is negligible. It is noted that a pore velocity of 0.001 m/a equates to a velocity of 1 km/Ma." It is also stated that "...the horizontal pore velocities in the Cambrian are generally less than 0.1 m/a beneath approximately the centre of Lake Huron." Note that 0.1 m/a equates to a velocity of 100 km/Ma.
EIS 09-442	• Section 10.1.3, Groundwater Section 11.4.3, Groundwater	• *Geosynthesis TSD: Section.4.4,* Hydrogeochemical Data from the Bruce Nuclear Site • *Figure 4.6,* TDS versus Depth for DGR Boreholes	Explain why pore waters (leachate) have not been distinguished from groundwater in plots showing TDS versus depth for DGR boreholes (e.g., Geosynthesis TSD, Figure.4.6). Provide a plot of TDS versus depth for DGR boreholes in which pore water (leachate) is distinguished from groundwater.	Formational pore waters play a role in the stability of shaft seals and waste containers. Formational pore water compositions in low-permeability stratigraphic units were obtained using leaching/extraction techniques. Such determinations are subject to a number of uncertainties. Accordingly, in the Geosynthesis TSD Section.4.4 it is stated that "the data are more properly considered leachate concentrations." In aquifers, groundwater was sampled directly.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-443	• Section 2.2, Public Participation • Section 2.5, Precautionary Approach • Section 10.2 Socio-Economic Conditions • Section 11.5.2 Land Use and Value	• *EIS*: Section 2, Public Participation and Aboriginal Engagement • *EIS*: Section 3, Project Justification • *EIS*: Appendix D, Public Participation • *Socio-Economic TSD* • *Independent Assessment of Long-Term Management Options for Low and Intermediate Level Wastes at OPG's Western Waste Management Facility prepared by Golder Associates (February 2004)*	Provide additional information relating to OPG's consultation with representatives from the United States including, but not limited to, Michigan elected representatives and their staff; members of the Michigan environment and geological agencies; and, representatives from Michigan environmental groups.	As an example, the EIS identifies Michigan elected representatives and their staff; the staff of Michigan environment and geology agencies; and representatives of Michigan environment groups as part of the target audience to provide information and access to information on the DGR (EIS page.2-3).
EIS 09-444	• Section 10.1.1, Geology and Geomorphology	• *PSR:* Section .3.3.1, Conceptual Model	Explain the choice of 300 Ma for the simulation of profiles of the natural tracers O^{18} and Cl. Indicate which interval in the geologic time scale would be covered by this interval.	The future behaviour of the geosphere barrier cannot necessarily be predicted based on its history. For the modelling, initial salinity values for the two boundary

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
	• Section 11.4.1, Geology and Geomorphology	• Section 4.3.3.2, Numerical Modelling Results • *Geosynthesis TSD*	Depending on the chosen geologic time period for diffusive transport, explain how present physical properties are relevant in modelling the process. Evaluate the possibility of advective solute transport prior and during deposition of post-Devonian sediments. Evaluate the time period needed to explain observed tracer profiles if diffusive transport is assumed to have initiated in the Devonian (taking into account evolution of pore volumes).	conditions are assumed to have been evaporated sea water brine (Silurian and Devonian) and normal marine sea water (Ordovician). Since the gradient between these boundary conditions would have been established by the Devonian, diffusive transport could have been activated at that time. A time period of 300 Ma was chosen to simulate profiles of the natural tracers O^{18} and Cl. No geologic time interval during which the diffusive transport occurred seems to be provided. Over a 300 Ma period members of a sedimentary sequence may be expected to undergo significant changes in physical properties (hydraulic conductivity, diffusion coefficients etc.) due to compaction, pore fluid expulsion, cementation, etc. In the Devonian the expected porosity and diffusivity values of the underlying stratigraphic sequence could have varied considerably from present values. Units had not yet been compacted by additional younger strata (estimated 1.5 km thickness) and diagenetic pore closure may have been less advanced.
EIS 09-445	• Section 13.4, Confidence in Mathematical Models	• *PSR:* Section 4.3.3.2, Numerical Modelling Results	Quantify the goodness-of-fit of the numerical model solutions to observed data in PSR Figures 4-48, 4-49, Figures 4-72 to 4-76.	The agreement between measured and calculated values is used to calibrate and verify models. The degree of this agreement assists in the evaluation of the reliability of the model predictions. When numerical model solutions are compared to observed data, the goodness-of-fit should be presented in mathematical terms rather than subjective visual descriptions.
EIS 09-446	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *PSR:* Section 8.8.4, Probabilistic Calculation	Provide information on simulation methods used for the probabilistic calculations undertaken to determine the sensitivity of parameter variability on the concentrations of leading radionuclides in well water. Provide the results for C-14 and Zr-93.	FRAC3DVS-OPG, a deterministic numerical model, has been used to simulate and evaluate groundwater flow and transport in the deep and intermediate groundwater zones. Most of the input parameters are associated with significant uncertainties arising from their measurement and their variability within both the site and regional domains. A deterministic model does not

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
			The simulations were run on the NE-RC reference case. State whether such simulations were run on any other cases. If not, explain.	provide information on prediction uncertainty. Observations of the predicted variables may be unavailable and measurement-based accuracy assessment is not possible for the time spans involved. Probabilistic calculations that include uncertainties and ranges of values for calculated well water concentrations for Cl-36 and I-129 are addressed in PSR Section 8.8.4. Such analyses were also run for C-14 and Zr-93. No information is provided as to the simulation methods used (stochastic, Monte Carlo, etc.)
EIS 09-447	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *Hydrogeologic Modelling TSD* • *Descriptive Geosphere Site Model Report*	Develop a modified version of the FRAC3DVS-OPG regional groundwater flow and solute transport model, and its embedded site-scale sub-model, incorporating the following features: • Refined vertical discretization of hydrostratigraphic units 4A (Salina A1 Upper Carbonate) and 4B (Guelph Fm.) to ensure explicit representation of their thicknesses and hydraulic properties as reported in the Descriptive Geosphere Site Model (DGSM) report; • Revised hydraulic parameters for the Shadow Lake Fm. in order to reflect a continuous basal permeable unit across the model domain; • Revised boundary conditions to ensure that observed hydraulic gradients and porewater velocities, both up-dip (Guelph, Cambrian) and down-dip (Salina A1 Upper Carbonate), are reproduced at the site; and • Use of the modified regional groundwater flow and solute transport model to investigate performance metrics for scenarios involving long-distance up-dip migration of radionuclides in the Guelph and basal clastic unit, and report results. Use the modified embedded site-scale	The Salina A1 Upper Carbonate unit and the Guelph, Cambrian/Shadow Lake Formations are thin, permeable layers that represent potential preferentialpreferential pathways for relatively rapid horizontal advective radionuclide transport away from the repository site. In order to investigate the fate of radionuclides migrating laterally beyond the boundaries of the DGR, and various near-field scenarios, the regional and embedded groundwater flow and transport models must faithfully represent hydrogeological observations from these units.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
			groundwater flow and solute transport sub-model to investigate tracer migration for scenarios including that of hypothetical discrete fracture zones hydraulically connected to the Cambrian/Shadow Lake Formations, and report results.	
EIS 09-448	• Section 10.1.3, Groundwater • Section 11.4.3, Groundwater	• *Hydrogeologic Modelling TSD* • *Descriptive Geosphere Site Model Report* • OPG Response to EIS-IR-04-126 (CEARIS #704) • OPG response to EIS-IR-04-129 (CEARIS #725)	Incorporate the Cambrian unit in the 3DS model and report on Performance Safety Assessment modeling that investigates near-field radionuclide migration in the presence of horizontal hydraulic gradients (in order to assess lateral advective radionuclide transport), as was done for the Salina A1 Carbonate and Guelph units in the NE-HG calculation case, and provide the results.	NRCan considers information request EIS-04-129 to be unresolved. The arguments advanced by the proponent for not including the Cambrian unit within the 3D Simplified (3DS) groundwater flow and solute transport model are not compelling. a) While Cambrian groundwater is saline and non-potable, groundwater in the Guelph Formation is even more so (Descriptive Geosphere Site Model Report, Table 4.17 yet this unit was included in the 3DS model; b) While the Cambrian per se may pinch out east of the Bruce site, it is likely that a thin permeable basal clastic unit persists eastward over the Algonquin Arch (see IR EIS-04-126); and c) While the nearest Cambrian outcrop may be more than 100 km from the Bruce site, advective transport velocities in the Cambrian are quite high. Without the supporting analyses requested in IR EIS-04-129, the proponent's claim that lateral advective transport in the Cambrian would lead to lower predicted dose consequences is conjecture. It is a matter of due diligence for the proponent to investigate a scenario corresponding to hydrogeological conditions actually observed at the site.
EIS 09-449	• Section 10.1.8 Noise	• *EIS:* Section 6.8, Noise Levels	Explain whether MP3 recordings were made of the continuous noise monitoring at points of reception R1,R2 and R3 for the purposes of isolation analysis; e.g., to distinguish local ambient	The EIS states on page 6-178 that continuous noise monitoring was carried out at R1 and R2 between May 4 and 11, 2007 with acoustical parameters logged every hour over

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
			noise from industrial noise.	182 hours and that continuous monitoring at R3 was completed between May 8 and 22, 2007. EIS Tables 6.8.4-1 and 6.8.4-2 (page 6-180) present summaries of noise levels at R1, R2 and R3 but there is no interpretation of the reported noise levels with respect to ambient versus industrial noise.
EIS 09-450	• Section 10.1.8 Noise	• *EIS:* Section 6.8, Noise Levels	Clarify whether the reported noise levels in Tables 6.8.4-1 and 6.8.4-2 of the EIS (page 6-180) include noise from existing nuclear facilities at the Bruce Nuclear site. Discuss the potential for the DGR to contribute to the phenomenon of "creeping ambient" noise and when that contribution to "creeping ambient" might become unacceptable.	"Creeping Ambient" is the phenomenon where "baseline" sound levels slowly increase over time, due to industrial development expansion and transportation infrastructure expansion, also including residential dwelling growth. For example, what was the "pre-build" baseline 20 years ago will never again be achieved, and what the now-existing baseline is will not be attainable 20 years from now. "Creeping Ambient" is an ever-increasing cumulative effect.
EIS 09-451	• Section 10.1.8 Noise	• *Atmospheric Environment TSD*: Section 5.5, Noise Levels	Explain whether the Larson Davis Model 720 Type 2 sound meter used for continuous ambient sound level measurement meets current standard of practice in environmental noise monitoring.	The Type 2 Larson Davis sound meter does not represent "industry standard" because of the high noise floor. ANSI/ISO/IEC Type **0** sound measurement instrumentation – "laboratory standard" – never goes into the field ANSI/ISO/IEC Type **1** sound measurement instrumentation – "precision" – standard practice for use by consultants doing environmental noise monitoring ANSI/ISO/IEC Type **2** sound measurement instrumentation – "general purpose" – used for non-expert purposes, i.e. a factory floor supervisor – not standard practice for use in environmental noise monitoring – old regulations considered them minimum requirement, yet most jurisdictions are now disallowing their use.
EIS 09-452	• Section 11.4.8 Noise and	• Atmospheric Environment TSD: Section 8.3,	Confirm that modelling of noise as described in Section 8.3 of the EIS included octave bands for all noise sources.	Modeling should be done using "octave band data" and the models run using "octave band calculations". These are the typical octaves (like a piano). Minimum suggested octave

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
	Vibration	Noise Levels		bands are 63 / 125 / 250 / 500 / 1000 / 2000 / 4000 / 8000 Hertz (Hz, cycles per second). Then, the model combines all the frequency-dependent values, and yields a "single-number descriptor", the "A-weighted" sound level, in units of "dBA". This is equivalent to or analogous to the frequency response of the human ear.
EIS 09-453	• Section 11.4.8 Noise and Vibration	• *EIS:* Section 7.8 Noise and Vibrations • Atmospheric Environment TSD: Section 8.3, Noise Levels	Explain whether modelling of noise from intake and exhaust fans incorporated the large variability of noise from such fans. Explain mitigation of intake and exhaust fan noise in more detail than is presented in Table 7.8.2-1 of the EIS.	Fans are often the primary noise source at operating industrial facilities and they operate 24/7. Mine head shaft ventilating equipment (#1 "forced draft" – FD – pressuring (blowing) air down the intake shaft, and also #2 "induced draft" – ID – extracting (sucking) air up the exhaust shaft) is provided by "blowers". A blower consists of a fan, a blower casing, a motor and some drive belts. Different types of fans exist (e.g. centrifugal, vane-axial), and different flow control designs exist (e.g. variable inlet guide vanes, inlet dampers), but mostly all fans are tonal. At this stage of the review, the manufacturer / model / operating condition of the fan and the blower have presumably not yet been selected by the proponent. Different fans can range +/– 20 decibels in octave bands. Therefore, information is required regarding the assumption used in the model - "average" noisy fan, a "louder" fan, etc. It is noted that silencers do not eliminate tone.
EIS 09-454	• Section 11.4.8 Noise and Vibration	• Section 11.4.8 Noise and Vibration	Explain the plans for mitigation of intermittent noise to be generated during site preparation and construction. Clarify and confirm that OPG intends to adhere to municipal noise bylaws regarding restriction of operations.	An unvarying noise can become background for receptors. An intermittent noise, such as during construction is received very differently, e.g., disruption of sleep.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-455	• Section 8.3, Operation	• *EIS*: Section 4.14 Organization and Management, pages 4-88-4-91. • Figure 4.14-1, NWMO's Site Preparation and Construction Phase Organization, page 4-90. • OPG response to IR EIS-05-212 (CEARIS #776)	Provide a description of how the 11 Managers illustrated in Figure 4.14-1 will communicate to ensure that there is sufficient awareness of issues as they arise, appropriate responses to those issues as per applicable policies and procedures, documentation of those responses, and follow-up to ensure the effectiveness of the responses. Provide examples to illustrate the communication system. Include examples from the Health, Safety and Environment Manager's area of responsibility.	From IR EIS 05-212: In Section 8.3 of the EIS Guidelines it is stated that "The proponent is also required to provide, or reference, the policies, programs and procedures that would be followed for the operation of the facility in order to provide some assurance that the facility could be operated safely and in accordance with the Nuclear Safety and Control Act and its regulations following construction." The Project Quality Plan is described on page 4-89 of the EIS as a plan that would ensure meeting minimum NWMO requirements, identification of responsibilities for quality assurance and control, specification of auditing and corrective actions and maintenance of a register of quality compliance. However, it is not clear how the lines of communication from the Quality Assurance Manager through to the 10 managers in charge of specific areas will operate. Nor is it clear how the 10 managers will communicate among each other. The risks associated with non-communication among managers can be considerable and require identification and management. The response to the first submission of this IR was not sufficient.
EIS 09-456	• Section 8.3, Operation	• *EIS:* Figure 4.14.2-1, Operations Phase Organization • OPG Response to IR-EIS 05-213 (CEARIS #776)	Provide information on where Health, Safety and the Environment (HSE) as well as Communications would fit within the organization chart in Figure 4.14.2-1. Provide information regarding how HSE and Communications would be integrated across the 10 management functions arranged across the bottom of the organization chart.	Operation of the DGR facility in a manner that will "provide some assurance that the facility could be operated safely and in accordance with the Nuclear Safety and Control Act and its regulations" must include the explicit inclusion of HSE and Communication functions within the management structure. The response to the first submission of IR EIS-05-213 was not sufficient.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-457	• Section 16, Follow-Up Program	• *DGR EA Follow-up Monitoring Program TSD:* Section 7.1 Underground Air Monitoring Program • OPG Response to IR EIS-01-32 (CEARIS #363)	Describe plans to monitor waste degradation rates (gas consumption, generation) within the sections of the repository to be closed off during operations in order to verify the EIS predictions on this matter.	The response to EIS 01-32 does not contain sufficient information concerning follow-up plans to monitor waste degradation rates within sections of the repository that will be closed off during operations. The EIS Guidelines state that "The follow-up program must be designed to incorporate … real time data which would consist of observed data gathered in the field. As part of the follow-up program, the proponent must describe the compliance reporting methods to be used, including reporting frequency, methods and format." It is understood that detailed plans for information requests such as this are part of the Operating Licence application that must be submitted prior to operation, and that availability of specific test procedures to use for data gathering may be only preliminary at this time. These factors should not, however, prevent OPG from providing detailed monitoring plan information that is not currently covered in the EIS. Compliance reporting methods, including frequency and formatting throughout the known period of measurement ("at least 10 years into the operations phase" in the case of closed panel measurement sites), are not dependent upon specific measurement techniques and can be better described at present.
EIS 09-458	• Section 6.3 Stakeholders	• *EIS*: Section 4.15, Environmental Protection Policies and Procedures.	Provide a conceptual public consultation plan for the site preparation and construction phases of the project.	The DGR Project will affect a diverse stakeholder base with a variety of needs, concerns and levels of awareness. It is expected that there will be a direct connection between the results of public consultation and the environmental management system.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-459	• Section 2.2, Public Participation and Aboriginal Engagement • Section 6.3, Stakeholders	• *EIS:* Section 2.4.1, Briefings with Local Municipalities and Agencies • OPG Response to IR EIS-05-205 (CEARIS #793)	Confirm that an OPG representative(s) attended the Community Consultation Advisory Group (CCAG) meetings. Provide any records (unofficial) such as memos, minutes, or notes produced by the OPG representative.	A Community Consultation Advisory Group (CCAG) can provide the most effective means of addressing community concerns during the planning and operational phases of a project. The JRP requires more specific information on the effectiveness of the DGR CCAG than has been provided in the response to EIS-05-205 in order to evaluate the community input into the project. The response to EIS-05-205 states that "Official meeting notes are not prepared for these meetings." On page 2-50 of the EIS it is stated that "A sample of the minutes from these meetings is provided in Appendix D13." This was not actually provided. Such records would provide clarity and confidence in the degree of community involvement in the planning process.
EIS 09-460	• Section 13.1, Long-Term Safety of the DGR	• *EIS:* Section 9.2.2, Disruptive ("What if") Scenarios • *PSR*: Section 8.7, Disruptive Scenarios	Include and evaluate additional disruptive scenarios that have a reasonable likelihood of occurrence, namely: a) abandonment before the complete filling of the repository (impact on the gas evolution scenario); and b) loss of ability to administer/ service/maintain operations (such as, for example, an inability to put the shaft seals in place) for: i. a limited time period (years); and ii. an extended time period (decades).	The disruptive scenarios currently evaluated do not include several reasonably likely scenarios.
EIS 09-461	• Section 13.1, Long-Term Safety of the DGR	• *Postclosure Safety Assessment TSD:* Section 7.2.1, Human Intrusion	Given the possibility that a 300-year period of institutional control may not be possible, provide dose rate calculations for human intrusion scenarios commencing at the time of decommissioning.	Postclosure Safety Assessment TSD Section 7.2.1 *Human Intrusion* presents Figure 7.18 showing the calculated average concentrations of radionuclides in wastes in panel 1, as a function of the time for the human intrusion Base Case (HI-BC). Figure 7.19 shows calculated concentrations of radionuclides in repository gas at repository pressure and Figure 7.20 the calculated doses from surface release of gas

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
				and drill core resulting from human Intrusion, as a function of the time of intrusion. In all cases the calculated values start at 300 years after decommissioning (i.e., at the end of the stipulated institutional control). The period of 300 years of institutional control after decommissioning has to be considered a significant uncertainty. Therefore, a precautionary approach should be invoked and calculations should be provided which do not assume that institutional control will be possible for 300 years.
EIS 09-462	• Section 13.1, Long-Term Safety of the DGR	• *EIS*: Section 9.1, Demonstrating the Long-term Safety of the DGR • *OPG Response to IR EIS 05-164 (CERIS #793)*	Explicitly explain how “existing structural discontinuities in the barrier rock formations” were incorporated into the “long-term geomechanical analyses of the DGR openings" and the DGR Safety Case and why the assumptions used can be regarded as conservative.	The response to EIS-05-164 states that " The conservative long-term geomechanical analyses of the DGR openings that considered long-term rock mass strength degradation, seismicity, glacial loading and repository gas pressure (7-8 MPa) support the conclusion that fault rupture or re-activation of existing structural discontinuities in the barrier rock formations will not occur or influence the DGR Safety Case."
EIS 09-463	• Section 13, Long-Term Safety of the DGR	• *EIS*: Section 9, Long Term Safety of the DGR • *Post Closure Safety Assessment* : Section 4.2.3.1 Repository Level • Section 6, Assessment Models • Section 7,Results	For each waste type within each of the three panel zones that will be created following panel closure, provide: a) information on the ranges of waste material quantities; b) distribution by type of waste; and c) gas generating potentials. Given that variable waste types will be emplaced in the separate panel zones at different operational times, describe the ranges of pressure for various operating intervals, and confidence limits on these predictions, that will develop in each zone through sequential placement operations.	It was noted in OPG’s response to IR-01-19 that closure walls would separate the repository into different domains that could, in principle, lead to higher gas pressures in a panel containing more gas-generating wastes per available void volume. The response given provides an estimate of “the peak gas pressures in each of the three panels, taking into account the reference waste distribution between the panels and the panel volumes.” No information concerning reference waste quantities (ILW and LLW), waste distribution by type and gas generating characteristics for each of the three sealed panel zones being considered was presented in this response. The impact of uneven waste distribution, particularly ILW in Panel 2, was cited as a source of higher gas pressure in this panel, though

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
		and Discussion • OPG Response to IR EIS 01-19 (CEARIS #363)		no indication of time at which such maximum pressure effect would result was stipulated.
EIS 09-464	• Section 10.1.1, Biophysical Environment • Section 13, Long-Term Safety of the DGR • Section 13.4, Confidence in Mathematical Models • CNSC Regulatory Guide G-320	• *EIS:* Section 6.2.6, Bedrock Geology • *EIS:* Section 9, Long Term Safety • Section 9.2.2.3, Poorly Sealed Borehole • *Preliminary Safety Report*: Section 3, Site Evaluation and Characterization • Section3.4, Additional Geoscientific Investigations • Section 8, Post Closure safety assessment • OPG Response to IRs EIS 02-36 (CEARIS #523)	Assess the dose effects from a vertical fault located 500 metres, 100 metres, 50 metres and 10 metres distance (or any distances in-between) to the north-west of the DGR. The assessments should be conducted without horizontal hydraulic gradients added in the intermediate groundwater zone, i.e., without changing other assumptions of the normal evolution scenario.	The response provided to EIS-02-36 does not permit the full evaluation of the sensitivity of the system in response to a vertical fault located in its vicinity.. By adding horizontal gradients to the intermediate groundwater zone, one might underestimate the possible effect of an unidentified fault on well water (its contribution to dose) and the sensitivity of the system.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-465	• Section 7.1, Purpose and Need for the Project	• *EIS:* Section 1.2.1, Purpose of the Project • OPG Response to IRs EIS 04-149 (CEARIS #759)	Provide information concerning the safety hazards associated with operations at the Western Waste Management Facility (WWMF) that may compromise the health and safety of the public, workers and the environment.	From IR EIS 04-149: Section 1.2.1 of the EIS, page 1-2 states that: "The DGR Project is proposed because… it provides a greater margin of safety than the existing facilities..."; and "…it provides a long-term management method for waste streams .. and (it) will do so in the absence of institutional controls." Little information regarding the "margin of safety" of existing facilities (i.e., WWMF) and/or safety hazards existing at the WWMF is provided to validate why the DGR is necessary other than that, through underground placement, no institutional controls (after 300 years) may be required to maintain safe material management. The OPG response to this IR was not adequate. Specific information regarding hazards, case examples and operational safety conditions existing at the WWMF is required.
EIS 09-466	• Section 2.5, Precautionary Approach	• <u>*EIS:*</u> Section 9, Long-Term Safety of the DGR • OPG Response to IRs EIS 06-275 (CEARIS #759)	Provide the following information with respect to the long-term safety of the proposed DGR Project: a) A description of the redundancies that have been incorporated in the design to ensure safety of the public.	The definition of redundancy can include several elements that work simultaneously and independently, and are capable of performing the same function. Redundancy may also include standby or backup systems that perform when the system needs them. The response to part a) of IR EIS 06-275 was not sufficient.
EIS 09-467	• Section 8.2, Site Preparation and Construction • Section 11.4.7, Atmosphere	• *EIS:* Section 4.7.1, Site Preparation, • Section 4.7.4.1, Shaft Excavation, OPG Response to EIS 05-201 (CEARIS #776)	Indicate what types of drilling equipment may be required for surface site preparation scenarios (grouting, freezing or both) involving surface construction and early shaft sinking operations that may be needed to control potential groundwater inflows. Describe the potential effects to air quality from the use of such specialized equipment.	The specific information requested in IR EIS 05-201 for surface air quality impacts resulting from use of surface drilling equipment was not sufficient.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-468	• Section 10.2.1, Economy • Section 11.5.1, Economy	• *EIS:* Section 7.9, Aboriginal Interests • Section 7.9.1.1, Aboriginal Communities • OPG Response to IR EIS 05-221 (CEARIS #783)	Describe the plans/measures in place to provide opportunity and training for Aboriginal persons during all phases of the DGR project.	The response to EIS 05-221 did not address this aspect of the IR.
EIS 09-469	• Section 10.2, Socio-economic Conditions • Section 11.5, Socio-economic Effects	• *EIS*: Section 6.10, Socio-Economic Environment; • *EIS*: Section 7.10, Socio-Economic Environment	Explain whether goals for spin-off economic benefits such as targeting opportunities for small business, encouragement of local manufacturing of DGR-related components, provision of training of local and regional mining personnel to create nuclear workers, and provision of educational opportunities for both pre- and post-secondary level students, were discussed and developed by OPG in collaboration with local and regional governments and other groups.	Section 7.10 of the EIS presents indirect and induced jobs resulting from the DGR.
EIS 09-470	▪ Section 10.1.4, Terrestrial Environment ▪ Section 11.4.1, Geology and Geomorphology	▪ *EIS:* Section 6.2.4, Soil Quality ▪ OPG response to IR EIS-05-219 (CEARIS #776)	Provide the assessment of extractable organic compound concentrations relative to MOE criteria from soils sampled at Site 28. Provide results of recommended further assessment work for soils at Sites 1 and 48.	The response to IR EIS 05-219 states that during Phase II Environmental Site Assessments investigations soil samples were taken at sites within or near the proposed DGR Project Area. At Site #28 all TPH results were far below the MOE Guideline criteria. Extractable organic compounds were also analyzed in these samples but no evaluations are provided. It is also stated that further assessment work was recommended at Sites #1 and 48.
EIS 09-471	• Section 11.1, Effects Prediction	• *Hydrology and Surface Water Quality TSD*: Section 8.2.3,	Provide contour maps (using 50 cm intervals) with supporting tables showing areas in the catchment for the North Railway Ditch and Stream C where ground surface conditions (in terms of potential for infiltration), topography, and subsequent runoff coefficients may vary relative to the current baseline	The response to EIS-05-190 claims that calculations based on drainage area, rainfall depth and a runoff coefficient are adequate for the purpose, and that loading of constituents of concern (COC) is linearly proportional to drainage area – therefore a decrease in drainage area will produce the same

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
		Direct Effects • Table 8.2.3-1, Likely Adverse Effects on Surface Water Quantity and Flow • OPG response to IR EIS-05-190 (CEARIS #776)	conditions. The maps should be prepared for the site preparation, construction and operation phases. The tables are to include volumes and depths of materials removed from each sub-catchment during site preparation and construction. Indicate on the maps for site preparation and construction where temporary sediment controls will be implemented.	percentage reduction in both flow and load of COC. However, surface conditions would change during site preparation and construction, and again once operations begin. Therefore, more information is required with respect to whether there may be measurable changes in the degree of runoff versus infiltration (and hence changes in runoff coefficients) in the catchment during different phases of the DGR Project. Furthermore, there may be significant differences among project phases with respect to the total catchment area, depending on the nature and extent of construction activities. A more refined understanding of the potential for changes in flow and loads of COC will assist in the planning of phase-specific mitigation.
EIS 09-472	• Section 8.1, General Information and Design Description	• *EIS:* Section 4.4.1.5, Stormwater Management System • OPG response to IR EIS-03-56 (CEARIS #608)	Provide a detailed explanation for how rapid deployment of water treatment will be accomplished in the event that treatment is required, e.g., sudden storm.	The response to EIS 03-56 did not provide the requested information.
EIS 09-473	• Section 10.1.5, Aquatic Environment • Section 11, Effects Prediction, Mitigation Measures and Significance of Residual Effects	• *Hydrology and Surface Water Quality TSD*: Section 5, Existing Environment • Section 6.2, Changes in Groundwater	Provide additional information and analysis with respect to the base flow of Stream C, the North Railway Ditch, and the South Railway Ditch with emphasis on the potential contribution of near surface groundwater related to infiltration during site preparation and construction. See related IR EIS 09-471 Evaluate the potential for a perched groundwater table above the impervious till layer. Confirm when additional surface hydrology data will be collected relative to surface flow to Stream C, South and North Railway ditches, and MacPherson Bay (as committed to in the	Further evaluation and analysis is required with respect to potential shallow connections among the stormwater management pond, the waste rock management area, wetlands, ditches and Stream C.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
		Flow • *Aquatic Environment TSD* • OPG response to IR EIS-07-299 (CEARIS #843)	response to IR EIS-07-299).	
EIS 09-474	• Section 8.1, General Information and Design Description	• *EIS*: Section 4.5, Waste to be Placed in the DGR • Table 4.5.1-3, Summary of Waste Acceptance Criteria • OPG response to IR EIS-04-122 (CEARIS #704 • OPG response to IR EIS-04-152 (CEARIS #704)	Explain how the estimated 53,000 waste packages, representing a total emplaced volume of approximately 200,000 m^3, will be further evaluated regarding processing and packaging requirements as the DGR repository design is refined and finalized. Provide the design requirements and criteria that would trigger changes in requirements for processing and packaging (and in the case of legacy waste – re-packaging and re-processing). Provide the time intervals between the commencement of emplacement room filling and their isolation by closure walls. Provide data on the integrity (time period) of each waste container type to be deposited in the DGR. The period of complete containment must be provided under external dry conditions and when exposed to humid conditions. Provide information on quantitative criteria used to evaluate the integrity of each container type to stresses induced by stacking (where applicable) in the emplacement rooms over the span of the operational phase of the DGR.	In the EIS Guidelines Section 8.1, page 33, it is stated that information should be provided in the EIS on: "The design of the waste containers/packages, their performance and longevity with respect to their containment function, including reference to international experience if available and applicable. " Considering the number and variety of existing and future waste packages, more information is required regarding what constitutes an acceptable waste package. The requested criteria must go beyond the current waste acceptance criteria as stated in the EIS (Table 4.5.1-3). Until closure walls are in place to isolate a set of filled emplacement rooms, the waste containers form the only barrier that prevents the possible release of radioisotopes and other toxic contaminants into parts of the repository environment occupied by workers. EIS-04-152 addresses the issue of container integrity for both legacy and more recent waste. The OPG response does not provide adequate information to evaluate any associated risks during the operational phase of the DGR. DGR Waste Acceptance Criteria (WAC) do not comprehensively evaluate the time periods of container integrity or their expected resilience to load conditions when stacked in the emplacement rooms. In the response to EIS 04-122, OPG stated that "Although

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
				waste containers are not credited with any function in the post-closure safety assessment, they are expected to maintain their integrity to the degree necessary to facilitate easy retrieval (if required) for a decade or more after emplacement in the DGR. In some cases, the containers will provide effective containment for longer periods."
EIS 09-475	• Section 8.1, General Information and Design Description	• *EIS:* Section 4.5.1, Waste Volumes	Provide a summary of incident reports of container failure or damage at the Western Waste Management Facility (WWMF), site of origin, and during transfer to the WWMF, involving containers that will be transferred into the DGR.	In many cases the waste containers currently stored at the WWMF will be transferred directly into the DGR after inspection. Confidence in the integrity of waste containers during transfer to, and storage in, the DGR can be based on their past performance.
EIS 09-476	• Section 8.1, General Information and Design Description	• *EIS*: Section 3.4.10, Waste Containment	Provide a review and rationale for the choice of radioactive waste conditioning methods to be considered for use at the proposed DGR, including, but not limited to, current practices of incineration and compaction. Compare the advantages and disadvantages of each conditioning option. Include a discussion of the effectiveness of each option with respect to volume reduction, minimization of gas production, and control of chemical reactions. Evaluate the overall reduction of long-term hazard caused by the combined presence of waste and waste packaging achieved by the conditioning methods. Distinguish between what is possible for conditioning existing waste and what could be implemented for future waste intended for the DGR.	The two primary reasons for waste conditioning are to achieve volume reduction and hazard reduction. The EIS provides inadequate information on waste conditioning in terms of these two objectives.

IR #	EIS Guidelines Section	EIS Section or other technical document	Information Request	Context
EIS 09-477	• Section 10, Existing Environment • Section 10.1.4, Terrestrial Environment	• *Terrestrial Environment TSD*: Section 5.4, Figure 5.4.1-1 and Figure 5.3.2-1. • OPG supplementary response to IR EIS-01-15 (CEARIS 683) • OPG response to IR EIS-03-85 (CEARIS #608) • OPG response to IR EIS-05-168 (CEARIS #785)	Provide the specific "generally accepted mitigation measures" that will be undertaken by OPG to ensure no unacceptable effects on snapping turtles.	The response to EIS-05-168 includes the following statement "Wetland 3 will be disturbed by site preparation and construction activities; however, appropriate environmental management plans will ensure that potential effects on sensitive turtles that might be utilizing the habitat at that time are controlled through generally accepted mitigation measures". More information is required with respect to which mitigation measures are the most likely to be effective and acceptable.

Attachment 2
Deep Geological Repository Project
Joint Review Panel LPSC Information Requests
Package 4 - February 8, 2012

IR #	NSCA Regulations Section #	Section # in OPG's LPSC Application	Information Request	Context
LPSC 04-63	• Section 4.1, Scope of Project	• *PSR*: Section 6.3.10.4, Underground Dewatering • *EIS:* Figure 4.4.2-1, Preliminary Layout of the Underground Repository • *OPG response to IR LPSC-01-19 (CEARIS #363)*	Provide clarification of the proposed underground dewatering system and its interconnecting flow path elements using a simplified plan view of underground features, as could be superimposed and displayed on EIS Figure 4.4.2-1.	The response to LPSC 01-19 was only partially complete. The sizing and general siting of main sump pumps, located at the Main and Ventilation shaft sump areas, have been detailed. However, no siting information or description of other underground drainage features, such as gravity drain systems located within and external to each repository panel, or the location of the oil/water separator station (the surface location for underground sump water release) in relation to other surface facilities, has been provided. A simplified graph illustrating flow connectivity of the underground dewatering system was submitted with OPG's response to LPSC 01-19, but this does not indicate the spatial location of sumps or interconnecting drainage flow paths between the various water collection points and sump systems, as originally requested.
LPSC 04-64	• Section 4.1, Scope of the Project	• Preliminary Safety Report: Section 9.4, Construction • Section 9.4.1, Ground Improvement • Modeling TIS, July 18, 2012	Using recent information obtained by borehole drilling and testing at the site of the proposed ventilation shaft (DGR-7), and provide information on the effectiveness of grout injection within the uppermost 180 meters of bedrock for reducing the local hydraulic conductivity of this bedrock formation and restricting water inflow into the future shafts. Provide estimates of predicted groundwater flows into the shaft structures prior to use of any ground improvement techniques, and compare predicted flow estimates that would exist after each ground improvement technique (ground freezing and	More recent information on geomechanical properties of near surface rock strata and groundwater flow characteristics of rock zones at future shaft site locations, than is available in the EIS, has been compiled following completion of two additional site boreholes (DGR-7 and DGR-8). Additionally, ground treatment through grout injection was undertaken at the ventilation shaft site to assess the capability of this technique for reducing potential groundwater inflow into the proposed shaft. Data that was obtained through this localized site drilling and grout injection program would provide additional baseline data for both initial and post-grouting water inflow and rock

IR #	NSCA Regulations Section #	Section # in OPG's LPSC Application	Information Request	Context
		• Modeling TIS Undertaking #7	grout injection) is applied.	hydraulic conductivity characterization of the upper strata, but has not yet been released. Revised calculations of mine water inflow rates into the future shafts and repository sumps, that incorporates site drill hole measurement data from drill hole DGR-7 following grout injection, was requested as Undertaking TIS 7 from the July 18, 2012 Technical Information Session. No documentation of site measurement data that reflects reduced hydraulic conductivity character of the uppermost 180 metres of rock has been supplied.
LPSC 04-65	• Section 8.1, General Information and Design Description	• *Deep Geologic Repository Project Management System:* Section 3.2, Contractor's Roles and Responsibilities • Section 3.3, Organizational Interfaces • *Project Requirements*: Section 4.0, Periodic Inspection and Monitoring Requirements • Section 18.0, Constructability Requirements	Describe how postclosure safety functions and geologic barriers may be impacted by changes to repository design features and modifications to planned construction activities that may be necessitated once in-situ development of the repository occurs. Should development-induced or other changes to in-situ stress conditions occur after initiation of the construction phase, explain how barrier features would be impacted by such changes and how modifications for features would be addressed and implemented. Describe plans and processes that will ensure that information relating to changes in planned construction activity will be identified and communicated to and between contractors for all phases of construction and development. Plans and processes should include, but not be limited to, the Design and Construction Phase Management System (DGR-PD-EN-0001) that describes the project management system to support construction activities.	A description of anticipated safety features, such as maintenance of geomechnical stability of excavations by shaping and aligning repository rooms according to the magnitudes and orientations of principal in-situ stress components, will require that detailed testing be performed prior to panel development.

IR #	NSCA Regulations Section #	Section # in OPG's LPSC Application	Information Request	Context
LPSC 04-66	• Section 9, Long-Term Safety of the DGR	• *EIS*: Section 8.3, Screening of Conventional Accidents • *EIS*: Section 4.7.8, Site Preparation and Construction Phase Program Requirements • *EIS:* Section 4.9, Risk Management • *Preliminary Safety Report* • *Preliminary Conventional Safety Assessment*	Provide a straightforward, standalone safety case for the Licence to Prepare Site and Construct. Required components of this standalone document are outlined below: • operational definitions of all goals for management of occupational and public health and safety risk, and environmental risk, e.g., an operational definition for statements such as "no unacceptable risk for workers" and "…ensures that pollution is minimized"; • a cohesive overview of the Preclosure Safety Assessment including, but not limited to, the following safety areas: o Occupational health and safety; o Public health and safety; o Environmental protection; and o Emergency response to conventional accidents and malfunctions. • the explicit connections between risk management (EIS Section 4.9) and the overall safety case. This may be provided in part by way of an illustration (e.g., Figure 1-4: Studies Contributing to the Safety Case - RA Phase, in the Preliminary Safety Report) of the connections between and among individual management plans for the site preparation and construction phases; • evidence that the risk management plan addresses all significant risks associated with site preparation and construction phases. Confirm that there are management plans that address all hazardous activities and conditions identified in the preliminary conventional safety assessment; • confirmation that there are management plans that	It is unclear how the Design and Construction Phase Management System reflects an overall, governing safety case for the Site Preparation and Construction phases. This safety case forms the licensing basis for the Licence to Prepare Site and Construct. Individual components of a safety case are currently scattered among the EIS, the PSR and various TSDs, and are not consolidated. Operational definitions have been provided for radiological safety, e.g., maximum allowable dose to workers. Similar operational definitions are required for other aspects of safety and environmental protection. OPG has stated that "If the mitigation and control measures are used, it is anticipated that there will be no unacceptable risks to workers resulting from the DGR project." (EIS Section 8.3.2.4) Further, OPG states that "A number of plans and procedures have been developed to protect the environment, and health and safety of the public and workers for the site preparation and construction phase of the DGR project." OPG also refers to the "Design and Construction Phase Management System." (EIS Section 4.7.8) OPG is also committing to "construction and commissioning activities… conducted in a manner that ensures employee and contractor health and safety." (EIS Section 4.7.8.7) These commitments are not supported by explicit compliance and verification criteria that reflect the overall safety case (e.g., acceptable Lost Time Incident frequencies). The derivation of these explicit criteria can be based, in part, on benchmarking for similar industrial activities, including mining. For example, best practice in construction-related health and safety might

IR #	NSCA Regulations Section #	Section # in OPG's LPSC Application	Information Request	Context
			address all environmental risks associated with the site preparation and construction phases, e.g., the management for potential acid rock drainage; e.g., comprehensive stormwater and mine water management plans; and • the objective and desired outcome, for each instance where an action is required to mitigate effects. e.g., the objective and desired outcome for reclamation of disturbed wetland habitat	produce a particularly rigorous benchmark for worker safety.