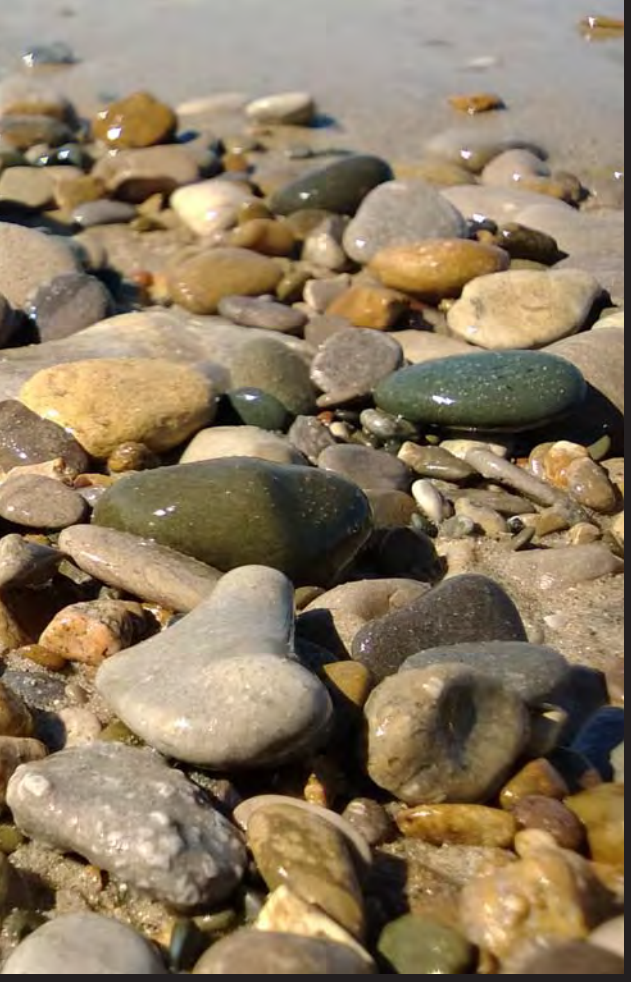


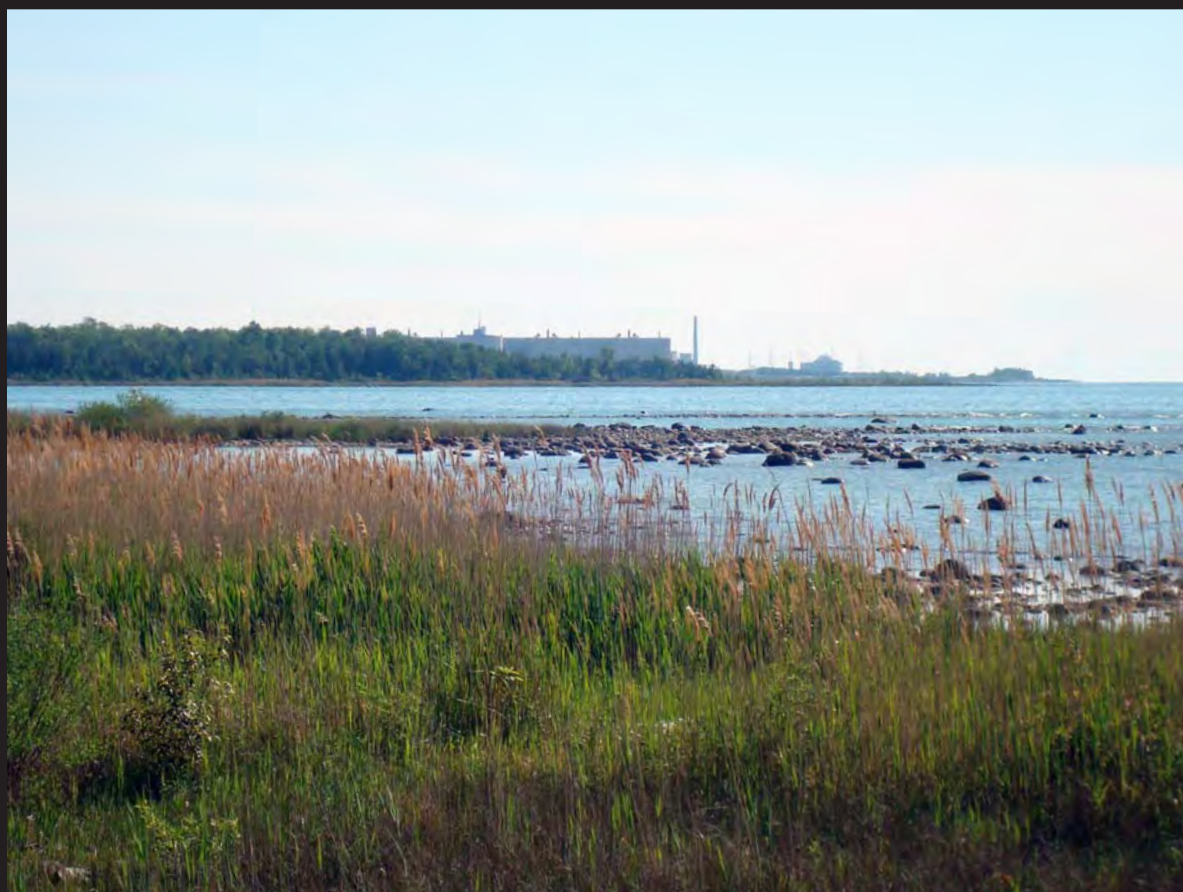
Joint Review Panel

Environmental Assessment Report

CEAA Reference No. 17520

Deep Geologic Repository for Low and Intermediate Level Radioactive Waste Project

May 6, 2015



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Acknowledgements

An environmental assessment of this magnitude requires the dedication and commitment of an outstanding team. The Joint Review Panel expresses its sincere gratitude to the co-managers of the Panel Secretariat, Debra Myles (CEAA) and Kelly McGee (CNSC), for their unwavering support and guidance throughout this assessment. Special thanks are also due to Michael Young (CNSC), David Haddon (CEAA), and Robyn-Lynne Virtue (CEAA) for their research, advice, and assistance. Denis Saumure (CNSC) and Pierre-Daniel Bourgeau (CNSC) provided valuable legal advice throughout the process. Sincere thanks also to Marie-Claude Valade (CNSC) for looking after the general welfare of the Panel.

The Panel wishes to acknowledge with gratitude the contributions of the proponent, the federal, provincial and municipal entities, Aboriginal groups, and the organizations and citizens who participated in the review. Their patience, civility, and respect for the process are greatly appreciated.

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www.ceaa-acee.gc.ca
www.nuclearsafety.gc.ca

May 6, 2015

The Honourable Leona Aglukkaq
Minister of the Environment
Les Terrasses de la Chaudière
10 Wellington St, 28th Floor
Gatineau QC
K1A 0H3

Dear Minister Aglukkaq:

The Joint Review Panel for the Deep Geologic Repository Project for Low and Intermediate Level Radioactive Waste has completed its environmental assessment of the project in accordance with the *Agreement to Establish a Joint Review Panel for the Deep Geologic Repository Project by Ontario Power Generation Inc. within the Municipality of Kincardine, Ontario* issued on January 26, 2009, and the Amendment to the Agreement issued on August 3, 2012. The Panel is pleased to submit its report for your consideration.

Sincerely,

Stella Swanson
Joint Review Panel Chair

James F. Archibald
Joint Review Panel Member

Gunter Muecke
Joint Review Panel Member

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EXECUTIVE SUMMARY

The executive summary presents a brief description of the review process, the proposed project and the main conclusions of the Joint Review Panel (the Panel). The Panel's recommendations are presented in Chapter 16 of this report.

THE PROPOSED PROJECT AND THE JOINT REVIEW PANEL PROCESS

Low and intermediate-level radioactive waste (L&ILW) is produced as a by-product of the operation of nuclear generating stations owned by Ontario Power Generation (OPG) at the Bruce, Pickering and Darlington sites in Ontario. This waste is currently stored at the Western Waste Management Facility (WWMF), a surface facility on the Bruce nuclear site. The Deep Geologic Repository Project (DGR) is a proposal by OPG to build and operate an underground disposal facility for 200,000 cubic metres of L&ILW on the Bruce nuclear site, in the Municipality of Kincardine.

The Minister of the Environment and the President of the Canadian Nuclear Safety Commission (CNSC) established the Panel on January 24, 2012 to undertake the review of the project under the *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act*. The Panel Members are Dr. Stella Swanson (Chair), Dr. James F. Archibald and Dr. Gunter Muecke.

The Panel's mandate was to: assess the proposed project in accordance with the requirements of the *Canadian Environmental Assessment Act, 2012*; consider the OPG application for a Licence to Prepare Site and Construct under the *Nuclear Safety and Control Act*; and obtain information about potential adverse effects that the project may have on potential or established Aboriginal rights, title or Treaty rights.

OPG proposed to construct the DGR approximately 1.2 kilometres from the shore of Lake Huron, near the existing WWMF. The DGR would be constructed in limestone in the Cobourg Formation, at a depth of approximately 680 metres below ground surface. The underground facilities would include two shafts, tunnels, emplacement rooms and various underground service areas and installations. The surface facilities would include underground access and ventilation buildings, a waste package receiving building and related infrastructure. The total surface footprint of the DGR would be approximately 30 hectares and the underground facilities would encompass approximately 40 hectares.

The purpose of the DGR would be to safely manage L&ILW in the very long term, so that the radioactivity in the waste will not pose a concern to the health and safety of persons and the environment. Low-level waste has low levels of radioactivity and can be handled without special radiation protection measures. It includes materials such as protective clothing, floor sweepings, mops, and rags. Intermediate-level waste consists of non-fuel waste that cannot be handled without radiation protection measures. It includes materials such as used reactor core components, refurbishment waste, and resins and filters from nuclear reactor operations.

The project is divided into preclosure and postclosure periods. The preclosure period would last about 60 years and would include site preparation and construction, operations and decommissioning. The postclosure period would include a period of institutional control followed by abandonment forever.

All project activities would be undertaken under the regulatory oversight of the CNSC and other government agencies. The project would be constructed using conventional mining techniques, operated using established radioactive waste management practices, decommissioned using conventional practices and natural processes, and would include mitigation and follow-up as required.

The proposed DGR is an important, unique, precedent-setting project. It would be the first of its kind in North America, and it is the first of its kind in the world to propose using limestone as the host rock formation. It is likely that the knowledge and experience gained through the project will assist the Canadian government in its separate Adaptive Phased Management process for the long-term management of used fuel.

SUMMARY OF CONCLUSIONS OF THE JOINT REVIEW PANEL

The Proposed DGR is Not for the Disposal of Used Fuel

The Panel heard several claims that the project might ultimately be expanded to include high-level radioactive waste (used fuel). The Panel emphasizes that the project would be for L&ILW only. OPG repeatedly and categorically stated that used fuel would not be placed in the DGR. The Panel notes that the Municipality of Kincardine passed a resolution stipulating that no used fuel would be placed in the DGR. The federal-mandated Adaptive Phased Management process for the management of used fuel is a distinctly different process than the Panel review process for L&ILW. The Adaptive Phased Management process is in the early stages of finding appropriate sites. A used fuel repository would have distinctive design requirements different than the DGR and would require a separate environmental assessment and licence application to the CNSC.

The Panel Obtained Information Regarding Project Effects on Aboriginal Interests

Obtaining Input from Aboriginal Groups

The Panel based its assessment of effects the project may have on Aboriginal interests upon: information provided directly to the Panel by Aboriginal groups through written and oral submissions; information obtained by OPG through its consultation with Aboriginal groups; and information provided by the Crown Consultation Coordinator (in this case CNSC staff).

Aboriginal groups were provided with opportunities to express their views. These opportunities were provided by OPG, the Crown Consultation Coordinator, and the Panel. Further, the Participant Funding Program administered by the Canadian Environmental Assessment Agency, together with the individual, private agreements entered into between OPG and the

participating Aboriginal groups provided those groups with important capacity to participate. The Panel is of the view that Aboriginal groups were well informed and understood how to participate in the Panel process.

The Agreement to Establish a Joint Review Panel specifically identified the Saugeen Ojibway Nation. The Saugeen Ojibway Nation were provided with the opportunity to present their views throughout the review. The Panel allocated specific times for the Saugeen Ojibway Nation to present their views at the public hearing. The Panel obtained information and evidence about the adverse effects the project may have on potential or established Aboriginal rights, title or Treaty rights, as identified to the Panel by the Saugeen Ojibway Nation.

The Panel acknowledges and encourages the communication and relationship-building with OPG that has been described by Aboriginal groups over the course of this review. The Panel expects that discussions of potential effects on traditional uses and resources will continue as part of the individual agreements entered into between OPG, the Saugeen Ojibway Nation, Métis Nation of Ontario and Historic Saugeen Métis. The Panel also notes CNSC's commitment to ongoing consultation with Aboriginal groups associated with this project.

Effects on Aboriginal Interests

The Panel concludes that the changes in the natural environment that may be caused by the project, such as changes in dust and noise levels during site preparation and construction, and changes in radioactivity levels during operation, are not likely to cause significant adverse effects on Aboriginal interests, including health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, provided all relevant mitigation measures are successfully implemented. These mitigation measures are not limited to those related to the Jiibegmegoong burial site, but also include the mitigation measures committed to by OPG or those recommended by the Panel relating to effects on air quality, noise, water quality, water quantity, radiation and radioactivity, plants and animals.

The Panel received information on the unique spiritual and cultural perspectives that Aboriginal groups brought to the assessment of this project. Aboriginal groups articulated concerns that such unique worldviews might not align with the technical analysis and measured evaluations of the project carried out to meet prescribed legal requirements. The Panel acknowledges and respects the information regarding the cultural and spiritual connections to the land, waters and all creation. The Panel believes that important bridges have been built between the scientific information for this environmental assessment and the cultural and spiritual worldviews of the Aboriginal people who participated in this review. Building community confidence and trust, demonstrating certainties and sharing information that will address anxieties is no doubt an ongoing responsibility resting on the shoulders of the Crown, OPG and the participating Aboriginal groups.

The DGR is the Solution for the Long-Term Management of Low and Intermediate-Level Radioactive Waste

The Panel agrees with OPG that the DGR is the preferred solution for the long-term management of L&ILW. OPG was of the view that permanent emplacement of the waste in a DGR, where it is separated from the biosphere by multiple geological barriers, would be a safer solution over the long term than the current method of storage at the WWMF. The Panel presents it observations regarding this conclusion below.

Underground Disposal Has Lower Risks than Surface Storage

The Panel agrees with the current international consensus that deep geologic disposal of radioactive waste is the preferred option for containing and isolating radioactive waste from humans and the biosphere. The Panel concludes that placing the L&ILW in an appropriately located underground repository would pose a lower risk to human health and the environment than surface storage. Compared to a surface facility, the additional protection of hundreds of metres of rock in a difficult-to-access location with limited or no exposure to natural surface phenomena reduces the likelihood as well as the consequences of both natural and human-related hazards. Natural hazards such as flooding, tornadoes, and earthquakes would have a higher probability of causing effects to humans and the environment when the waste is on the surface. Malfunctions, accidents, and malevolent acts would also be more likely to result in environmental effects if waste is at the surface.

The DGR Should be Built Now Rather than Later

The Panel is of the view that the sooner the waste is isolated from the surface environment the better. The Panel notes the importance of reducing and, if appropriate, reusing and recycling the waste. However, it recognizes that current technologies to alter the waste to render it no longer hazardous are limited, particularly for intermediate level waste that contains radionuclides with longer half-lives. The Panel concludes that the likelihood and consequences of an event resulting in the release of radionuclides from surface storage are greater than they would be for a DGR. The Panel is of the view that the risk of waiting until technologies are available to eliminate the hazards associated with longer-lived radionuclides outweighs the benefits.

There is a Strong Safety Case for the DGR

OPG presented a safety case for the DGR. The Panel is of the view that the safety case for the project is strong because of:

- the highly suitable geology;
- the nature of the waste;
- robust engineering design;
- built-in, long-term safety features;
- good long-term performance under normal conditions, including glaciation;
- acceptable risks under unlikely, ‘what if’ scenarios; and

- the demonstration of passive containment provided by natural geology in other settings (natural analogues).

Highly Suitable Geology

OPG proposed to build the DGR at a depth of 680 metres below the surface in the thick, stable and solid limestone rock of the Cobourg Formation. The Cobourg Formation has very low permeability, which means that liquids and gases cannot pass easily through this rock because it has very few cracks and very few and tiny pores. The Cobourg Formation is underneath 200 metres of shale-rich bedrock (called the cap rock) which also has very low permeability. Because of the very low permeability of the Cobourg Formation and the cap rock, the movement of water and gas from the repository will be dominated by diffusion. Diffusion in rocks is a very slow process. For example, it would take a water particle at the repository depth in undisturbed rock approximately 10,000,000 years to move one metre.

The host rocks of the Cobourg Formation are very old and have remained stable under nine glaciations over the past one million years. The formation extends far enough laterally to provide room for the repository. The limestone of the Cobourg Formation has not been subject to the formation of cavities caused by percolation of water down from the surface (called karst formation). There is no evidence that glacial meltwater and water from precipitation has been able to reach the Cobourg Formation for at least 2.5 million years; this is because of the low permeability of the cap rock above it. The groundwater at the repository level is ancient and has not moved for millions of years, demonstrating the low permeability of the rocks. The area is not prone to frequent and/or large earthquakes. The repository is expected to have very low oxygen levels in the postclosure period, leading to low rates of microbial activity and producing chemical conditions that favour the formation of insoluble forms of some contaminants such as metals. The rock formation at the repository level has lower fluid pressure than the surrounding rock formations, meaning that the tendency would be for movement of water or gas to occur towards the repository rather than away from it.

The Nature of the Waste

Eighty percent of the waste volume will be low-level waste. Over half of the total radioactivity of the L&ILW would decay between the start of the project and the closure of the repository. About three-quarters of the radioactivity would be gone 100 years after closure. Most of the very long-lived radionuclides are within corrosion-resistant Zircaloy; therefore, even though they would still be present, their release from the Zircaloy would be very slow.

Robust Engineering

The proposed DGR would be built in strong rock that is not associated with major failures such as roof collapse. After waste emplacement, individual waste panels would be separated from the shafts by distance and concrete barriers, thus limiting the opportunity for radionuclides to migrate to the surface via the shafts during operation. The proposed repository would be designed for stability, with thick pillars and rooms aligned with the natural rock stress direction. OPG determined that backfilling the repository rooms to increase stability would not improve the safety case; rather, it would be better to leave space for gas generated from waste degradation. The Panel is satisfied that OPG would conservatively design the structural features of the DGR

using best mining technology and practice to ensure the integrity and effectiveness of the repository.

Built-in, Long-Term Safety Features

OPG proposed to limit the design of the DGR to two shafts in order to limit the number of potential direct pathways to the surface. The Panel agrees with this assessment. The principal engineered barrier for restricting potential contaminant release to the surface will be the shaft seal structures. It is therefore important that OPG minimize the development of the excavation damaged zones about each shaft surface, and maximize the effectiveness of the shaft seal elements within each shaft.

As described by OPG, when the repository is closed, the shafts would be sealed with a bentonite/sand mixture and an asphalt mixture. These seals would limit any migration of contaminants via groundwater and gas flow in the shafts. A concrete monolith would be built at the base of the shafts to provide long-term support to the shaft seals and the repository tunnels in the vicinity of the shafts. Concrete bulkheads would be placed in the shafts at the levels of two more permeable rock layers (the Guelph and Salina A formations), in order to prevent groundwater flow in these layers from affecting the shaft seals. These bulkheads would also provide structural support for the overlying shaft seals. The Panel is satisfied that the proposed approach is reasonable.

Good Long-term Performance under Normal Conditions

The Panel is confident that the DGR will perform well in the long-term under normal conditions, which would include the degradation of waste containers and seals over time, gas generation, earthquakes and glaciation. The modelling of the repository performance showed that none of these likely events would result in unacceptable doses to humans or non-human biota. This was true even when it was assumed that rockfalls from the roof of the repository occurred shortly after closure, all organics and metals fully degraded into gases, the radionuclide inventory was 10 times higher than in the 2010 inventory, radionuclides were released instantly on contact with water, all radionuclides were soluble in water, and there was very little retardation of radionuclide movement due to being adsorbed to rock surfaces. Even with all of these (and more) conservative assumptions, the maximum calculated dose rate to humans was 100,000 times lower than the limit for exposure to the public, and would occur thousands of years in the future to a family assumed to be living right on the DGR site. The maximum dose rate to a person living farther away and consuming fish and water from Lake Huron was orders of magnitude lower than for the people living at the DGR site – virtually zero.

The Panel is confident that the modelled doses have not been underestimated. This confidence is based upon the multiple conservative assumptions used in the model. OPG used these assumptions to account for uncertainty about what might happen in the future. In other words, no matter how wrong the model might have been about exactly what, when and where certain things might happen, it would be extremely difficult to produce a combination of features, events and processes that would result in doses any higher than what was estimated without deliberately assuming basic natural laws (such as gravity) are no longer applicable. Furthermore, OPG's models were calibrated to minimize differences between calculated and measured variables and verified to confirm the proper functioning of the computer codes. OPG's

confidence in its models was enhanced through participation in international co-operative projects in which the same problems were solved using different computer codes and the results compared to establish that equivalent results were obtained.

Acceptable Risks Under "What If" Scenarios

The Panel assessed the "what if" scenarios evaluated by OPG and concludes that even if these unlikely events were to occur, risks to humans and the environment would be acceptable. The inadvertent human intrusion and severe shaft failure scenarios resulted in the highest projected doses. The projected doses from these scenarios exceeded the dose limit for protection of the public; however, because they were so unlikely, the risk was deemed to fall within the definition of acceptable risk (1 in 100,000 risk of additional cancer).

The presence of economic quantities of gas or oil resources would be a potential feature contributing to human intrusion into the DGR. Therefore, the Panel recommends that the level of confidence in the absence of economic oil and gas deposits in the vicinity of the DGR be increased through further investigation.

The Panel also recommends that OPG continue to research the performance of shaft seal materials such as bentonite and asphalt. Confidence in the very low likelihood of severe shaft seal failure will be increased by following the Panel's recommendation.

Natural Analogues

The Panel heard a lot of concern regarding the requirement for very long-term performance of the DGR. The DGR will largely rely on passive barriers to contaminant movement provided by the natural geology. Natural analogues provide examples of such passive barriers. OPG cited examples such as Appalachian basin shale cap rocks which have contained hydrocarbon gases for millions of years at high pressures. Another example of a natural analogue is in Saskatchewan, where the world's richest deposits of uranium have existed for millions of years without contaminant movement and with no radioactive signature by uranium or its daughter products evident at the earth's surface.

The Bruce Nuclear Site is Appropriate

The Panel concludes that locating the DGR on the Bruce nuclear site is appropriate relative to other alternative sites because of the highly suitable geology (as described above) and because additional transportation of the waste to a site distant from the WWMF would not be required. The Panel notes that a comparison of the proposed DGR in the Cobourg Formation to a hypothetical repository in granite showed that the main difference between the two was the additional risk of transporting the waste from the Bruce nuclear site to the granite site. The relative performance of the two rock types (Cobourg limestone and high-quality granite) was not different enough to distinguish either one as having better performance over the long-term; both would perform well within regulatory requirements for safety and environmental protection.

The Panel agrees with OPG that a DGR at the Bruce nuclear site is more sustainable than if it were built on an undeveloped offsite location. The relative environmental effects of constructing a DGR on an undeveloped site would be higher than on the already-disturbed Bruce nuclear site. There would be socio-economic challenges at an undeveloped site, notably, the

requirement to obtain, train and retain skilled staff, provide infrastructure such as roads, and obtain services specific to the nuclear industry. In addition, the Bruce nuclear site is highly secure; thus, the risk of malevolent acts is already managed and low.

The Project is Not Likely to Cause Significant Adverse Effects

The Panel concludes that OPG provided adequate information for the Panel to conduct its environmental assessment of the project, and that OPG incorporated the guiding principles outlined in the Environmental Impact Statement (EIS) Guidelines. OPG committed to mitigation measures designed to: reduce the magnitude, spatial extent, frequency, and/or duration of effects; or to create or enhance the reversibility of effects. None of the residual adverse effects remaining after application of mitigation measures were judged by OPG to be significant.

The Panel concludes that the project is not likely to cause significant adverse environmental effects. The prevention of significant residual adverse effects depends upon the complete and timely implementation of mitigation measures committed to by OPG plus additional mitigation measures recommended by the Panel. Comprehensive follow-up monitoring to verify the predictions in the environmental assessment will also be required. The Panel has made a number of recommendations regarding follow-up monitoring. The Panel places particular emphasis on the importance of additional mitigation measures to prevent residual adverse effects on water quality and fish, especially lake whitefish, caused by the discharge of conventional contaminants from the stormwater management system to MacPherson Bay of Lake Huron.

The Panel evaluated OPG's assessment of both non-radiological and radiological malfunctions and accidents and is satisfied that these events would not be likely to cause significant residual adverse effects. OPG's malfunction and accident scenarios incorporated a range of events, including fire; explosion/detonation; electrical accidents; spills of fuel, chemicals, lubricants or oils; and vehicle accidents. The Panel's conclusion relies upon OPG's application of its fire protection measures and emergency and spill response procedures.

The Panel is of the view that, with the implementation of OPG's proposed operating procedures, conventional worker safety would be maintained at levels similar to or better than those of comparable commercial mining operations in the Province of Ontario. To achieve these goals, OPG's safety management systems must prioritize measures to mitigate malfunction and accident events that possess the highest likelihood of occurrence. The Panel has made a recommendation regarding underground vehicular traffic accidents and rockfall accidents.

The Panel is satisfied that credible malevolent acts are not likely to result in significant adverse effects, both on and off the DGR site. The Panel concurs that the effects of OPG's credible malevolent act scenarios would be bounded by those of non-radiological malfunction and accident scenarios. The Panel is satisfied that malevolent acts are not likely to occur, given the security and mitigation measures described by OPG.

Learning from experience will be a fundamental component of OPG's preparedness for malfunctions and accidents. In addition to its own operational experience, OPG can call upon the experience of the nuclear and mining industries world-wide. Of note, OPG's review of incidents at the Waste Isolation Pilot Plant (WIPP) in the United States revealed the importance

of a strong safety culture including: the maintenance of high quality management systems; effective oversight by managers and regulators; continued development of the safety case for the lifetime of the project; and maintenance of effective worker training and safety cultures during all project phases.

The Panel is of the view that it will be important for OPG and the CNSC to be prepared for any malfunction or accident, not only in order to protect the health and safety of workers, the public and the environment, but also because no matter how small the consequences may be from a science point-of-view, such an event could negatively affect the public perception of the project.

As part of its cumulative effects assessment, OPG provided information regarding the potential future inclusion of reactor decommissioning waste in the DGR. These activities would require separate review processes by the CNSC, and were not included as part of the proposed project. The Panel is satisfied that the cumulative effects of the potential inclusion of decommissioning waste in the DGR have been adequately addressed and concludes that no significant adverse effects to the environment are likely to occur, provided that mitigation measures are effective. The Panel notes that adaptive management may be required for OPG to adjust to new information that becomes available over the next two to four decades.

The Panel concludes that it is not likely that there would be significant residual adverse cumulative effects from the project. The Panel notes the importance of a consistent, long-term commitment to mitigation for surface water quality, and also notes the importance of mitigation for air quality and noise. The Panel emphasizes the importance of follow-up monitoring to confirm the absence of significant residual adverse cumulative effects. Specific details of the monitoring program will be further defined should the project be approved and proceed to licensing.

The Panel notes that cumulative effects at an ecosystem scale were not addressed by OPG in its EIS, nor was this explicitly required under the EIS Guidelines. However, the concerns expressed by participants about the ecological integrity of Lake Huron and the potential for cumulative effects on the lake, and the Great Lakes in general, illustrates the need for a societal discussion regarding how such concerns can be addressed – if not by individual proponents, then by provincial and federal regulatory agencies.

Worker and Public Health and Safety Will be Protected

The Panel concludes that the project is not likely to cause significant adverse effects on the health and safety of the public and workers taking into consideration the commitments made by OPG, the proposed mitigation measures, and the additional recommendations from the Panel. The Panel is of the view that OPG adequately described the likely residual effects of the project, as well as their significance, for workers, local residents, seasonal users and members of Aboriginal communities. The Panel emphasizes that it is important that OPG, and the CNSC, continue to engage with persons who have an interest in the project and its effects on human health.

Worker Health and Safety

The Panel is satisfied that OPG's review of activities and the scope of conventional and radiological hazards was reasonable, extensive and credible. The Panel is of the view that these hazards will be managed by OPG, with regulatory oversight by the CNSC and provincial agencies, in order that worker and public health and safety are protected. The principal activities that would be undertaken by workers during each stage of DGR development and operation were clearly defined, and appropriately described. The Panel is also satisfied that OPG committed to appropriate mitigation and control measures for each conventional safety hazard. Plans for mitigation and monitoring to ensure radiation protection were described in sufficient detail that the Panel is confident that regulatory dose limits for nuclear energy workers will be met.

The Panel notes that while OPG has developed an excellent conventional and radiological health and safety record for its workers at its nuclear facilities in Ontario, diligence will be required to ensure worker protection during activities for which OPG has less experience, particularly those associated with mining.

The Panel stresses the importance of OPG maintaining a strong safety culture over the long life of the project. OPG management systems must continue to incorporate systems and measures that encourage continuous improvement in all aspects of occupational safety to mitigate hazards and ensure worker safety. These systems must be upheld throughout site preparation, construction, operations and decommissioning.

Public Health and Safety

The Panel is satisfied that the project is not likely to cause adverse effects on public safety, considering OPG's Emergency Management System and its commitment to coordination with local emergency response service providers. The effectiveness of safety programs at the DGR is essential for maintaining public safety.

The Panel concludes that the project is not likely to cause significant adverse effects to the overall health of members of the public. Overall health encompasses the effects of changes in physical, socio-economic, cultural and emotional determinants of health caused by the project. The Panel concludes that it is not likely that changes in air quality, noise or radioactivity levels caused by the project would result in significant adverse effects on the health of the general public, including people living near the project site, provided mitigation measures are implemented and are effective. This conclusion is based upon the Panel's confidence that effects have not been underestimated, due to the highly conservative nature of the modelling. The Panel suggests that there be public input into follow-up monitoring of air quality, noise and radiation in order to increase trust in the monitoring information among concerned community members.

The Panel heard from both permanent and seasonal residents with concerns regarding emotional determinants of health; these concerns require acknowledgement and specific action (to be determined through dialogue). Anxiety is a key emotional determinant of health, regardless of whether physical determinants have been affected or not. The Panel suggests that

participation of personnel from the Grey-Bruce Health Unit could be beneficial, particularly with respect to addressing concerns related to emotional determinants of health.

Aboriginal Health and Safety

The Panel concludes that changes in the environment as a result of the project are not likely to cause significant adverse environmental effects on Aboriginal health and safety.

The Panel notes that some concerns were raised that the project could result in the perception that the quality of traditional resources may change. This view would be associated with emotional determinants of health. The Panel expects that explicit discussion of effects on traditional uses, and thus potential effects on emotional determinants of health, will be part of the dialogue associated with agreements between OPG and the Saugeen Ojibway Nation, the Historic Saugeen Métis and the Métis Nation of Ontario.

RIGOROUS AND RELIABLE ADAPTIVE MANAGEMENT SYSTEMS WILL BE REQUIRED

The Panel is of the view that OPG's management systems for worker and public health and safety and protection of the environment are central to the prevention of significant adverse effects. The project management systems must be particularly rigorous and reliable because of the longevity of the project and the lack of prior experience with this specific type of project. Over the preclosure phases of the project, the extent of knowledge and understanding of key environmental indicators and the appropriate action levels will increase and evolve. It is likely that advances in scientific knowledge and technology will enable additional, alternative, or enhanced mitigation measures. There will be many opportunities to learn from the results of follow-up monitoring.

The Panel emphasizes that it is important that OPG maintain the capacity for the development and implementation of an adaptive management system that: identifies appropriate key indicators of performance; predetermines action levels used to identify the requirement for corrective management measures; identifies testable predictions about the performance of the DGR mitigation measures; and develops a range of available options in response to action levels.

The Panel emphasizes that a rigorous application of the Geoscientific Verification Plan coupled with an adaptive management system is required to further confirm and enhance the safety case and further verify the postclosure assessment. The Geoscientific Verification Plan can provide confidence in the models used to predict long-term repository performance by systematic and diligent data acquisition during the construction and operational phases of the project. Data obtained from the Geoscientific Verification Plan must be used within OPG's adaptive management system in a timely and efficient manner. As noted above, this will require that a clear and defensible set of action levels be established to identify when the difference between actual and expected conditions differs sufficiently that action must be taken. This action could range from additional, more detailed monitoring to cessation of the development of

the DGR until the safety case can be re-confirmed through design change or the DGR is permanently halted.

THE DGR PROJECT WILL NOT AFFECT LAKE HURON

The protection of Lake Huron and the Great Lakes was a dominant theme in written and oral submissions to the Panel. The location of the proposed DGR 1.2 km from the shoreline of Lake Huron was a catalyst for concerns and comments from Canadian and American citizens about drinking water quality, recreational use, aquatic ecology, and the economic, cultural and spiritual value of the lake.

The Panel concludes that the project is not likely to cause significant adverse effects on the water quality or aquatic ecosystems of Lake Huron or the other Great Lakes, provided that mitigation measures, including the Panel's recommendations, are implemented. This conclusion also applies to MacPherson Bay of Lake Huron.

The Panel is confident that there will be no significant adverse effects on Lake Huron or the other Great Lakes because:

- radiation releases from the project during preclosure and postclosure phases would be extremely low relative to current radiation levels in Lake Huron and negligible relative to dose limits for the protection of the public;
- malfunctions, accidents, and malevolent acts during the preclosure phase would not have the potential to release sufficient radiation to exceed dose limits for the protection of the public via use of Lake Huron;
- natural processes, barriers and physical laws present and active during the normal evolution of the postclosure phase could not produce the conditions that would result in exceedances of regulatory limits for the protection of the public;
- disruptive, "what if" scenarios would not result in exceedances of dose limits related to human uses of water from Lake Huron;
- the project will not contribute significantly to any of the current primary risks to Lake Huron and the other Great Lakes, such as invasive species;
- the project will not contribute to cumulative effects to Lake Huron, provided all discharges comply with applicable statutes and regulations, notably the *Fisheries Act*; and
- there would be no significant adverse effect on the use by Aboriginal peoples of drinking water, fish or other species in Lake Huron due to radionuclides or chemicals of concern.

Environment Canada informed the Panel that Canada had met its obligations under the *Great Lakes Water Quality Agreement* with respect to the project. Canada, through the Great Lakes Executive Committee Co-chair, notified the U.S. and the Great Lakes Executive Committee of the DGR public hearing and the process for participating in the hearing on June 21, 2013.

The Panel notes that some people, particularly Aboriginal people, may have concerns about effects on Lake Huron that are based upon their worldview and accompanying spiritual requirements regarding showing respect for the earth. This would include asking permission of the earth to construct the DGR. The Panel expects that such concerns will be part of the ongoing dialogue between OPG and Aboriginal peoples under the terms of various agreements.

The Panel fully agrees that Lake Huron and the other Great Lakes are precious resources that demand society's highest level of protection and regard. To that end, the Panel applauds the efforts of Canadian and American federal, state, provincial, and municipal agencies as well as First Nation, tribal, Métis, and private groups, as they address the primary risks to the lakes. The Panel notes that the future sustainability of the Great Lakes depends upon society's collective ability to reduce the significant stressors on the lake, notably invasive species, habitat disruption or destruction, non-point source pollution, and climate change. The Panel is of the view that the relative position of the proposed project within the spectrum of risks to the Great Lakes is a minor one, albeit one that demands strict attention and regulation.

ENGAGEMENT WITH ABORIGINAL GROUPS AND THE PUBLIC IS VERY IMPORTANT

The Panel emphasizes that OPG must continue to engage with members of the public and Aboriginal groups. The Panel expects that future licensing requirements related to public engagement will include the respectful attention to all concerns from Aboriginal and non-Aboriginal people.

The Panel is of the view that engagement is an interactive and iterative process of discussion among citizens that contributes meaningfully to specific decisions in a transparent and accountable way. It includes the free exchange of ideas, with acceptance of different values.

The Panel encourages OPG and the CNSC to continue to develop their public consultation programs in such a way that the programs move beyond the provision of information to dialogue and, ultimately, to engagement. The Panel believes that the resolution of public concerns and anxiety regarding the project will rely not only on science, but on true engagement with citizens.

OVERALL CONCLUSION

The Panel concludes that the project is not likely to cause significant adverse environmental effects, taking into account the implementation of the mitigation measures committed to by OPG together with the mitigation measures recommended by the Panel.